Port Expansion Project EIS

Table of Contents

Table of Contents

Executive Summary

Part A

Part B

Part C

Port Expansion Project EIS

Appendix List

AECOM BMT WBM

Appendix List

L1	Threatened and Migratory Species
L2	Potential Effects of Light on Migratory Waders
L3	Avifauna Survey for the Townsville Port Expansion Project
M	**CH9 Air Quality**
M1	Meteorological Data Analysis
N	**CH10 Noise & Vibration**
N1	Nomenclature
N2	Summary – noise and vibration risk assessment
N3	Operational noise assessment methodology
N4	Accuracy of CONCAWE
N5	Historical wind roses
N6	Instrumentation
N7	Noise logger results
N8	Noise targets
N9	Operating noise modelling assumptions
N10	Noise contour plots – operational port expansion
O	**CH11 Greenhouse Gas**
O1	Calculation of Greenhouse Gas Emissions
P	**CH13 Social**
P1	Community Profile & Demographic Data
Q	**CH14 Transport & Infrastructure**
Q1	Port Expansion Operational Modal Split
Q2	Port Expansion Construction & Operational Traffic Spreadsheets
Q3	Additional Port Expansion Traffic Spreadsheet
Q4	Intersection 1: Benwell Road / Secondary Access SIDRA Summaries
Q5	Intersection 2: Benwell Road / Archer Street SIDRA Summaries
Q6	Intersection 3: Boundary Street / Benwell Road / Southern Access / Townsville Port Access Road SIDRA Summaries
Q7	Intersection 4: Boundary Street / Saunders Street SIDRA Summaries
Q8	Intersection 7: Bruce Highway / Townsville Port Access Road SIDRA Summaries
R	**CH15 Indigenous Cultural Heritage**
R1	Indigenous Cultural Heritage Report
S	**CH17 Visual**
S1	Queensland Coastal Plan Assessment Findings
S2	Obtrusive Light Study
T	**CH19 Economics**
T1	Trade Forecast Report (Deloitte)
U	**CH20 Health and Safety**
U1	Queensland Approved (and Pending Approval) Codes of Practice

Port Expansion Project EIS

Executive Summary

AECOM BMT WBM

1.1 Introduction

1.1.1 Proponent

The Port of Townsville Limited (POTL) is a government owned corporation under the *Government Owned Corporations Act 1993*. It is declared as a port authority under the *Transport Infrastructure Act 1994* and responsible for establishing, managing and operating effective and efficient port facilities in the Port of Townsville and the Port of Lucinda. POTL, as proponent of the Port Expansion Project (PEP), is responsible for gaining all relevant approvals necessary to facilitate its development.

POTL contact details are listed below:

PO Box1031

Townsville

Queensland 4810

1.1.2 Environmental Record

POTL has a successful history of compliance with its environmental obligations and has maintained a strong and important facility against a backdrop of the region's high-value environmental resources. POTL has successfully and efficiently managed the port's operations within existing legislative frameworks and strongly encourages all port operators to do the same. Section 88R(j) of the *Great Barrier Reef Marine Park Regulations 1983* requires applicants proposing works within the Great Barrier Reef Marine Park (GBRMP) to supply details of their current environmental record. POTL's environmental record includes:

- compliance with all Environmentally Relevant Activity (ERA) licence requirements under the *Environmental Protection Act 1994* (EP Act)
- compliance with approval conditions for dredging and placement of capital and maintenance dredge material under the *Environment Protection (Sea Dumping) Act 1981* (Cth)
- ISO 14001 accreditation for an independently certified Environmental Management System
- undertaking ongoing environmental monitoring and associated annual reporting of monitoring results
- recording and applying conditions specified through approvals (Berths 10A and 8 redevelopment, Townsville Marine Precinct, other development approvals).

1.1.3 Overview of Port of Townsville

Since the site was first established in 1864, the Port of Townsville has been integral to the development of the economy of Townsville and North Queensland. The port is now Queensland's third largest multi-commodity port, handling 14% of the total international trade export by earned value, yet only 4 to 5% of the total tonnage emanating from Queensland seaports. It provides North Queensland with a gateway for commerce and trade. It services the north-east and north-west minerals provinces of the state, handling 73% of all metals traded through Queensland in the 2009/10 financial year. As such, the port is one of Queensland's most strategic assets, playing a significant role in the local, regional and state economy.

The port is well located to support the regional mineral and agricultural industries and as a regional trade hub for North Queensland. It is strategically situated to serve the Mount Isa region, and is the terminus for the Mount Isa rail line. It is also strategically situated to serve the activities of the Townsville State Development Area, which is located to the port's south-east (Figure ES.1). The Townsville State Development Area was declared in 2003 to assist the Townsville region to achieve its potential as a major base metals processing centre. Its proximity to the port and the minerals rich north-west makes it strategically positioned in relation to North Queensland commerce including new opportunities for processing minerals and transport and distribution services connecting Australia to the Asia-Pacific region.

The significance of the Townsville port for the economy is recognised in the *Northern Economic Triangle Infrastructure Plan 2007-2012* (DI, 2007b) and the *Townsville Economic Gateway Strategy* (DI, 2007c). A major strategic objective of these plans is to ensure the future development and efficient operation of the port. A key contributory factor for the continued economic development of the region is achieved through the adoption and progressive implementation of the *Port of Townsville Master Plan* (Maunsell AECOM, 2007).

A significant expansion of sea-borne trade is expected in North Queensland in the next few decades and beyond. Growth at the Port of Townsville in the near term is expected to exceed the Australia-wide average, due to some major resource projects in magnetite, nickel and fertiliser, and the potential introduction of the coal trade to Townsville, which is expected to cause very high growth rates.

1.1.4 Project Rationale

The PEP evolved from comprehensive master planning for the port and its surrounds involving key stakeholders, with consideration given to supply chain activities and planning of land transport systems.

The PEP responds to both the immediate need for additional berths as trade increases, but also has a function to plan, investigate and design the necessary infrastructure to allow the port to grow incrementally as trade demand arises over the next 30 years and possibly longer.

In this context, the PEP design recognises existing port infrastructure and future port activities and seeks to integrate the development of port components to achieve an optimum path of development. The design considered the cumulative spatial and capacity planning requirements of cargo handling facilities, road, rail and shipping.

A summary of PEP infrastructure and activities is:

- construction of breakwaters and land perimeter revetments
- dredging works for channel augmentation (principally channel deepening) and development of an outer harbour
- development of port land for future throughput of goods and trade
- development of port infrastructure including new wharves and berths
- road and rail development on port land and ancillary services

A study into the port’s future, including the Preliminary Engineering and Environmental Study in 2009 (AECOM, 2009), identified the requirement for demand responsive expansions of the existing port to meet North Queensland’s predicted growth. POTL’s development strategy relies on an extension of the port and its infrastructure into Cleveland Bay to cater for increases in demand for trade and port capacity, including a greater emphasis on bulk goods handling, especially for mineral products. The seaward extension of the port also responds to the proximity and historical encroachment, as the City of Townsville grows residential areas to the south and west of the current port. The extension seaward as envisioned by the PEP will provide a greater distance between essential port operations and existing residential land uses.

The increase in trade will ultimately require shipping with larger vessels, along with the development of additional berth space, deepening and other minor modifications to the channels to the port (the Platypus and Sea channels). These capital improvements are required to overcome constraints imposed on vessel size by the present channel geometry.

Dredging works will be undertaken in stages according to shipping requirements and demand for additional port facilities. Geotechnically suitable dredged material where possible will be re-used as reclamation fill. The quantity of dredged material will exceed the volume required for reclamation and part of it will not be of suitable geotechnical quality. Remaining dredged material will be placed offshore, including the uppermost metre of soft silty sediment, which has a compressible nature.

The potential environmental impacts of PEP have been a key consideration in the design process and development of a construction methodology. Studies, surveys and data collection have been undertaken since 2008 in support of the Project; with many of these studies included in the EIS appendices. As a result, the preferred designs and methodologies have responded to and reflect a long period of design refinement that seeks to avoid environmental impacts or otherwise derive environmental management measures that seek to reduce impacts as far as practicable.

The construction of the port will be incremental, not continuous over the estimated 30-year time horizon. Construction will be in defined stages interspersed with consolidation and monitoring of construction and operational activities. Given this, a long-term adaptive strategy to environmental management and monitoring is endorsed in the PEP EIS to ensure environmental values are monitored and protected over time and corrective actions can be implemented if unacceptable impacts are detected.

PEP provides a new outer harbour, cargo shipping berths and backing land to support new berths. Channel deepening is also required. PEP will allow POTL to:

- satisfy its responsibility under the *Transport Infrastructure Act 1994*, including establishment, management and effective and efficient operation of port facilities
- respond to forecast trade growth and provide essential trade pathways for current and future trades in accordance with the National Ports Strategy (IA, 2010), thereby enhancing the economic prosperity of the region
- provide competitive market conditions for import and export of bulk and general cargo through the Port of Townsville
- establish and maintain strong links between the local, regional, state and global economies
- accommodate future trends in global shipping practices.

The infrastructure and services provided by PEP will enable sufficient capacity to be delivered ahead of expected demand, avoid capacity constraints at the port from impacting on trade growth opportunities, and provide sufficient flexibility to accommodate demand.

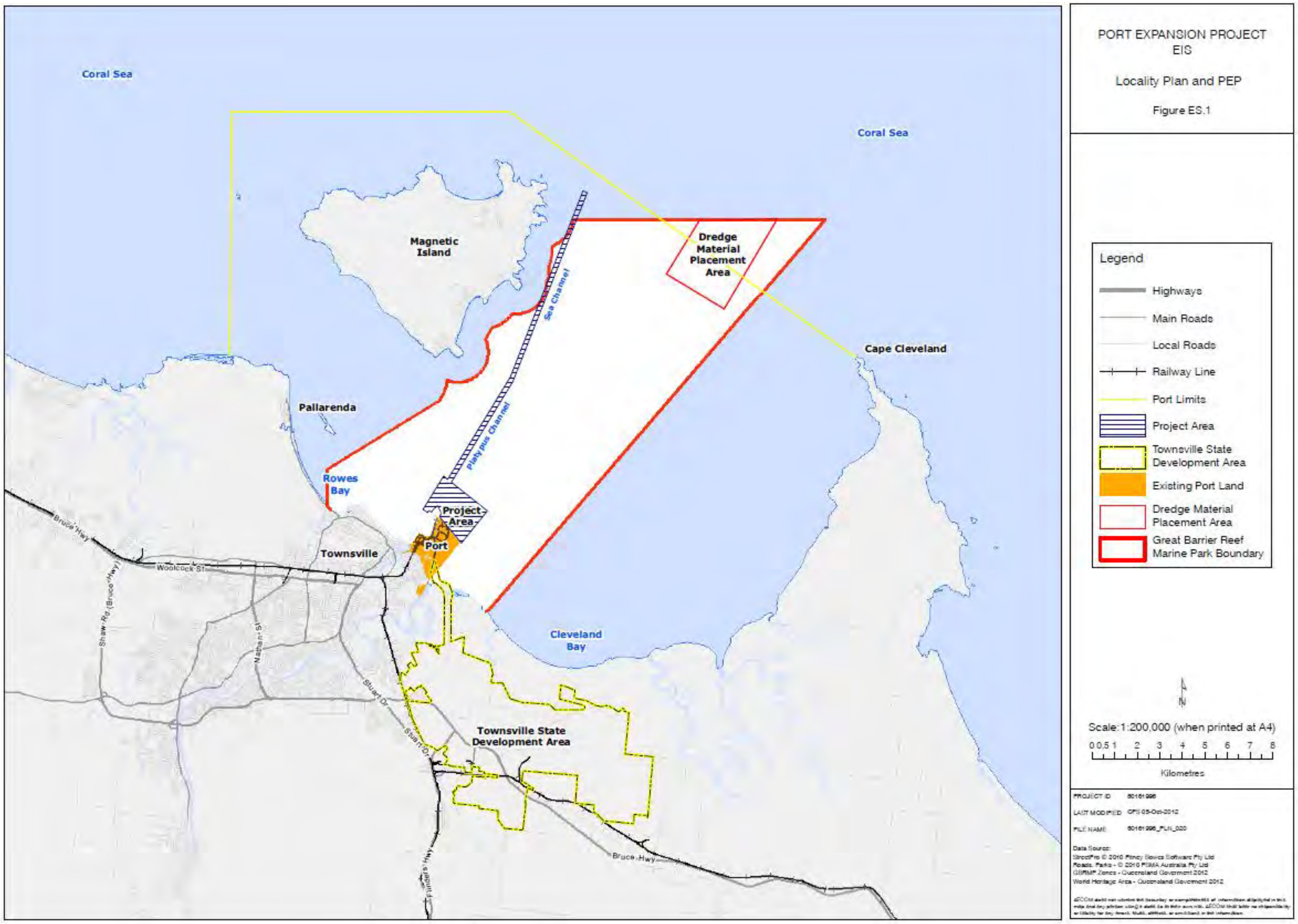


Figure ES.1 Locality Plan and PEP

1.1.5 Potential Alternatives

Essential in the planning is that the best potential infrastructure development is determined for full and complete assessment. Consideration was given to potential alternative options to the final PEP arrangement. Six alternative options with different sites and/or infrastructure configurations were examined as well as a 'no action' option. Key points with respect to the consideration of these alternatives are:

- Under a do nothing scenario there would be insufficient capacity within existing port infrastructure to accommodate the forecast increase in trade. The development of additional port infrastructure is required to provide increased capacity to service projected trade forecasts and economic growth, so the 'no action' option was seen as untenable.
- Port expansion options considered were:
  - a new harbour to the west of the inner harbour at Cape Pallarenda
  - a new harbour to the east of the inner harbour
  - unprotected berthing outside the inner harbour using exposed port berths
  - a new harbour without reclamation using remote land cargo transfer (conveyor) and storage
  - additional berthing in a new harbour at Cape Cleveland
  - preferred new harbour adopted as PEP.

The most feasible arrangement is the port expansion layout in the *Port of Townsville Master Plan* (Maunsell AECOM, 2007), which creates a protected outer harbour seaward of the existing port with a significant reclaimed area for cargo storage.

Other design options that were assessed tended to:

- fragment and duplicate port facilities
- disconnect from existing land and sea access infrastructure
- require a major new approach channel to be dredged
- not provide opportunities for beneficial re-use of the dredged material produced from the harbour basin and berths
- have significant additional capital costs (including the provision of road and rail access) and additional risks of adverse environmental effects in excess of those applying to the development of berth space in the environs of the current developed port and supporting infrastructure.

The preferred option, the PEP, provides the following benefits:

- protected berths for cargo transfer and better protection during extreme events
- does not require new landside and sea access infrastructure corridors by making use of the existing shipping channels and the Eastern Access Corridor now under construction
- reduces additional channel dredging required as it uses the existing channels (which minimises dredge campaign period)
- reduces the amount of dredged material placed at sea by placing some of it into reclamation
- has the least overall capital cost of the alternative options considered
- reduces port infrastructure duplication and operating costs by being an extension of the existing port facility
- can be built in an area of modified existing environmental values within an existing port area (adjacent to the existing port and urban areas) with manageable wider-field environmental effects in the world heritage area
- consistency with the Great Barrier Reef ports strategy

1.2 The Environmental Impact Statement

1.2.1 Purpose and Structure of This Document

The objectives of the EIS are to provide:

- an understanding of the Project and existing environmental, social and economic values and potential impacts that may occur and measures to be adopted to mitigate potential adverse impacts
- a framework for assessing impacts of the Project in view of legislative and policy provisions
- a mechanism for sustainable environmental outcomes, including control measures and strategies to be implemented during the construction and operational phases through environmental management plans (EMPS).

The EIS consists of four parts that provide the following information:

Part A: Background information about the Project and the proponent to assist in setting spatial, environmental, economic, social and legislative contexts for the PEP

Part B: Impact assessments on a range of potential environmental, economic and social effects including residual and cumulative effects, as well as recommended measures for mitigating potential impacts

Part C: Descriptions and specification of recommended environmental management requirements through specific management plans to be implemented at different stages using prescribed standards or recommended practices

Part D: Appendices that present more detailed technical investigations (studies, analyses and assessments) that support the statements made in preceding EIS parts.

Each Part of the EIS is further broken down into chapters to provide discussion on specific environmental factors and development aspects. The EIS chapters address elements of the natural and built environment such as land, water, air, acoustics, nature conservation, heritage, waste, health and safety, as well as key social and economic conditions.

1.2.2 Consultation Findings

POTL consulted stakeholders at the commencement and during the preparation of the EIS in order to understand and address concerns raised by the community, government and industry. This helped with the framing of technical investigations and analysis for the Project's planning, design and assessment. Consultation facilitated community understanding of the PEP and provided opportunities for community involvement through raised awareness and contribution.

Overall, the community engagement activities undertaken during the past and recent phases of consultation have confirmed:

- there is strong support for the Project based on economic and employment indicators; however, potential environmental impacts are of concern and are expected to be managed appropriately
- the community appreciates positive action from POTL, which position it as a good neighbour, such as the installation of park infrastructure and planting of vegetation
- concerns around mitigating noise, light and dust re-enforced in that they need to be managed
- dredging and associated potential impacts on the Great Barrier Reef are of particular concern
- consideration needs to be given to existing and future infrastructure (roads and rail) with regard to an increase in port traffic
- the community is concerned about types of products that may be transported through the port.

Key matters raised through consultation have been addressed in the respective EIS parts and chapters. Ongoing communication through existing Port communication mechanisms will provide opportunity for community and stakeholders to respond to the effectiveness of these measures, allowing POTL to amend them as necessary for maximum benefit.

1.2.3 Terms of Reference and EIS Guidelines

The location of the PEP, the multiple approval jurisdictions and instruments that apply to the Project, its potential significance to the State of Queensland as major infrastructure investment, its location adjacent to sensitive environments and recent decisions regarding a number of other projects led to the referral of the Project to the Coordinator-General who subsequently declared it a ‘significant project’ under the *State Development and Public Works Organisation Act 1971.* The location of the PEP within the Great Barrier Reef World Heritage Area (GBRWHA) and its relationship with other matters of national environmental significance under the Commonwealth’s *Environment Protection and Biodiversity Conservation Act 1999* led to the Project being determined a ‘controlled action’ by the Minister for Sustainability, Environment, Water, Population and Communities.

As a result of those instruments the PEP EIS has been prepared to address two separate regulatory requirements set by terms of reference for the preparation of an EIS as required by the state and Commonwealth governments under two legislative instruments being:

- Coordinator-General’s *Townsville Port Expansion Project Terms of Reference for an environmental impact statement* (ToR) (Appendix A1)
- Department of Sustainability, Environment, Water, Population and Communities and the Great Barrier Reef Marine Park Authority *Guidelines for an Environmental Impact Statement for the Port of Townsville Port Expansion Project, Queensland (EPBC 2011/5979/GBRMPA G34429.1)* (EIS Guidelines) (Appendix A2)

The PEP EIS needs also be considered in the context of the comprehensive strategic assessment of the GBRWHA and the adjacent coastal zone that is being undertaken by the Commonwealth, the Great Barrier Reef Marine Park Authority (GBRMPA), and the Queensland government. That assessment is a key recommendation of the recent UNESCO mission and report on the status of the GBRWHA property. In the context of that strategic assessment, Townsville’s port is recognised as historically significant, long-standing and established, with future development subject to approval on the basis that the proposed expansion does not result in significant or unacceptable impacts to the Great Barrier Reef and its protected values.

1.3 Impact Assessment Methodology

The assessment methodology used to address the matters stated in the ToR and EIS Guidelines during the preparation of this EIS is summarised in Figure ES.2. This risk-based assessment framework takes into account the specific requirements of these documents as they relate to matters of national environmental significance as well as state interests. The EIS has been consolidated into a single comprehensive document for public consultation purposes and any submissions made on the document will be reviewed by both the Australian and Queensland governments.

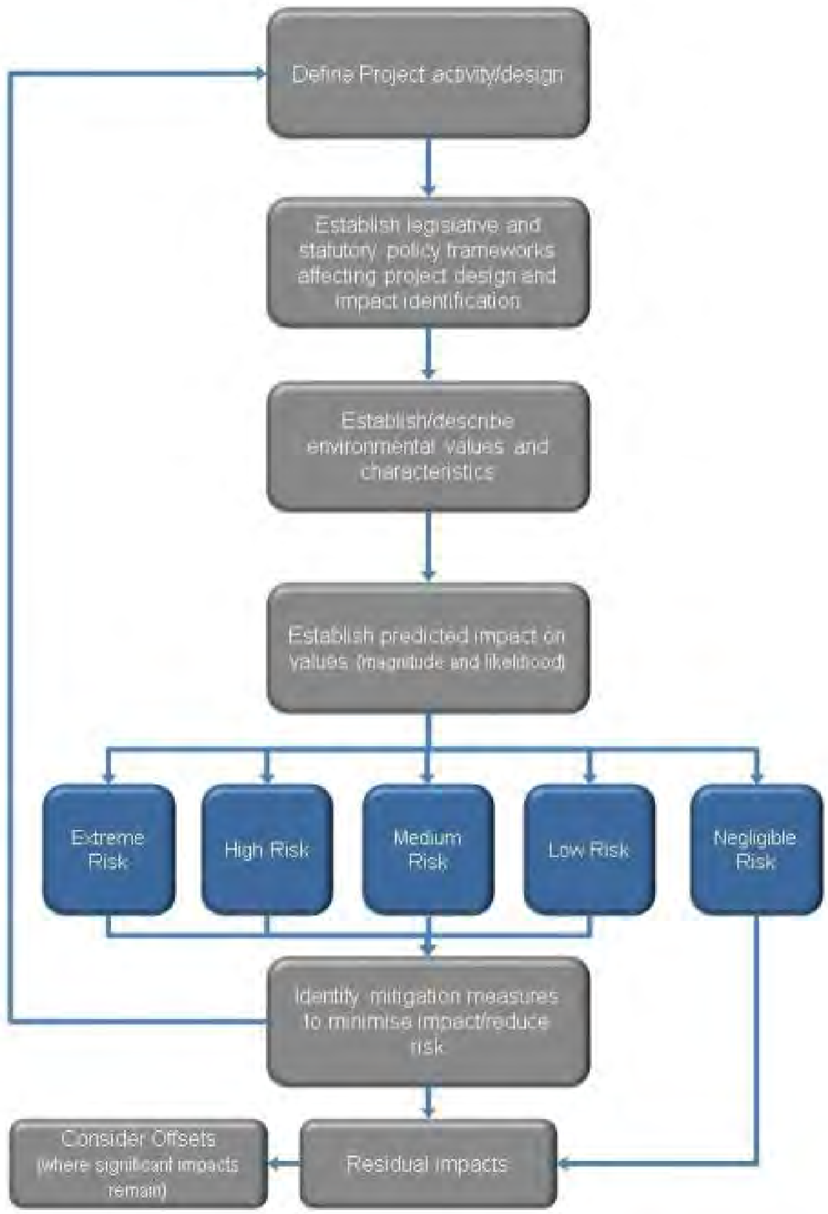


Figure ES.2 Overview of the impact assessment process

1.3.1 Project Assessment and Approvals Framework

Approvals are considered in terms of Commonwealth, state and local government jurisdictions and deal with matters that are referred under specific legislation. Detailed assessment requirements are dealt with in each of the technical chapters of the EIS Part B under the heading 'Assessment Framework and Statutory Policies'.

The legislation that applies to the PEP is discussed in terms of its general intent and operation with a separate, more detailed discussion in Section A2.6, providing the context of the approval requirements.

Approvals for further development as part of the operational phase of the PEP (i.e. by port tenants once reclamation and servicing of the site has been completed) will be dealt with under separate approval processes by the specific tenants. This will occur when the land is included as Strategic Port Land and will be determined by the *Sustainable Planning Act 2009* (SP Act) and POTL's *Land Use Plan* (POTL, 2010b), the *Environmental Protection Act 1994* and other environmental legislation.

In addition to assessment requirements that are typical of a planning or environmental nature, the EIS also identifies a number of legislative requirements in relation to quarantine, maritime safety and operations, security, safety and land transportation that need to be considered during the construction and subsequent operation of future stages of PEP.

The EIS recognises that the *State Development and Public Works Organisation Act 1971* includes provisions to ensure that any conditions required by the Coordinator-General for a significant project have primacy. Any conditions imposed under a future approval applying to the assessment of development applications that are inconsistent with the conditions of the Coordinator-General are superseded by the Coordinator-General's conditions. This does not apply to Commonwealth legislation, including approvals required under the *Great Barrier Reef Marine Park Act 1975*, *Environmental Protection (Sea Dumping) Act 1981* where a future approval is warranted for offshore disposal of dredge material, or *Native Title (Queensland) Act 1993* legislation.

1.4 Proposed Construction and Staging Methodology

The following outlines a strategy for staging of the PEP development over the planning horizon based on the adopted trade forecast (Section **Error! Reference source not found.**) and an assessment of the cargo capacity requirements. The staging includes two navigation design depths based on a forecast of ship sizes and ship traffic. Although the development stages are indicative, they do provide a reasonable basis for identifying likely construction methodology for each stage and to undertake an assessment of impacts.

1.4.1 Development Staging

It is expected that the PEP works in the new outer harbour will be undertaken progressively to match the need for additional port facilities, which will be driven primarily by the demand to accommodate the growth in existing and/or new trades. While development decisions for each stage will be made when favourable business cases can be demonstrated and will be subject to the availability of capital funding, a feasible development schedule has been prepared which the EIS is based on.

The north-eastern breakwater defining the entire footprint for the new outer harbour will need to be built at the beginning of the Project to provide the appropriate protection for the progressive development of new berths. However, the berths and reclamation areas behind the breakwater will be developed in a staged manner in response to demand from increase in cargo throughput or the advent of new trades. This expansion may be developed on a sequential berth-by-berth basis or in stages involving the development of multiple berths.

The ensuing staging of the works for marine infrastructure, reclamation and channel development will be determined by a number of factors, in particular:

- The removal of all soft material from the north-eastern breakwater footprint, bunded reclamation area and from the initial outer harbour basin dredging area will be undertaken at the outset of the Project.
- The construction of the north-eastern breakwater and revetments will be undertaken at the outset of the Project.
- The development of marine infrastructure in the new outer harbour may be undertaken on a berth-by-berth basis or groupings of two or more berths at a time.
- The dredging of the outer harbour basin will be undertaken in a staged manner to provide the vessel manoeuvring area appropriate to the staged berth development.
- The development of the reclamation area will be undertaken in a staged manner to match the berth development requirements.
- The deepening of the approach channels will be undertaken in stages to meet shipping requirements. The driving parameters will be the draught of the prevailing vessel fleet and the level of service for the vessels in terms of access criteria and the level of tide-assisted transits required. For the purposes of the EIS the channel deepening is envisaged to be undertaken in two stages.

1.4.2 Project Timetable Overview

While it is not possible to predict exactly when the new berths and associated infrastructure will be developed, an estimate of the timetable for development has been put together as a feasible development scenario to guide the preparation of the EIS, based on the long-term trade forecast prepared for the EIS. In practice the sequence and timing will be regularly reviewed and adjusted to reflect the actual demand for cargo handling capacity and shipping requirements.

The indicative timing of the main components of the PEP development is shown on Figure ES.3 and discussed below.

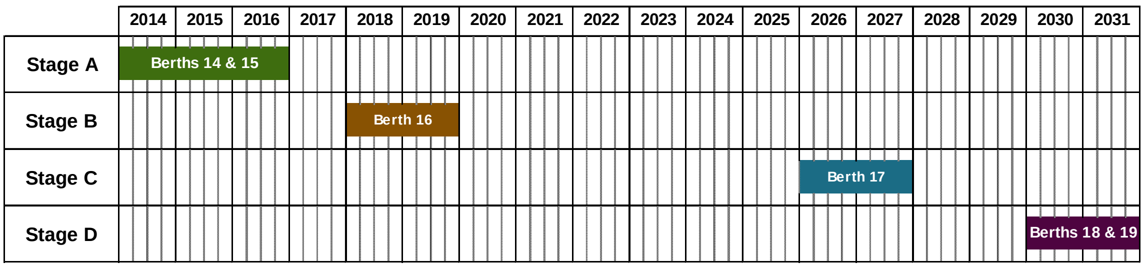


Figure ES.3 - Indicative development program

1.4.2.1 Stage A (2014 to 2016)

Stage A development of the PEP is planned for construction from 2014 to 2016 involving:

- develop bunded outer harbour reclamation area (entire outer harbour reclamation footprint) with revetments and north-eastern breakwater protection (western breakwater if required)
- develop new Berths 14 and 15
- undertake dredging works:
  - dredging of soft marine sediments in the footprints of the reclamation area, bund and north-eastern breakwater structures, Berths 14 and 15 manoeuvring basin with relocation of dredged material to the existing offshore DMPA
  - deepening of the basin of Berths 11 and 12, with placement of dredged material in bunded areas as reclamation fill
  - dredging of Berths 14 and 15 manoeuvring basin with placement of dredged materials in the bunded areas as reclamation fill or relocated to the existing offshore DMPA
  - Stage 1 deepening of the Sea and Platypus channels and widening of Platypus Channel (between beacons P11/P13 and P12/P14) with relocation of the dredged material to the existing offshore DMPA.
- development of a rail loop and wagon unloading/loading infrastructure required for Berths 14 and 15
- construction of landside infrastructure for cargo storage and transfer (by port tenants) required for Berths 14 and 15
- construction of road and other infrastructure to support port operations required for Berths 14 and 15.

1.4.2.2 Stage B (2018 and 2019)

Stage B development of the PEP (refer outer harbour layout in **Error! Reference source not found.**) is planned for construction during 2018 and 2019 involving:

- development of new Berth 16
- Undertake dredging works:
  - dredging of soft marine sediments in the footprint of Berth 16 manoeuvring basin with relocation of dredged material to the existing offshore DMPA
  - dredging of Berth 16 manoeuvring basin with placement in bunded areas as reclamation fill.
- development of additional rail and wagon unloading/loading infrastructure required for Berth16
- construction of landside infrastructure for cargo storage and transfer (by port tenants) required for Berth 16
- construction of road and other infrastructure to support port operations required for Berth16.

1.4.2.3 Stages C and D

Development of Stages C and D of the PEP (refer outer harbour layouts in **Error! Reference source not found.** and **Error! Reference source not found.**) is planned for construction from 2026 to 2035 involving:

- sequential development of new Berths 17, 18 and 19.
- undertake dredging works during Stage C:
  - dredging of soft marine sediments in the footprint of new manoeuvring basin areas with relocation of dredged material to the existing offshore DMPA
  - dredging of the remaining manoeuvring basin area, plus deepening of previously dredged basin area, with placement in bunded areas as reclamation fill
  - Stage 2 deepening of the Sea and Platypus channels with relocation of dredged material to the existing offshore DMPA
- sequential development of additional rail and wagon unloading/loading infrastructure required for Berths 17, 18 and 19
- sequential development of landside infrastructure for cargo storage and transfer (by port tenants) required for Berths 17, 18 and 19
- sequential construction of road and other infrastructure to support port operations required for Berths 17, 18 and 19.

1.5 Economic Values

1.5.1 Economic Environment

Townsville is located in Queensland's Northern Economic Triangle supporting the local, regional and state economy by ensuring capacity meets demand and providing local Queensland producers and industries with access to international markets. The economy of Townsville performs well, shows strong population growth, enjoys incomes on par with Queensland and is well-diversified. The main competitive advantage of this region and particularly Townsville, as the main urban centre in the Northern Economic Triangle, lies in its skilled population, diversified and growing economy and existing infrastructure linking major resource centres in North West Queensland.

POTL has prepared trade forecasts to 2039/40 fiscal year, which underpin the need for the PEP. Those forecasts are based on a detailed assessment of individual resource projects being developed by several major resource companies, particularly nickel, magnetite, copper, coal and fertiliser. The summarised forecasts are supported by a detailed mine-by-mine analysis of port capacity needs. The export of magnetite is a trade that has recently been introduced to Townsville following several magnetite mine developments. The coal export trade could be a possible new trade, which may be developed at Townsville to handle coal exports from the northern end of the Galilee Basin. Nickel, copper and fertiliser are existing trades whose volumes are also forecast to grow as the economy develops towards 2040. The result is that the port's current trade of 11 Mtpa (million tonnes per annum) in 2010/11 is expected to more than double to nearly 25 Mtpa within 5 years and 30 Mtpa within 10 years once new mines are developed and commence exporting. These projections exceed the current capacity of the port, which is approximately 23 Mpta (including the development of Berth 12).

The expected growth in key exports from Townsville is reflected in the growth also being experienced by the Townsville (7% net migration rate), which is largely occurring to support the growth of industries.

The initial construction phase of the PEP involves a significant boost of around 6 to 7% above usual investment levels in the region over the period to 2025. This additional investment will impact on the employment levels and living standards of the region.

On average, over the period to 2040, the Project will create an additional 616 full-time equivalent positions per annum in the Townsville area[1], with a peak impact of just under 2,300 full-time equivalent positions at the height of the construction activity. Combining the associated mining developments in the Northern Economic Triangle with the port results in an employment impact of close to 8,400 person-years of employment in the initial phase of port and mine construction to the end of 2019.

[1] From 16,620 person years of employment.

The best measure of the impact on living standards is gross national income, which takes national production (gross domestic product or gross regional product; gross regional product at the regional level) and adjusts for income flows overseas. On this measure, the total increase in Australian living standards from the PEP and associated mining developments is $12.6 billion in net present value terms at a discount rate of 7%. Of that boost to living standards, $8.1 billion remains in the Northern Economic Triangle region, just over $10 billion accrues to Queenslanders and the remainder benefits residents in other jurisdictions of Australia (mainly due to tax revenues flowing to the Commonwealth and being redistributed to the other states and territories).

The PEP is likely to create a short-lived peak in labour demand during the initial construction period. Townsville already experiences transition movements of personnel as a result of defence personnel fluctuations. In the longer term any adverse effects of the PEP on the housing and labour markets will be minimal, given the background growth in employment in the area and the consequent needs for housing.

1.5.2 Port Operations

Given the pivotal nature of the development impetus, POTL, as a port authority under the *Transport Infrastructure Act 1994*, will be responsible for planning the development of PEP. The operational framework will be a progressive expansion of existing port infrastructure and operations under the same management structure. The operations that will result from the PEP will be conducted using established road and rail networks and shipping channels used by the existing port and other separate developments that are underway or being planned by POTL. In addition, road and rail as part of the Eastern Access Corridor (EAC) will also service the PEP as they come online. As such, the PEP planning and design was integrated with the broader port operations.

Significant port operations relate to shipping, road and rail, since the above-wharf development of cargo handling facilities will be by the port's as-yet-unidentified tenants who would lease POTL land and berth facilities. They will construct their own operating infrastructure, as and when they take up their lease and the operating approvals would be independently undertaken by those proponents at the appropriate time.

In order to manage potential impacts from the port, management plans have been prepared that include both existing and additional measures that are to be applied to the operation of PEP to manage environmental impacts and reduce risk from a range of hazards.

Specifically, the Maritime Operations Management Plan provides mitigation measures to address the potential impacts of increased shipping associated with upgrades to facilities being implemented across the port, other planned upgrades and expansion projects and the PEP. It details a range of management measures for maintaining safe, efficient and effective vessel operations in the Port of Townsville. It also details the relationship with Maritime Safety Queensland and its Regional Harbour Master.

With the management plans in place the predicted growth in port operations can be appropriately managed with operational procedures being reviewed over time and amended to account for the staged development of the PEP.

1.6 Natural Physical and Ecological Values

The following sections describe existing conditions and predicted effects of the PEP on natural and built values.

1.6.1 Land – its Qualities and Uses

The Port of Townsville is underlain by Quaternary-age alluvium and colluvium sediments, which in turn overlie basement geology comprising Late-Palaeozoic age Granite (Golder Associates, 2012b). The near surface lithology comprises Holocene sediments more than 12,000 years old, including silts, mud and sand described as coastal tidal flats, mangrove flats and supratidal saltpans.

Seismic analysis beneath the PEP undertaken in 2008 and more recently in 2011 confirmed the presence of relatively shallow density (soft) sediments generally matching the stratigraphy identified by the drilling programs conducted by Golder Associates (2008a) and GHD (2008a). According to the Golder

Associate's investigation offshore of the north-east boundary of the existing port land, bedrock is probably at least 16.5 m below the current seabed.

The soil profile in the Platypus and Sea channels is broadly similar to that of the outer harbour and proposed reclamation area. Along the Platypus Channel, prior to dredging in 1993, the reported surface sediment thickness generally ranged from 1 to 3 m. The soft surface sediments vary in thickness but are relatively thin, thought to arise from tidal and seasonal movement of the seabed sediments. The underlying in situ material is generally comprised of very stiff sandy clay and medium to coarse grained clayey sand.

Previous dredging campaigns and borehole investigations indicate that there are some areas of low strength rock or cemented material in the channel, which were not successfully dredged previously by a trailer suction hopper dredger. A grab dredge was employed for excavation of small quantities of these cemented materials.

Risk of land contamination from the Project is low, being mainly associated with potential contamination from spills and leaks during construction and operational stages. These risks will be managed through construction and operational EMPs. Without the implementation of suitable mitigation measures development and operational activities may contaminate land created by PEP. Past port operations have successfully occurred without significant incidents of land or water contamination because of dutiful use of EMPs.

Land use and tenure of land adjacent to the port have been assessed to identify potential impacts including on:

- surrounding land uses and human activities, specifically:
  - surrounding (non-port) land uses
  - recreational uses on Cleveland Bay
- town planning objectives, controls and development constraints.

Mitigation measures that relate to land use matters apply primarily to potential direct and indirect impacts including:

- Boating and yachting activity in Cleveland Bay: notably for craft navigating from Ross River and Ross Creek, due to removal of water area from Cleveland Bay, and obstruction to navigation resulting from seaward extension of the port
- Residential and other sensitive land uses along or near Boundary Street: due to potential reductions in amenity and safety resulting from increases in heavy-haulage vehicle movements, Residential and other sensitive land uses along the existing rail corridor to the port
- Potential increased noise resulting from more frequent rail movements to and from the port in the future
- The Eastern Access Corridor aims to alleviate future road and rail constraints once full operational status is achieved.

Other mitigations concerning land uses will require:

- consultation and community awareness of the PEP's staged works and updates on its progress relating to the development timeframes, including communication regarding likely effects and opportunities that this may have regarding additional housing or land and property development for industrial or commercial use development by port growth
- ongoing engagement with local government about strategic and statutory planning needs for the surrounding area to preserve the port as a significant land use of local and regional importance and to emplace controls in the new planning scheme to highlight future land use along Boundary Street
- liaison with Department of Transport and Main Roads and Townsville City Council in relation to the transport planning and any related land use planning control needed for development along Boundary Street.

1.6.2 Surface Waters and Hydrology

The Ross River Basin has an area of 1,707 km² and flows to the sea at Townsville with the main rivers being Bohle, Little Bohle and Ross. The Ross River catchment is the single largest in the Townsville City Council area. The majority of the Ross River catchment is upstream of Ross River Dam with approximately 760 km² draining to the dam. Downstream of the dam a further 145 km² drains to Ross River through the tributaries of Stuart Creek, Gordon Creek, Annandale Drains and University Creek. Ross Creek drains most of the urbanised area of Townsville, including the suburbs of South Townsville, Hyde Park, Mundingburra, Gulliver, Currajong, Pimlico, Mysterton, Aitkenvale, Vincent and Cranbrook. With the exception of Castle Hill, the catchment area is flat and almost fully urbanised.

During wet seasons, Townsville commonly receives intense and heavy rainfall often associated with severe weather forming in the vicinity of monsoonal troughs. The heavy rainfall generally occurs between November and April; January and February are usually the wettest.

Modelling of potential flooding and storm-event catchment discharges clearly show that there would be no change to flood levels, flood extents or inundation times as a result of the PEP, as it sits entirely in the ocean.

As a result of severe runoff events, like other developed Queensland coastal catchments, there are potential effects on the surface water via stormwater drainage during the construction and operation stages. Such effects will potentially arise from:

- leaks from storage of oil, fuel and chemicals on site
- handling and leaks from storage of hazardous goods, with contaminants from liquid and solid materials potentially entering the existing waterways
- runoff of stormwater enriched with suspended sediments from the construction period.

Once the site has been filled and sealed, infiltration from rainwater directly below the surface will cease (as it is capped and paved). Localised recharge on areas outside of sealed surfaces (grassed verges; vacant land) is likely to continue to result in small groundwater mounds. The presence of sealed surfaces and purpose-built drainage will result in surface water flowing into a port-wide reticulated drainage system. Outflow of surface waters through drainage will be swift due to anticipated heavy tropical storms. Site management will be required at the operational sites of each port tenant as management of stormwater contamination risk is best done at source.

Depending on the bulk materials stored and handled on PEP, there is likely to be purpose designed water and runoff site treatment system such as sub-catchment bunding and roofing, treatment systems (including diversions), proprietary products and/or retention ponds. Land management aspects of stormwater management will be consistent with *Queensland Urban Drainage Manual* (DNRW, 2007).

A range of mitigation measures have been recommended associated with maintaining the integrity of surface and ground water in and around the PEP footprint through the management of sediment and erosion and prevention of spills. The identified management measures for the construction and operational phases of the Project will reduce the potential impacts on water resources. If managed properly the impacts associated with adjacent marine surface waters will be minimal.

Groundwater will not exist during the initial land development phase. Judicious management (including testing and placement of clean reclaim material) will prevent the development of an acidic and/or contaminant enriched content in any artificial aquifer that may establish after the final land development.

1.6.3 Marine Waters

Cleveland Bay is a naturally turbid environment, with wind driven re-suspension of fine seabed sediments, particularly in winter months, and significant fluvial influences as a result of flooding in summer months. Benthic primary producers such as seagrass have adapted to the highly variable water quality conditions that occur in the bay and provide critical habitat for fisheries and marine species of conservation significance.

The PEP has the potential to influence water quality in Cleveland Bay during both construction and operation. Impacts on water quality during construction will result from dredging the outer harbour, Platypus Channel and Sea Channel, including placement of dredged material, reclamation, and construction of breakwaters. The influences on water quality from these activities will be short-term.

Dredging is the principal activity that will result in the resuspension of sediment particles into waters of the bay. Visible turbid plumes will occur as a result of Project activities, particularly from dredging in the Platypus and Sea channels. Turbid plumes, containing natural sediments re-suspended from the seabed of Cleveland Bay, will likely be carried by currents across the bay and into parts of greater Cleveland Bay, risking impacts to nearby sensitive ecological receptors such as hard corals. During winter, wind and wave fetch moves surface waters westward. Numerical modelling has shown that the extent of those plumes during dredging will depend on a range of factors including season, wind strength and direction, currents, tide status, location and type of dredge, as well as dredge working methods and productivity.

The primary means of managing changes to ambient marine water quality will be through establishing monitoring programs for contemporary baseline conditions, and providing ongoing water quality data during the staged dredging and construction phases of PEP. In addition to data analysed as part of the EIS, a 12 month water quality data collection campaign is currently being undertaken at key habitats in Cleveland Bay to establish a seasonal baseline.

A reactive monitoring program for water quality and ecological health will form part of the EMP as well as a specific Dredge Management Plan. The Dredge Management Plan sets out a framework to develop trigger water quality levels which, if being approached or exceeded, will require the works program to be adjusted, changed or suspended to manage marine water quality to within acceptable levels, prior to ongoing works recommencing. This approach will be combined with marine ecological assessment of coral and seagrass health prior to, during and following major dredging events.

1.6.4 Coastal Processes

Cleveland Bay is located approximately 50 km north of the Burdekin River and halfway between the Burdekin and Herbert Rivers, which provide the dominant sediment supply to the central Great Barrier Reef coast (Belperio, 1983; Moss, Rayment, Reilly, & Best, 1993). Bedload sediment, which is predominantly sand, comes under the influence of wind and wave-induced longshore drift, and is transported northwards along the coastline, along with more local inputs. During summer floods, suspended load muds, and some finer sand, are discharged directly onto the inner shelf, where they either accumulate on the seabed at depths out to 20 m, or are processed back into the mangrove systems that fringe the coastal plain.

Cleveland Bay has accumulated sediments to become relatively shallow, deepening to only 10 to 11 m (chart datum) along its northern entrance. The predominant source of this ongoing supply of fine sediments and very fine sands is the Burdekin River. Kroon et al (2012) have estimated that the average yearly export of suspended sediment from the Burdekin River is 4 Mtpa. These sediments, once deposited on the sea floor, are advected northward by longshore currents driven by the prevailing south-easterly winds and waves (Belperio, 1983). Orpin *et al* (1999) conclude that wave-induced bed stress is the most significant mechanism of sediment re-suspension with non-cyclonic suspended-sediment concentration events mostly limited to the inner shelf in water depths less than 15 m.

Woolfe and Larcombe (1998) indicate that the three embayments north of the Burdekin River (Bowling Green, Cleveland and Halifax Bays) show successively decreasing rates of terrigenous infill. Orpin et al (2004) conclude that 80 to 90% of the Burdekin River sediments are captured in Bowling Green Bay. Orpin et al. (1999) estimate the longshore sediment export from Bowling Green Bay into Cleveland Bay to be approximately $3x10^8$ kg per annum. Orpin et al (2004) find that Cleveland bay traps about the same amounts of sediment, about 5 to 10% of the total average Burdekin River fluvial discharge, with accumulation rates less than 1 mm per annum. They note that the accumulation rate is a function of re-suspension and re-deposition as well as supply, and that the Cleveland Bay tidal and sub-tidal zone is extensively reworked, re-suspended and re-deposited with relatively small net inputs during the last century. Further, they suggest an episodic rather than continuous pattern of deposition, as deduced from core data.

Two broad coastal process categories can be made, based on the predominant sediment transport mechanisms and the observed effects:

- Cleveland Bay hydrodynamics and sedimentation, including direct siltation in dredged areas and effects from dredged material placement
- indirect beach processes along the shoreline.

Extensive numerical modelling has been undertaken as part of the EIS to understand any potential impacts from the Project on these hydrodynamic, sediment re-suspension and shoreline processes.

Once the bunds, revetments and breakwaters of the PEP are constructed changes in hydrodynamic current velocities of ocean waters are confined to areas immediately surrounding the PEP, with small magnitude changes of up to 0.2 m/s in ocean currents. The velocities within the outer harbour and adjacent channels are generally reduced.

Numerical modelling of sediment transport and deposition showed that the outer harbour rock walls will cause the redirection of the suspended sediment to drift around the PEP reclamation. A small net reduction in fine sediment drift from east to west of the port may occur due to the combined interception effect of the outer harbour extension and the partly wider and deeper Platypus Channel. This small reduction in fine cohesive sediments would not be expected to generate a perceptible morphological change to sand supply to The Strand, either in the short or long term. The PEP reclamation may cause a slight increase in sediment deposition rates in Cleveland Bay immediately to the east of the outer harbour and Platypus Channel.

There will be a reduction in the energy of certain types of waves at The Strand due to the PEP. Waves generated locally in Cleveland Bay, presently incident on The Strand beach from east south-east to east north-east direction, will be reduced in height and altered in incident angle to varying degrees along the beach length. There will be a somewhat less effect on the longer period sea waves that propagate from offshore past Cape Cleveland. This will result in a very slight reduction in a northward component of the longshore transport of sand to varying degrees along the beach length. Wave propagation analysis shows no increase in wave heights at any location along The Strand beach; in fact, storm waves at the southern to mid parts of The Strand are likely to be reduced in height. The beaches there will be less subject to erosion or wave overtopping from storm events.

Because of the uncertainties and the complexity of interaction of various processes and events, it is not feasible to predict any clear climate change tendency in marine sedimentation and siltation in the shipping channel or harbour. Over time maintenance dredging will be required to remove deposited sediments from the channel as it is now. While the larger channel cross-sections will be more efficient at trapping fluxful sediments, a significant reduction in siltation will arise because of the enclosure of the outer harbour. This will contribute to a predicted net 25% reduction in the current annual maintenance dredging volume. Maintenance dredging of the port has been undertaken in Cleveland Bay for over 100 years in order to maintain navigable shipping channels, berths and vessel manoeuvring areas (GHD, 2008a). The existing, approved offshore Dredge Material Placement Area (DMPA) in Cleveland Bay has a long history of use, as have two inshore DMPA that are no longer in use. The implications of the placement of a large volume of capital dredge material from channel deepening as part of PEP into the existing Cleveland Bay DMPA has been assessed with the following key findings:

- There is sufficient volumetric capacity within the existing DMPA to accept the dredge material from PEP, as well as cater for other proposed projects and future maintenance dredge requirements.
- Water quality impacts from the placement activity have been modelled and turbid plumes are predicted to be minor, temporary and localised. There are no sensitive receptors in close proximity to the existing DMPA.
- Sediment re-suspension processes within the bay are significant and occur over a broad scale. The relative contribution of additional dredge material placement at the DMPA when compared to bay-wide re-suspension processes is considered to be minor. Although some material placed at the DMPA will be naturally advected toward the north-eastern coast of Magnetic Island under normal wave and tidal conditions, the marine ecology assessment has not predicted any significant impacts from this process on corals or other key habitats present.
- Two alternative DMPA sites have been examined further offshore from the existing DMPA. These sites do not present any specific or significant environmental benefits over the existing site. They

would introduce potential conflicts with other marine uses (commercial fishing and shipping), represent ‘greenfield’ sites in the Great Barrier Reef Marine Park (GBRMP) that have not been exposed to previous disturbance, and do not provide hydrodynamic benefits in the context that they would remain dispersive, despite placement at greater water depths.

1.6.5 Marine Sediments

The principal impacts from marine sediment quality are associated with the liberation of potential contaminants within them as a result of dredging disturbance.

Catchment land uses, coastal zone industry, urban development and transportation have resulted in elevated levels of nutrients and other contaminants in surface sediments, particularly in places within the Ross River and Ross Creek waterways and nearshore areas of Cleveland Bay. Deeper, stiffer clay sediments below 1 m within native seabed of the outer harbour and channels can be characterised as being uncontaminated.

Acid sulfate material is present in marine sediments beneath the PEP, as nearshore marine sediments are often naturally-rich in sulfur. These have high capacity to neutralise sulfur that oxidises due to the presence of carbonates from shell and coral debris in the sediment itself. As the sediments of the seabed are fully submerged, Golder Associates (2012b) concluded that there could be no actual acidity. Where any disturbance of acid sulfate soils is undertaken (limited to the upper seabed layers), generation of acid through prolonged exposure above water would be unlikely as the majority of that material is to be placed at the DMPA.

Low level contamination that triggers the requirement for further scientific investigation exists in some surface marine sediments adjacent to the existing Berth 11 and the future Berth 12 area. These sediments are being further investigated and managed as part of POTL’s long term dredge material disposal strategy and will largely be removed prior to PEP capital dredging commencing (the PEP involves further deepening of these areas). Sediment that is to be disturbed by PEP will undergo further testing and activities will meet the requirements of *Environment Protection (Sea Dumping) Act* for onshore and offshore handling and placement of segregated clean or potentially contaminated sediments.

1.6.6 Marine Ecology and Conservation

Cleveland Bay is known to support a broad range of marine ecological values and functions. Notable marine ecological values include:

- a wide diversity of marine habitat types including beaches, mangrove forests, saltmarshes, intertidal shoals, subtidal soft sediment habitats, rock walls, fringing coral reefs and rocky shores
- one of the largest seagrass meadows in the North Queensland region
- coral communities of high biodiversity significance around Magnetic Island
- habitats for a wide range of fish and shellfish of direct economic significance
- significant feeding areas for marine turtles and dugongs, which are listed as threatened or migratory under Commonwealth and/or state legislation
- habitat for a range of other threatened or otherwise listed marine megafauna species, including whales and dolphins protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitats and biological communities in the port, the dredged channels and the foreshore of Townsville are in a modified condition. Habitats and biological communities elsewhere in Cleveland Bay are considered to be in a slightly to moderately modified condition and relatively resilient to disturbance; however, climate-induced disturbances can create conditions that make them more susceptible to anthropogenic disturbance.

Impacts and impacting processes include:

- Permanent irreversible impacts as a result of reclamation and breakwater construction. While there are no seagrass communities (observed as part of current sampling or historically) or rocky reefs present within the area of the works, the reclamation and associated breakwater construction will result in the loss of approximately 110 ha of unvegetated soft substrate. These habitats are characterised as having low to moderate biodiversity values, but are contained in the core habitat area of the Australian snubfin (*Orcaella heinsohni*) and other coastal dolphin species.

- Temporary residual impacts will arise from capital dredging in the outer harbour and the deepening of the Platypus and Sea channels. The total area of capital dredging in the outer harbour and channels is estimated to be approximately 220 ha. The areas subject to capital dredging in the nearshore are characterised as having low to moderate biodiversity values. The footprint of capital dredging in the outer harbour has no seagrass communities (observed as part of current sampling or historically) or rocky reefs present. The capital dredging associated with the PEP is a temporary activity. The deeper areas will recolonise with benthic organisms rapidly (in the order of months) following disturbance. The benthic assemblages that recolonise these areas will be similar in character to other areas of the port where dredging has previously occurred.
- There will be a permanent beneficial impact from the creation of rock wall habitat around the perimeter of the reclamation along the major breakwaters. This has been estimated in the design as creating 10.55 ha of subtidal rock wall habitat and 1.45 ha of intertidal rock wall habitat. The ecosystem services provided by the created rock wall habitat are considered to be significantly greater than the current unvegetated soft sediments they will replace. Key values include habitat for fisheries of commercial and recreational significance, supplemental feeding habitat for foraging green turtles and opportunistic high tide roosting habitat for migratory and resident waterbirds.
- Potential effects arising from introduction of marine pests from an increase in foreign vessels visiting the port. Such occurrences have not been known to occur in Townsville's waters. Visiting ships will be expected to manage ballast in accordance with existing Commonwealth and international legislation and biosecurity requirements.
- Potential effects on animals such as dolphins, whales, dugongs, turtles and other marine megafauna associated with underwater noise generation, light, vessel strike and marine pollution events. A series of management plans (construction environmental management; vessel traffic management (construction) and maritime operations management) will be adopted to manage associated development and operational risks.

Based on historical seagrass mapping, very sparse ephemeral deep seagrass habitat has been known to occur in central Cleveland Bay. If present at the time of dredging, these deep water seagrass communities could be directly disturbed by channel deepening activities and placement of dredged material in the DMPA. Survey work since 2010 conducted for PEP, by each of GHD and BMT WBM, did not detect these deepwater seagrass communities, so they are not known to have occurred since the 2007 surveys undertaken by the Department of Agriculture, Fisheries and Forestry.

The PEP areas are not known to support the nearshore permanent seagrass that occurs in Cleveland Bay that provides high quality foraging habitat for marine megafauna, fish or shellfish of economic significance.

With minimal direct impacts, the greater risk to environmental values from the Project will be indirect impacts to benthic habitats and communities (particularly permanent seagrass beds and hard coral communities) associated with the generation of turbid plumes during dredging.

Extensive predictive modelling of key water parameters such as turbidity and photosynthetic active radiation (a measure of water clarity) have been undertaken to assess if dredging – particularly deepening of the Platypus and Sea channels by a medium-sized trailing suction hopper dredge - could have acute (short term) or long-term chronic (press-type) disturbance to those nearest seagrass meadows and corals at Magnetic Island and Middle Reef.

This assessment has also drawn on the findings and data from the environmental monitoring undertaken during the 1993 dredge campaign in Cleveland Bay, which was the last major capital dredging campaign for the Platypus and Sea channels.

To reduce the residual risk to sensitive benthos (being soft bottom benthos, seagrass and hard corals) the following mitigation measures will be adopted:

- Use of green valve by the trailing suction hopper dredge to reduce sediment spill and plume dispersion.
- Implement a range of measures to reduce sediment laden tailwater discharges into Cleveland Bay.
- Dredging during winter months to reduce the potential likelihood for turbid plumes to impact on sensitive receptors such as seagrass and coral communities. These communities are considered to be more resilient during winter.
- Implement a reactive monitoring program to prompt feedback and facilitate appropriate corrective action if nominated triggers are exceeded.

While the modelling does not predict significant or long-term impacts to these systems from PEP, an integrated reactive monitoring program has been devised based on the inter-connection of rapid pressure/stressor monitoring of water quality combined with receptor monitoring of sensitive and/or valued indicator taxa. This monitoring programme will be implemented to ensure exceedences to water quality and ecological limits are detected during the dredge operation and corrective actions are implemented before permanent impacts occur. The reactive monitoring program will be further refined and implemented by an advisory group made up of government and non-government experts similar to the approach taken to dredge environmental monitoring in 1993.

An increase in vessel traffic around the port area during port construction activities will increase the likelihood of boat strike and the avoidance of the work area by megafauna. A dredge management plan and vessel traffic management plan have been developed to take into consideration of cumulative impacts of port activities with strategies such as speed limits, fauna spotters, and other controls to avoid interactions with megafauna.

Specific commitments to marine megafauna include:

- implementation of management actions to reduce construction related events
- implementation of controls to reduce the potential for underwater noise impacts; including the implementation of a scientifically-based exclusion zone around pile driving activities
- undertaking monitoring of marine megafauna during construction to reduce the risk of interactions with construction vessels
- designing lighting to reduce potential disruption on the minimal nesting and hatching of marine turtles that occurs on nearby mainland beaches.

Through the implementation of these and other mitigation measures, the PEP is assessed as not having significant impacts to matters of national environmental significance or unacceptable impacts to marine species and features of high conservation or fisheries significance. It remains that the Project (due to its size and scope) will result in some residual impacts that cannot be completely designed or mitigated out.

The key residual impacts associated with marine ecological matters include:

- permanent loss of soft bottom benthic habitat associated with reclamation and breakwaters
- the temporary direct impacts to benthos in dredged areas
- potential indirect impacts to adjacent marine habitats associated with turbidity from Platypus channel dredging.

Environmental offsets are only applicable to residual impacts – that is when the impacts from a development or action cannot be avoided or reduced and if all other government standards are met.

Based on Commonwealth and state environmental offset policies and guidance, and based on preliminary consultation with relevant agencies, POTL has outlined a preliminary offsets proposal for the key residual impacts of PEP for consideration as part of the EIS. The offsets proposal includes a range of direct (habitat protection, water quality improvement) and indirect (research and long term monitoring) offset measures.

1.6.6.1 Terrestrial Ecology

As PEP is a marine development, it does not require any vegetation clearing and it will not result in the disturbance of any natural terrestrial habitat. The focus is on terrestrial environmental values in the broader region particularly of migratory and wading shorebirds that may use nearshore habitats at the interface of terrestrial landscapes. Emphasis has been placed on shorebird habitat associated with the surrounding areas of Ross River and along the coastline of Magnetic Island where indirect effects may potentially occur.

Environmental values of the Study Area assessed included:

- GBRWHA, wetlands of international and state importance and other protected areas
- East Asian – Australasian Flyway, wildlife corridors and avian foraging and roosting habitats
- vegetation communities and regional ecosystems as potential fauna habitat
- threatened species and ecological communities
- migratory species.

The potential impacts to terrestrial ecology associated with construction and operation of the PEP potentially include:

- direct removal and/or creation of land forming habitat for plants and animals
- indirect effects from changed hydrology and potential sedimentation at the interface with intertidal lands
- spread of invasive terrestrial species
- noise, vibration and light emissions during construction and port operations.

The permanent creation of land will provide opportunistic foraging and/or roosting potential for migratory and resident shorebirds known in the area. A relatively small migratory bird population is known to have infrequently inhabited parts of the existing eastern reclaim of the port for feeding, and species richness there approaches that of the Ross River site (NRA, 2012). The eastern sandspit, across the Ross River from the Marine Precinct, is the primary natural roosting and foraging habitat for birds in the immediate area. The existing port land, breakwaters and revetments provide alternative additional habitat in the natural landscape. Birds opportunistically using the port land, breakwaters and revetments may temporarily be displaced from the northern edge of the port’s eastern reclaim to the eastern Ross River sandspit during construction. Such an effect is unlikely to be significant to regional bird populations.

The removal of the existing north-eastern revetment will temporarily affect rock wall habitat as it affects shellfish and fish availability as food. The revetment currently supports algal and invertebrate communities and removal of the revetment will reduce foraging resources there in the short term. The sooty oystercatcher, among other species, is known to use rock walls for roosting. This impact will be temporary, as a new and longer breakwater and revetment will be constructed to counteract any longer term habitat loss. The seaward side of the new breakwater and revetments will have a frontage that results in a net gain of over 1,600 m.

The eastern reclaim area and Marine Precinct reclamation ponds provide lower-lying transitional foraging areas and their use by birds will change throughout the PEP reclamation program. Stage A of PEP development will increase the area of partially-filled cells with settlement ponds covering approximately 75 ha. During construction, the reclamation ponds will increase from 11 ha to 75 ha and during their use will have the effect of maintaining the opportunistic foraging area available to avian species.

The PEP construction activities will take place at a distance well away from the sensitive natural bird roosting and feeding habitats of Ross River sandspit and, given construction will be undertaken in intermittent campaigns, it is unlikely that birds will be significantly affected by noise, light or vibration, particularly not in the long term. From NRA (2012) there is no indication that construction works undertaken in the recent past at the Marine Precinct had any effect on the local bird population abundances on POTL land or in dissuading their visitation levels on adjacent Ross River mudflats and sandspit. The Construction EMP and Operational EMP will use measures to reduce noise and vibration, light spill and accidental pollution emissions for site management.

1.6.7 Matters of National Environmental Significance

For PEP, the following matters of national environmental significance have been considered:

- world heritage properties
- national heritage places
- wetlands of international importance
- listed threatened species and ecological communities
- listed migratory species
- Commonwealth marine areas
- Great Barrier Reef Marine Park.

1.6.7.1 World Heritage properties and National Heritage places

PEP is situated entirely within the Great Barrier Reef World Heritage Area (WHA), which is both a world heritage property and national heritage place. Key impacts relate to the irreversible loss of soft sediment benthic habitat due to PEP reclamation, and ongoing effects associated with day-to-day operations of the port facility. Temporary impacts may occur to other benthos as a result of dredging. Noise generated by maritime activities such as dredging, piling and construction is also likely to result in the temporary avoidance by marine megafauna and fish. Adverse impacts to ecological values are expected to occur at localised spatial scales (measured in hundreds of metres in the vicinity of the construction/dredging footprints) and, with the exception of reclamation, expected to occur only in the short to medium term (measured in months to years). A wide range of mitigation measures and strategies will be adopted to reduce harm to marine ecological values supported by the Great Barrier Reef WHA.

Given highly localised spatial scales, the PEP is not expected to result in the loss of or have significant impacts on any of the environmental values that contribute to the ‘outstanding universal value’ of the GBRWHA such as hard corals fringing Magnetic Island. With reference to the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DEWHA, 2009b), it is not expected that the PEP would result in world heritage values being lost, degraded or damaged; or notably altered, modified, obscured or diminished.

1.6.7.2 Wetlands of International Importance

The PEP area is located 9 km from the Bowling Green Bay Ramsar listed wetland, which will not be directly affected by the Project. Indirect effects from turbid plumes generated by the Project, due to the dominant winds and currents, will not be likely to advect into southern Cleveland Bay waters or near the Ramsar site. PEP is unlikely to affect populations of marine fauna that inhabit the Cleveland Bay region, which inter-connects with part of the Ramsar site.

1.6.7.3 Threatened Species and Communities and Listed Migratory Species

Cleveland Bay supports habitats for migratory or transient threatened or protected marine fauna including whales, dugongs, dolphins and marine turtles. These animals have different likelihoods of occurring in the PEP area. The species with the highest likelihood of occurring in the PEP area are green turtles (*Chelonia mydas*). Loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*) and flatback turtles (*Natator depressus*) are not common in Cleveland Bay inshore waters (GHD, 2008a; GHD, 2011a). Two dolphin species are relatively common in and adjacent to the PEP footprint and the nearshore environments throughout Cleveland Bay: Australian snubfin dolphin (*Orcaella heinsohni*) and Indo-Pacific humpback dolphin (*Sousa chinensis*) (GHD, 2011a). These two dolphin species are likely to regularly feed in port areas (including over the PEP seabed) as both species have feeding and nursing areas in around Ross River.

Most other listed marine species tend to favour offshore waters (e.g. whales, turtles), and could potentially occur at the DMPA from time to time. Humpback whales (*Megaptera novaeangliae*) have been observed in the waters of Cleveland Bay (October to January) as they undertake their annual migration.

Dugongs (*Dugong dugon*) are relatively abundant in Cleveland Bay, particularly over the seagrass nearest Cape Cleveland. They occur throughout Cleveland Bay as they move between seagrass meadows in and outside the bay. As there is no seagrass in PEP areas, and sparse, sporadic seagrasses at the DMPA and adjacent to dredged channels, it is most likely that dugongs only pass through these areas.

For migratory birds, recent studies by NRA (2012) showed that sooty oystercatcher, among other species, is known to use existing breakwaters and revetments for roosting and other migratory birds use the eastern reclamation from time to time for foraging. No significant adverse impacts are expected to arise through PEP development. In the years soon after its development, the new reclaim areas are likely to enhance opportunistic foraging opportunities in emplaced marine sediments and roosting along greater lengths of breakwater and revetments.

The following processes are of relevance to listed threatened and/or marine migratory species:

- disturbances to feeding and foraging habitats including
    - permanent loss of benthic habitat due to reclamation
    - potential temporary reduction of benthic habitat productivity (particularly seagrass and reefs) and their resident prey populations due to water quality and/or sedimentation effects from dredging
    - pollution resulting from spills, or inadequate stormwater management
- animal and construction and operations interactions:
    - vessel strike
    - noise emissions and visual disturbance, resulting in modified foraging and breeding behaviours, and movement patterns
    - light pollution and its effects on habitat usage patterns.

An increase in vessel traffic during port construction will increase the likelihood for megafauna interactions, particularly green turtles, or the avoidance of the area by some mobile species such as the dolphins. A Vessel Traffic Management Plan will be implemented for construction plant used for PEP works, which will include strategies such as speed limits, fauna spotters and other strategies to avoid interactions with marine megafauna.

By 2025, cargo ship numbers to the Port of Townsville are projected to increase to over 1,000 pa. This will see the current average rate of two ships per day increase to an average of less than four ships per day. Increased ship movements may lead to increased potential for interactions with megafauna. The management of vessel interaction risk is outside the control of POTL, as it rests with vessel operators. Harmful vessel interactions with marine fauna occur infrequently, if at all; therefore, it is unlikely that there would be a significant impact on these megafauna populations.

1.6.7.4 Great Barrier Reef Marine Park

PEP is largely located outside the Great Barrier Reef Marine Park (GBRMP); however, the existing Sea Channel (adjacent to Bremner Point) intersects the GBRMP in an area zoned as Habitat Protection. The deepening of the Sea Channel will extend the overall length into the GBRMP General Use Zone. The Sea Channel deepening has a total length of 2.7 km and area of 24.8 hectares. After dredging and recovery of the soft bottom benthos, no major changes to the functional or biodiversity values presently supported in this portion of the Sea Channel are predicted.

Impact significance has been assessed against the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DEWHA, 2009b) for the GBRWHA and GBRMP. Based on the implementation of appropriate mitigation strategies, PEP will not have a significant impact on the environment inside the GBRMP.

1.6.7.5 Commonwealth Marine Areas

The PEP is located in Queensland State waters, as is the DMPA which is approximately 3 nautical miles from the coastline. Those parts of PEP in the GBRMP are in the Commonwealth marine area. Potential impacts on the Commonwealth marine area will be far less than for the previously discussed Great Barrier Reef WHA, which includes the entire PEP area and Cleveland Bay. Based on the implementation of appropriate mitigations, PEP will not have a significant impact on the environment in the Commonwealth marine area.

1.6.8 Climate and Natural Disaster Risks

Climate change relates to trends in the average pattern of weather over a long period of time. POTL is proposing to expand the port to address current capacity constraints and accommodate forecast growth in trade for a planning horizon to 2040. Changes in climate and natural hazards are projected for this time period as well. Design, construction, operation and maintenance of the PEP take into account predicted changes to avoid significant adverse effects.

Climate change scenarios and projected changes to climatic conditions have been investigated by the Intergovernmental Panel on Climate Change (IPCC, 2007). IPCC reported evidence from all continents and most oceans showing that many natural systems are now being affected. Warming of the climate is unequivocal. In order to determine the potential risks to the port for the timeframe of the PEP, a risk assessment was undertaken in relation to those climatic parameters likely to change. Predictions of increased occurrence of severe tropical cyclones, resulting in increased storm surge frequency and height are likely to result in a number of potential impacts for PEP. Impacts requiring mitigation actions were also identified for factors such as increased temperature, increase number of days over 35°C and rising sea level. POTL already has existing procedures in place for addressing emergency extreme weather situations at the port, which will continue for PEP; for example, ensuring appropriate onsite emergency equipment and suitable site access for emergency vehicles, undertaking channel assessments and inspections of the condition of port infrastructure after cyclone events, and evacuation of ships prior to cyclone events.

1.6.9 Air Quality

The port is bounded directly by Cleveland Bay to the north and east and a combination of commercial and residential lands immediately to its south and west. The nearest residences are located adjacent to the port’s southern boundary, along Archer Street, South Townsville. Prevailing winds are typically from the south-east during the morning hours, shifting to stronger sea breezes from the north-easterly direction in the afternoon.

The Project will have a number of emission sources during both construction and operation. Construction works will generate particulate and dust emissions through vehicle movements, materials handling and wind erosion of exposed surfaces. These emissions were collectively assessed through dispersion modelling using the CALPUFF[2] model to estimate likely pollutant concentrations at specific receptor locations in close proximity to the port. As the emission sources will typically emit pollutants (including dust) at a low height (generally at ground level), any adverse effects on air quality will occur relatively close to the site of generation. Ground level pollutant concentrations at distances further from the development would be expected to be lower.

Ambient concentrations of total suspended particulates (TSP) were typically lower than the *Environmental Protection (Air) Policy 2008* (EPP(Air)) criterion, with an annual concentration of 43.6 µg/m³ in 2011. Exceedences of the EPP (Air) 2008 criterion for 24 hour PM_{10} have been recorded between 1994 and 2011 at Berth 10. However, modelling predictions undertaken for construction predicted that concentrations of TSP will generally be below the EPP(Air) criterion (established for health and wellbeing).

Longer term annual average PM_{10} concentrations were predicted to comply with NSW criterion (Queensland does not adopt a criterion for the annual time period). If the PEP construction is operated in

---

[2] CALPUFF is an advanced non-steady-state meteorological and air quality modelling system developed by Atmospheric Studies Group scientists (ASG, 2012)

accordance with a well-designed and targeted site management plan that takes into account predicted winds, adverse effects are not expected to occur during construction.

The operational phase will consist of a number of material handling and storage activities, which are yet to be determined. All product would be stored in enclosures away from weather (wind, sunlight and rain), and minimal amounts of particulates would be expected to be emitted to the atmosphere. While the lack of information upon which to base modelling of the bulk trade activities means it was not quantitatively assessed, reference to other port facilities undertaking large bulk loading and unloading activities indicate that air quality conditions can be managed to protect the risk to communities and people, often in the absence of enclosed handling and storage facilities.

Activities on the site will be undertaken with the objective of preventing visible emissions of dust beyond the site boundary. In order to reduce adverse impacts, a range of mitigation measures will be implemented during construction. Air quality monitoring and management, with mitigation measures and site practices to reduce the generation of dust from the site, particularly during periods where dry and windy conditions may mobilise dust, will be implemented for both the construction and operational periods in common user areas.

1.6.10 Noise and Vibration

The area immediately adjacent to the landside boundary of the PEP is an operating port. The area surrounding the existing port is mainly residential, with some commercial buildings and the nearest school in South Townsville. The existing ambient acoustic environment is characterised by noise from both port and urban traffic from Townsville and noise from port activities.

Sensitive receptors, as defined in the Environmental Protection (Noise) Policy 2008, include dwellings, libraries and educational institutions, childcare centres and kindergartens, outdoor school playground areas, medical institutions, commercial and retail activities, protected areas, marine parks and passive parks and gardens. For this Project, these receptors include:

- dwellings in Townsville, South Townsville, and Railway Estate comprising traditional single-storey, traditional double-storey apartments and Jupiters Townsville Hotel and Casino and dwellings on Magnetic Island
- Townsville South Primary School in South Townsville
- buildings with commercial and retail activity in Townsville and South Townville
- commercial and retail buildings in the otherwise predominantly industrial Townsville Marine Precinct
- passive recreational parks/gardens in Townsville and South Townsville.

Noise impacts are influenced by the sound of the most noise-intensive activity and not necessarily a cumulative effect of sources. The impact of construction noise is negligible for most construction activities. Predicted noise levels are below the existing daytime background typical quietest and ambient average noise levels for construction activities, except piling at berths and wharves and limited rock breaking work for breakwaters and revetments. Predicted noise from sheet piling (for constructing bulkhead wharves) may be up to 14 dB(A) higher than the average ambient noise levels and 25 dB(A) higher than the existing daytime background typical quietest noise levels at the nearest sensitive receptors.

The likely highest construction and operation vibration levels at the nearest sensitive receptor will be well below the most stringent goals for human comfort and the threshold limit for potential building damage.

Operation of the PEP outer harbour (including access traffic noise and low frequency noises) will result in only small increases in noise levels at most sensitive receptors (worst-case predicted noise levels achieve the identified noise limits) and are predicted to be within existing daytime ambient levels. Operational noise at the closest residential locations assessed (that is, Jupiters Townsville Hotel and Casino and Breakwater Quays) may exceed the identified noise goals, with predicted noise levels greater than existing night-time ambient levels and potentially audible.

The cumulative daytime operational noise impact of the PEP along with the Townsville Marine Precinct is predicted to be negligible at all receivers (up by 1 dB). The night-time cumulative noise levels of the existing and future port operations indicates negligible change in amenity for the residences in South Townsville, and small but unnoticeable (that is, less than 3 dB) at Picnic Bay, Magnetic Island and at Jupiters Townsville Hotel and Casino. At Breakwater Quays, the estimated cumulative effect on the acoustic environment by known port related developments is just noticeable at 3 dB, in combined effect when compared to the set of developments without the PEP.

1.6.11 Greenhouse Gases

A strengthening scientific position, heightened public interest and expectations, and an increasing focus on national and international policy means that managing greenhouse gas emissions at the corporate and national level has become standard practice. The business environment now includes a price cost on greenhouse gas emissions as a direct result of government action, and companies see adapting to climate change as a long-term risk averse and cost effective position.

Scope 1 emissions refer to direct emissions where the point of emission release is owned by the organisation in question, such as company-owned equipment. Scope 2 emissions refer to indirect emissions, which are from the purchase of electricity, heat or steam consumed by the organisation. Scope 3 emissions refer to all other indirect greenhouse gas emissions that are not Scope 2 emissions. These occur outside the boundary of the organisation's operations, but are a result of activities of the organisation, such as embodied energy emissions from construction materials, air travel and waste production. Reporting under the *National Greenhouse and Energy Reporting Act 2007* requires that organisations report Scope 1 and Scope 2 emissions, but not Scope 3 emissions which are reported voluntarily.

The existing sources of greenhouse gas emission by the Port of Townsville Limited include refrigerants (from air conditioning), stationary energy fuel use (from emergency generators) and electricity use, plus POTL owned fleet, pilot vessel and machinery. This will continue in the future in relation to PEP operations. The quantity of these or future emissions does not trigger the *National Greenhouse and Energy Reporting Act 2007* and are considered minimal in the context of Australian corporations.

The total greenhouse gas emissions will be higher for PEP construction than from routine POTL operations. Over the entire construction phase, emissions are estimated at 237,900 t of CO_{2e}[3] comprising:

- transportation of materials to site (28.5%)
- onsite machinery (11.4%)
- capital dredging (29.1%)
- embodied energy in construction materials (31.0%).

The responsibility for managing and reporting the Scope1 and 2 emissions will be determined during development of PEP construction contracts. Although unlikely to be affected directly by a carbon pricing mechanism, POTL may be exposed to a range of indirect costs associated with a carbon price including increased costs of energy and materials.

1.6.12 Waste

Ports act as the interface between marine vessels and land-based waste disposal systems for wastes generated while at sea. In addition to vessel waste, port activities produce their own waste through the loading and unloading of cargoes, effluents, and runoff from the handling of raw cargo. Waste is also generated from port activities as a result of maintenance and upkeep of port infrastructure, as well as domestic waste generated by port employees and users.

POTL currently manages waste generated by its activities through its Environmental Management System. The primary performance objective in relation to waste is to ensure appropriate management for the handling and storage of waste materials in the common port areas.

[3] CO_{2e} (equivalent CO_2) is the concentration of CO_2 that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas.

Waste can be generated on vessels and in facilities at the port. It is important that this waste be managed with respect to the waste hierarchy; that is, avoid (cleaner production), reduce, reuse, recycle, recover and reclaim and finally treat and dispose of wastes. POTL manages wastes in the common areas of the port under its Environmental Management System, via waste contractors which must include waste management practices and procedures in accordance with legislation and regulations. This system seeks to reduce waste, prevent pollution, promote efficient use of resources, reduce environmental impacts, and continually improve environmental and management system performance. Future tenants will be required to implement required waste measures in accordance with separate approvals sought prior to commencing individual operations, and in accordance with Port guidelines and requirements.

Waste management is an integral part of planning for any new project and appropriate planning will be taken into consideration for each Project phase (pre-construction and construction, operation and decommissioning) to ensure that appropriate waste management strategies and provisions are implemented to reduce potential offsite effects in the receiving environment.

A Construction EMP will be implemented through the PEP construction phase to promote the efficient use of resources, limit the release of waste into the receiving environment, and provide for the safe handling, transport and disposal of waste materials. The placement and management of dredging material will be undertaken in accordance with the Dredge Management Plan.

1.7 Social Values

1.7.1 Sustainable Development

Ecological sustainability is the fundamental purpose of *Sustainable Planning Act 2009* (SP Act). The PEP represents development that is subject to the provisions of SP Act for assessable development. The assessment manager for development on strategic port land is the port authority and, where a development application is assessed under the provisions of SP Act, consideration of the principle of ecological sustainability applies to any such development.

The need for and development of the PEP is a result of ongoing strategic planning at state, regional and local levels. This planning pertains to the sustainable development of Queensland and, in particular, the optimal development of the port. A key aspect throughout the EIS is the incorporation of the principles of sustainable development.

The sustainability of the PEP has driven an impact assessment that has used a risk based approach to identify those impacts of higher consequence and risk. Subsequently mitigation measures have been recommended that aim to reduce impacts to levels that can be considered sustainable, not just environmentally but also economically and socially. Specifically, the principles of sustainable development have been addressed in relation to the factors below:

- a detailed review of the potential impacts to ecological systems and natural processes, including potential impact to the hydrology of Cleveland Bay has been undertaken
- consideration and characterisation of net benefits of investment and growth of industry
- a balance that integrates environmental considerations and short-term economic outcomes
- maintenance of the economic, physical and social wellbeing of people and communities of Queensland.

1.7.2 Public and Community Engagement

Stakeholder consultation and community engagement has helped gather information from stakeholders including relevant interest groups and local residents about their attitudes regarding PEP. A full list of stakeholders, methods used to engage with stakeholders, content of the material distributed, and the detailed responses received from the consultation process are described in Part B and Appendices. The information received has been used in the assessment of potential social and cultural impacts that may result from the PEP, notably in the Study Area (being the local area nearest the port).

Following Project inception formal community consultation for the Project was first notified to the public on 16 July 2011. Prior to this date, POTL had undertaken extensive informal consultation with a range of stakeholders to more clearly identify issues that may be relevant to the PEP. Community consultation was also undertaken to support public notification of the Coordinator-General's draft Terms of Reference. The PEP has been the subject of stakeholder and community engagement through a range of community information sessions, engagement activities and the maintenance of open feedback channels to POTL and its consultants.

Results from recent feedback indicate respondents generally believed the PEP will have mixed effects with positive impacts on the local economy and employment opportunities, neutral impacts on lifestyle and community aspects, and negative impacts on the environment. The two main reported environmental impacts were noise and dust. Other community concerns raised included the impacts on roads and rail, the potential increase in traffic, products to be transported through the port and the potential impacts on the Great Barrier Reef.

Consideration of the community's concerns is reflected throughout this EIS with attention paid to areas of concern in order to reduce potential impacts from PEP through thorough assessment and recommendations of mitigation measures.

The community will be kept informed over the course of the development. This includes engagement at the local and regional levels and in a manner that is sensitive to the needs and issues of the community, noting that social values and the concerns of the community are likely to change over time.

Key issues for future consideration in further stakeholder engagement include informing people about approvals (for example, legislative and statutory requirements affecting decision making), timetables for construction works, environmental management, safety, workforce participation opportunities and leveraging opportunities for other businesses and residents (e.g. housing accommodation).

1.7.3 Social Environment

Existing social and cultural values and characteristics are influenced by many factors. A large part of the social and cultural values and characteristics are determined by assessment frameworks and statutory policies that apply to an area, its development and the use of land in public and privates holdings. While these framework elements provide guidance and 'rules' for planning and development of land and property, social values and characteristics are usually a reflection of demographic characteristics of a growing community that is responding to changes in development patterns, the function of urban centres and opportunities for access to new services and other opportunities that population growth can bring.

Key characteristics influencing the social and cultural values of communities likely to be affected by the Project are considered in detail in the EIS including:

- populations and households: to identify the baseline characteristics of people that are likely to be affected by the PEP
- workforce: to identify current and required skill capacity and workforce numbers to cater for the growth in production and service needs of the community, both due to the Project and the broader growth management requirements of Townsville and the region.
- housing and accommodation: to identify the extent of housing availability and affordability, and the effects of any increased demand resulting from the needs of the Project.
- socio-economic indexes for areas: to determine the welfare of areas based on census information
- population projections: to identify trends in changing population and related living characteristics
- land use and tenure: to identify patterns of land use surrounding the Project and any expected changes in land uses (residential; commercial, including fishing; industrial; recreational, including fishing; entertainment; and services) and associated infrastructure over time; to identify the strength of association of residents in an area through different ownership.
- social infrastructure: to identify the level and accessibility of services in communities that are likely to be affected by any changes that may be attributable to the Project.

1.7.3.1 Workforce and Employment Opportunity

The expected PEP workforce is likely to remain small compared to the overall workforce of Townsville; both present and projected. The PEP workforce will be used over a considerable construction period during which time the overall workforce of Townsville is expected to grow significantly, with an estimated increase by almost 45,000 people. The ability to absorb and cater for the PEP workforce will be assisted as Townsville grows over the life of the PEP.

The PEP is still regarded by the respondents to the community consultation program, in particular, as representing an employment benefit. Strengthening of employment opportunities due to the PEP is likely to contribute to a stronger economy at the social and cultural levels, acting as a catalyst for further private and public sector investment in the region and district.

POTL has existing programs in place that facilitate Indigenous employment opportunities in the port. Project specific plans will be developed when PEP is ready to proceed. The policies include the existing *Local Industry Participation Plan* and *Employment and Procurement Policy*.

1.7.3.2 Housing and Accommodation

The establishment of an additional workforce due to PEP construction and operation has the potential to impact on the demand for housing in the regional and local area. At the local level, this impact is expected to be masked by the larger housing market, but is likely to have a more pronounced impact cumulatively, when considering the PEP in the context of multiple other projects and their combined effect.

More pronounced impacts are likely to be experienced in the local area. There is a likelihood that parts of an additional long-term workforce generated by the PEP may find living options close to the port attractive, especially when considering the large range of services and entertainment options that the area offers. This is considered to represent a positive impact for the district and local areas.

1.7.3.3 Access to fishing grounds and boating opportunities

Reclamation works for the PEP will remove an area of water that is currently available for small craft passage, fishing and any other marine recreational activity. This area is not known to have significant value for commercial fisheries efforts. This reclamation is also likely to restrict the passage of craft in and around the harbour areas that are to be created. Use of the DMPA is only likely to be restricted during dredge placement operations, in accordance with existing maritime navigation requirements. Use of the Sea Channel will not significantly change as a result of the PEP. Restrictions regarding small craft passage and other vessels in the vicinity of larger ships are regulated by legislation.

1.7.3.4 Lifestyle

Lifestyle effects relate to effects associated with dust, noise and changed visual cues including vehicular movement patterns, primarily by heavy-haulage vehicles, and alteration of views and landscape features. These particular effects are specifically assessed in individual chapters in Part B, such as Chapter B17 – Scenic Amenity, Chapter B9 – Air Quality and Chapter B10 – Noise and Vibration.

Incorporated into the overarching stakeholder engagement plans, the existing Port Community Partnerships Forum is an excellent means to maintain ongoing consultation with interested community-based groups, who provide comment on port related policies, development plans, management programs and ongoing operations that may also serve specific community interests. The forum will also provide an opportunity for POTL to provide the community with information regarding operations and future development activities at the port.

1.7.4 Scenic Amenity and Lighting

The Project will result in the extension of the existing port boundary approximately 1 km northwards from the mainland, through reclamation of subtidal land, forming a prominent peninsular.

Cleveland Bay provides visual containment of the port from the wider maritime landscape through two key headlands (Cape Pallarenda in the north and Cape Cleveland in the south). Activities during construction and operations are likely to affect several near and distance receptor groups and the scenic values associated with the GBRWHA designation. Receptor groups include people living, working and visiting residential properties, local attractions and recreational tracks, such as The Strand, Magnetic Island and Castle Hill, their roads and the Port of Townsville.

Thirteen representative locations gave a broad regional perspective on viewpoints enabling an assessment of the scenic amenity of PEP, against the backdrop of current established conditions. Key activities during the construction and operational phases that are anticipated to affect these receptors include:

- an increase in the transit of light vehicles carrying workforce and visitors between places of accommodation in Townsville and the port on a daily basis
- some increased movement of heavy vehicles, although the completion of the Townsville Port Access Road in the Eastern Access Corridor (EAC) will considerably alleviate the amenity values of traffic on the local road network
- activities occurring during construction (e.g. the breakwater and bund construction, harbour dredging, reclamation works, bulk earthworks and ground treatment, civil works, and installation of wharf structures), which would be visible from various viewpoints; including potential visibility of temporary turbid plumes in Cleveland Bay during breakwater and revetment placement and dredging
- operational impacts of the Project, which would also be observable from each of the nominated 13 representative viewpoints, including the presence of container handling gantry cranes, up to six vessel berths, ship loaders, cargo operations zone, materials and cargo storage area, internal access roads, rail loop and dredge pond and the movement of Panamax sized bulk ships across the port.

Most views illustrated a change reflective of open marine waters becoming land dominated by industrial architecture. The three views assessed as a neutral change were those at a longer distance, where (in most cases) the works would be viewed against an existing port landscape.

The most important designated landscape in the Study Area is the GBRWHA. Both the construction and operational activities of the PEP change its scenic values of natural views. Given the construction and operational activities associated with the Project would be viewed in the context of existing industry, the GBRWHA views are already affected by the existing development (and mostly in place prior to the WHA listing), which lowers the magnitude of perceived change. PEP development and infrastructure is entirely consistent with port development, first commenced on the nearby coastline almost 150 years ago. PEP, in concert with existing port infrastructure, is only a small section of the GBRWHA landscape and its broader scenic values would be maintained beyond Cleveland Bay.

An assessment of the visual impact of lighting was undertaken at representative viewpoints. It is predicted that there would be an intensification of night-time light levels in close proximity to the Project. Night lighting can be divided into light glow, which is effectively the glow of night lighting off air particles and light spill, which refers to those areas from which light sources are visible. This increase in night-time light levels is predicted to increase. In all cases the change is anticipated to be an incremental increase in existing light levels of neutral effect due to the existing lit context and because many viewers would expect to see a port illuminated at night.

1.7.5 Transport and Services Infrastructure

PEP will increase the shipping capacity through the port by staging its development. In order to accommodate trade throughput, rail and road infrastructure will be upgraded. Substantial previous studies of the capacity and constraints of road access to the port have been undertaken by the Department of Transport and Main Roads as part of the Townsville Port Access Road (TPAR) project. Traffic assessments prepared as part of the TPAR project formed the basis for evaluation of road capacity and constraints for the PEP, with a key assumption that the Eastern Access Corridor will be operational prior to any traffic generation (construction or operational) from the PEP.

Based on the traffic demand derived for this assessment and utilising the layouts and signal phasing developed for the assessment of the Townsville Marine Precinct EIS, traffic modelling of five intersections identified as being potentially worst affected by PEP showed that, at existing capacity, Intersection 4

(Boundary Street/Saunders Street) will not operate sufficiently under future traffic demand scenarios. Investigations into road traffic impacts identified a potential need to upgrade road pavements as a result of additional PEP-related road traffic volumes and tonnages. POTL will negotiate the funding of road maintenance programs with the relevant road owners, with responsibilities for road maintenance being either Department of Transport and Main Roads or council, if subsequent modelling at detailed design phase confirms early indications.

Upon completion, TPAR will link Flinders and Bruce highways directly to the port. It will provide a more direct access to the port from the west and south as well as reducing heavy vehicle traffic on the local road network and residential areas of Townsville. In line with Department of Transport and Main Roads' intention to limit the volume of non-port related traffic on the TPAR, as part of an overall network strategy for PEP, port related traffic will need to be segregated from the general traffic accessing the city. Options will be considered in more detail during the detailed design phase.

Increased traffic generated by heavy-haulage truck movements using the port create perceived adverse social impacts on amenity, safety, sense of place and wellbeing. An increase in the capacity of the port is expected to generate higher numbers of truck movements. Heavy vehicle traffic through South Townsville and Railway Estate is expected to reduce significantly once the TPAR opens in December 2012. This will relocate movements from the west along Flinders Highway and from the south along the Bruce Highway through the Townsville State Development Area and is expected to lead to significant amelioration in the rates and tonnage of vehicles.

Rail will be the main mode of land transportation for cargo handled through the PEP. The likely drivers for the development of the PEP is expected to be high tonnage dry bulk commodities e.g. nickel, magnetite, copper, coal and fertiliser, as identified in the latest trade forecast. These will require the development of rail access through the Eastern Access Corridor due to the capacity and efficiency limitations of the existing rail network.

The development of rail access via the Eastern Access Corridor and tenanted sites in the PEP will require further assessment and approvals in the future. POTL, Queensland Rail and other stakeholders will continue the collaborative development of a long-term strategy for the interface between rail and port infrastructure, to optimise rail network efficiency.

1.7.6 Indigenous Cultural Heritage

Aboriginal cultural heritage values are interwoven with Aboriginal and Torres Strait Islander people's ongoing connection to and use of the landscape and country to connect with their past and retell their stories. It is defined and managed by Aboriginal parties who are culturally responsible for a place's heritage values.

An Indigenous cultural heritage assessment was undertaken in consultation with representatives of the Aboriginal parties, which identified the significant Aboriginal cultural heritage values of the Project Area and its surrounds (Bird & Heijm, 2009). It is recognised that although the surrounding area has been substantially modified, it still plays a role in understanding the Aboriginal cultural landscape and values of the greater Townsville region. The development area of the PEP is completely on subtidal land and the adjoining port land has been highly modified over decades through previous dredging and reclamation activities. As a result, the risk of disturbing or destroying items of Aboriginal cultural significance is low.

Through a consultative process with representatives of the Aboriginal parties, a Cultural Heritage Management Plan has been developed with a number of practical strategies and actions that identify Aboriginal cultural heritage values and specifies the mitigation measures to manage potential impacts and development risks. The Cultural Heritage Management Plan has been registered with Department of Environment and Resource Management (now Department of Natural Resources and Mines). Its implementation fulfils the requirement for a Cultural Heritage Management Plan under the *Aboriginal Cultural Heritage Act 2003* and POTL's duty of care under the Act.

1.7.7 Non-Indigenous Cultural Heritage

Archival and library research of relevant documents and written histories were reviewed to complete a thematic history of the area. The thematic approach is consistent with the framework recommended by the Australian Heritage Commission in its publication *Australian Historic Themes* (AHC, 2001). It provides a broad framework through which to interpret the heritage values of the Study Area and assists in the interpretation of specific places of heritage significance.

The port has played a leading role in the development of Townsville since 1864. The non-Indigenous cultural heritage study describes a vibrant and exciting European heritage dating back nearly 150 years. The study found that the Port of Townsville and the adjacent suburb of South Townsville have a complex and interrelated history. In the case of South Townsville, this history is represented in a number of places and sites of cultural heritage significance that appear on the Queensland Heritage Register and the Townsville City Council Local Heritage Database.

As the PEP is to be constructed entirely on reclaimed subtidal land, it is highly unlikely that any places or sites of heritage significance will be directly affected during the construction or operational phase of the Project. Should there be any items of potential heritage significance discovered during dredging activities, work around the object should cease and Department of Environment and Heritage Protection will be notified immediately in accordance with s. 89 of the *Queensland Heritage Act 1992*.

Existing heritage values of the port and its immediately adjacent areas are recognised with a limited number of mitigation measures provided to manage the potentially low risks of adverse impact on existing historic heritage items and values.

1.8 Hazard and Risk

1.8.1 Health and Safety

POTL's commitment to providing and maintaining the best possible standard of occupational health and safety for employees and contractors at the port is supported by its safety policy, which sets out the occupational health and safety standards necessary for achieving the objectives of the port Occupational Health and Safety Management System, which is certified to *AS/NZS 4801:2001 Occupational health and safety management systems - Specification with guidance for use* (Standards Australia, 2001).

Serious events such as cyclones, storms, explosions, major chemical spills, or acts of vandalism or terrorism can place the port and the safety of port workers and the broader communities at risk. Planning for prevention, preparation, response and recovery of such events are managed through POTL's security and emergency plans and procedures.

A Project risk assessment identified, prioritised and recommended mitigation for potential effects to property and people by undertaking a preliminary risk assessment following the principles of *AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines* (Standards Australia, 2009). That standard aligns with the basis of the port's *Risk Management Policy and Procedures*.

Health and safety impacts from the construction and operation of the PEP covered ten work hazard categories: biomechanical (manual tasks), mechanical, electrical, chemical, noise/vibration, potential and stored energy, thermal, radiation, biological and work stressors.

Risk levels can be attenuated by existing or planned mitigation measures. These issues are largely covered by work health and safety legislation (including supporting Codes of Practice) and by meeting compliance requirements. The hazards may be mitigated to avoid or reduce health and safety impacts. POTL's Occupational Health and Safety Management and Environmental Management systems provide processes to facilitate risk mitigation actions and the monitoring and review of control performance. Risk management during design presents an essential step in the delivery of work health and safety and environmental objectives across PEP's lifecycle.

1.8.2 Security, Property and Critical Infrastructure

A variety of threats associated with aspects of national security have the potential to impact on critical infrastructure and the continuity of essential services associated with the Port of Townsville, including PEP operations.

The Port of Townsville is essential infrastructure, described by the Queensland government as part of Australia's physical facilities and supply chains, which if destroyed, degraded or rendered unavailable for an extended period would impact on social or economic values.

The nature of maritime business and infrastructure associated with the Port of Townsville falls in the statutory requirements of the *Maritime Transport and Offshore Facilities Security Act 2003* (Cth), which provides safeguards against unlawful interference with maritime transport and establishes security levels for the port, its projects and its infrastructure.

POTL has:

- an existing security plan and associated governances to support the conduct of port operations to protect the security of facilities, infrastructure, people, maritime operations and the wider community
- operational safeguards and security training and awareness for its staff
- preparation for response to security events.

Changes associated with the construction and operation of the PEP will require variation and modification of the existing arrangement to suit the nature of work, risk of security event and degree of preparedness required to mitigate the risk. It is anticipated that additional Project risk specific security management plans will be required as applicable.

Updates of POTL security management governances from change in risk profile will translate directly to variation of the existing *Local Disaster Management Plan* (TCC, 2011d) .

1.8.3 Emergency Management

Queensland is highly susceptible to extreme climatic events and natural hazards such as tropical cyclones, floods, bushfires and storms. Additional potential hazards resulting from the presence of humans such as inadequate design, industrial incidents, anti-social behaviour and potentially terrorism have resulted in the development of a coordinated approach including response frameworks to deal with these events.

Emergency management planning for the port follows formal processes structured on the principles of *AS 3745-2010 Planning for emergencies in facilities* (Standards Australia, 2010a). Governances used have been independently audited and accredited. These approaches are consistent with current industry practice for emergency management.

POTL recognises the need to meet its obligations in respect of work health and safety, environmental and other regulatory areas by instigating appropriate corporate governances and responsibilities to inform and direct compliance. This extends to its contribution to the district and state disaster management strategies, which will continue during the construction and operation of the PEP.

1.9 Environmental Management

POTL maintains its commitment to sustainable development and operation through its Environmental Management System (EMS).It provides a framework for environmental management at the Port of Townsville, and reflects POTL's environmental policy and commitment to manage its activities with concern for people and the environment.

Throughout the EIS, recommended mitigation measures have been applied to the various construction and operational activities that may risk environmental impacts. Different mitigation measures apply to different phases and geographical (landside or portside) areas of implementation. To accommodate these variances a suite of EMPs has been prepared, which separates construction and operational requirements, and landside and portside requirements. This format will aid in the EMP implementation and the effectiveness of the plans. The structural relationship of the set of EMPs is illustrated in Figure ES.4.

The EMS provides clear objectives and outcomes based on the results of the impact assessment phases. The EMPs are designed to implement appropriate controls and mitigation actions, and provide for continual feedback and reporting allowing internal and external stakeholders to conduct audits or investigations as necessary in the event of an incident, or as a means of identifying areas of improved environmental management.

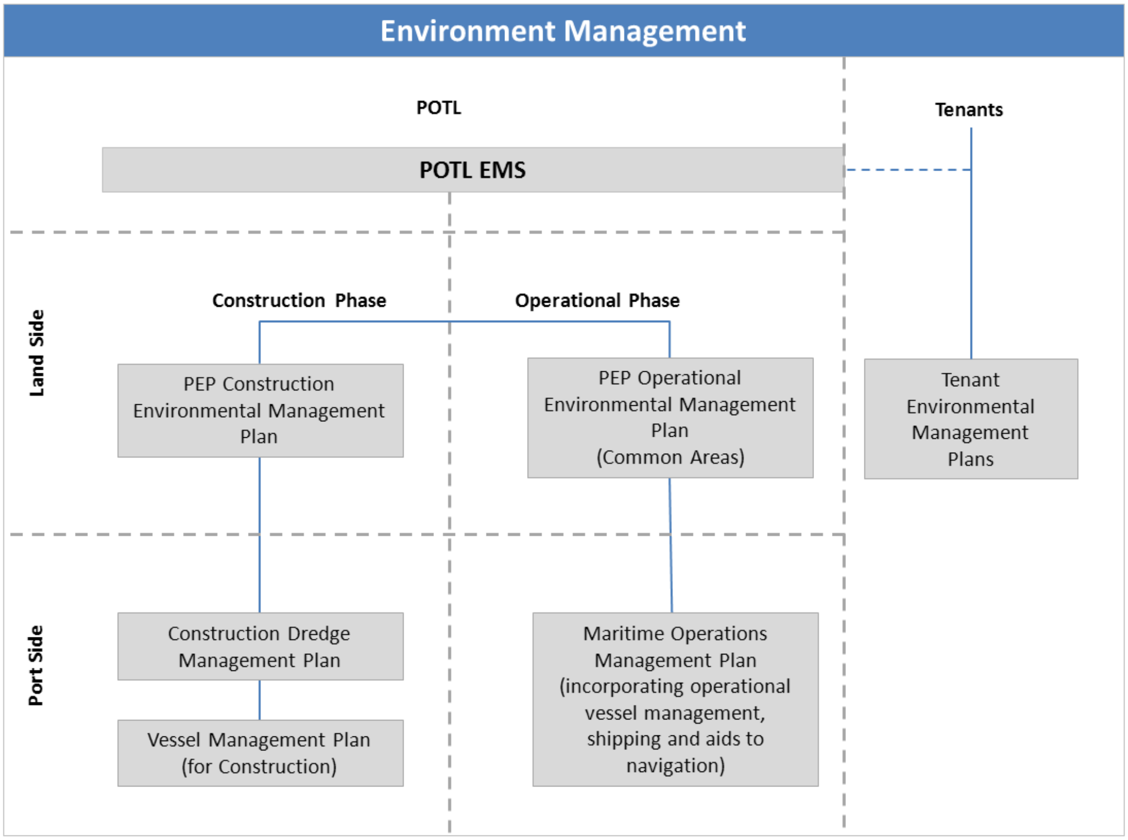


Figure ES.4 Interaction of the PEP Environmental Management Plans

To apply appropriate mitigation measures to manage potential impacts, the set of management plans shown in Figure ES.4 have been prepared. They include a range of management measures that relate to identified environmental risks from the body of the impact assessment in Part B. Those primary aspects where the PEP may potentially cause impacts are listed below, along with a summary of key mitigation measures.

- Marine water quality:
  - implement the Construction EMP for maritime works, such as marine piling, berth construction and breakwater construction
  - implement the Dredge Management Plan during dredge construction periods that involves the pumping of dredge material into the reclamation area and management of supernatant tailwater
  - implement the Dredge Management Plan for capital dredging activities, including monitoring programs that include a framework for a reactive monitoring plan. Using 12 months of real-time water quality data being collected by POTL, this plan will set trigger levels for water quality that will be combined with ecological monitoring to ensure an adaptive approach to dredging that protects marine environmental values. The plan sets out corrective actions for the dredge contractor to vary work practices where trigger levels are exceeded and sets out the formation of an expert advisory panel to oversee development of the reactive monitoring plan as well as implementation of the dredge campaign.
- Marine ecology:
  - implement the Dredge Management Plan, including -

        - operate dredge and support vessels in a manner that reduces impact and potential impacts to marine megafauna
        - undertake monitoring of coral and seagrass communities in accordance with the reactive monitoring plan
        - reduce effects to soft bottom benthos by only working in designated areas
    - implement Maritime Operations Management Plan, including vessel operations which reduce potential impacts to marine megafauna
- Marine sediment quality:
    - implement the Dredge Management Plan, including screening and testing, planning for recovery and approval for disposal of potentially contaminated sediments in accordance with the National Assessment Guidelines for Dredging (DEWHA, 2009a)
    - implement the Construction EMP and Operations EMP for potentially contaminating incidents
- Terrestrial ecology/migratory species including shorebirds:
    - implement the Construction and Operations EMP to reduce offsite noise and light spill that might disrupt migratory patterns or roosting behaviours of birds
- Introduced marine species/exotic species:
    - implement the Dredge Management Plan for dredge vessels and Vessel Traffic Management Plan for construction vessels in relation to inspection and ballast water management
    - implement Maritime Operations Management Plan to ensure that vessels:
        - operate in accordance with Australian regulatory inspection and reporting procedures for international ships
        - manage ballast water in accordance with Department of Agriculture, Forestry and Fisheries requirements
- Noise and air quality:
    - implement the Construction EMP and Operations EMP to monitor ambient conditions and log, assess and respond to public information
    - implement the Construction EMP
        - for noise management practices throughout the construction phase through a range of operational techniques and procedures
        - for a range of operational techniques and procedures to reduce the exposure and mobilisation of dust (for example, use of water carts and limit dust generating activities during wind speeds above mobilising velocities).

1.10 Conclusions

PEP involves:

- the development of a new harbour (the outer harbour) enclosed in a new breakwater (north-eastern breakwater)
- deepening the bathymetry of existing channel alignments, together with minor widening near the outer harbour entrance
- the development of a new reclamation to the north-east of the existing port area based on re-use of over 4,000,000 m³ of dredged material

The EIS has investigated potential environmental impacts including social, economic and cultural effects that could result from the construction and operation of PEP. Detailed consideration has been given to the need for and alternatives to the Project. Literature reviews, database searches, baseline studies and original marine and atmospheric numerical models and calculations provide quantification and context to the assessment of impacts and identification of relevant mitigation and management measures.

Based on analysis and assessment presented in the EIS, a range of potential impacts were identified. Potential impacts can be largely managed through the adoption and monitoring of recommended mitigation measures. It was found that for certain marine environmental quality matters, residual impacts would occur or be at risk of occurring to an extent requiring an offset in response to development effects on the seabed of Cleveland Bay. These impacts relate to the permanent reduction in the seabed area inhabited by soft bottom benthos and a temporary reduction of benthos on seabed disturbed by shipping channel augmentation. Indirect effects such as on coral health on Magnetic Island fringing reefs and marine megafauna such as dolphins, dugongs and turtles, will be managed in frequency, extent and magnitude through the adoption of mitigation actions that reduce the effect of noise, vessel activity and re-suspended sediments in turbid plumes on marine waters. Because of its maritime situation, only a few landside biophysical effects may eventuate. These include management of construction activities to minimise potential impacts on migratory birds.

Air and noise effects will arise during PEP’s construction phases. A high quality air monitoring system and predictive tools will enable adaptive management of port activities to both control emission levels and manage potential exposures at sensitive locations in the nearest suburbs of South Townsville and Townsville, and elsewhere. Further environmental assessments will precede industrial port side development through the *Sustainable Planning Act* and other approval mechanisms. More detailed analysis and validation will be given to those derived developments when the nature of potential emissions is known.

Construction and operational impacts, including potential cumulative impacts, have been identified for specific biophysical, socio-economic and cultural factors. Having assessed the likelihood and consequences of the set of development aspects and potential impacts, a detailed set of mitigation measures has been formulated and compiled into succinct outcome-based EMP to guide their implementation, monitoring and corrective actions throughout the development of PEP. Relevant mitigation and management strategies are prescribed in EMPs put forward, in response to the ToR and EIS Guideline stipulations, as outlined in Part C of the EIS.

An overall assessment has been made in relation to risks of cumulative impacts on significant factors and values especially for matters of national environmental significance. This assessment has concluded that the project will not lead to significant cumulative impacts on matters of national environmental significance or other environmental values.

The PEP can potentially deliver considerable economic benefits, not only to the economy and community of Townsville, but also to the North Queensland region, Queensland and Australia. The positive flow-on economic impacts resulting from the PEP would support employment in a number of industries and associated service providers, both at the port and further afield in the transport and mining sectors. This in turn would lead to positive social benefit of increase population growth, quality of housing and services and revenue base for government to place into public assets.

Port Expansion Project EIS

Part A

Project Description

AECOM BMT WBM

A.1 The Port Expansion Project

Port of Townsville Limited (POTL) proposes development of a new outer harbour, wharves, channel deepening, backing land, and associated infrastructure to support new berths (for cargo handling), collectively known as the Port Expansion Project (PEP). Development of the PEP is based on a clear strategy aimed at providing for future trade, in line with the *Port of Townsville Master Plan* (Maunsell AECOM, 2007) forecasts.

The PEP will allow POTL to:

- satisfy its responsibility under the *Transport Infrastructure Act 1994* (TI Act) including establishment, management, and effective and efficient development and operation of port facilities
- respond to forecast trade growth and provide essential trade pathways for current and future trades in accordance with the National Ports Strategy (IA, 2010), thereby enhancing the economic prosperity of the region
- provide infrastructure for import and export of bulk and general cargo through the Port of Townsville for operations under competitive market conditions
- establish and maintain strong links between the local, regional, state, national and global economies
- accommodate future trends in global shipping practices
- facilitate redevelopment of the port.

The PEP will result in

- sufficient future capacity being delivered ahead of expected demand, avoiding bottlenecks or capacity constraints at the port on trade growth opportunities
- sufficient flexibility to accommodate demand, especially if trade growth driven by the mining sector growth is more rapid than predicted.

In summary, the PEP comprises:

- a new harbour (the outer harbour) enclosed within a new breakwater (north-eastern breakwater) and new reclamation area to the north-east of the existing port area
- deepening of the existing channels, together with minor widening near the harbour entrance and extension at the seaward end of the existing Sea Channel by approximately 2.7 km.

A.1.1 Introduction

The Port of Townsville is located in Townsville, North Queensland. Currently it is a successful, multi-purpose port that handles predominantly bulk and general cargo through nine operational berths (Figure A.1.1). The port serves a large geographical region. The significant mining and mineral processing industries in the region have shaped the development of the port and underpin its significance.

The port plays an important role in the economy in a local, regional and state context and this is recognised under the *Northern Economic Triangle Infrastructure Plan 2007-2012* (DI, 2007b) and the *Townsville Economic Gateway Strategy* (DI, 2007c). Strong imperatives for future development and efficient operation of the Port of Townsville are promoted. It is in response to these strategic documents, current trade forecasts, and current land use pressures that Port of Townsville Limited (POTL) proposes the PEP.

The annual trade through the port during 2010/11 amounted to approximately 11 million tonnes (Mt). Current trade forecasts predict a fourfold increase in this trade tonnage throughput by 2040. This increase is expected to result from increases in existing trades (particularly those linked with the mining and industrial sectors) and new bulk trades.

POTL proposes an expansion of the port to address current capacity constraints and accommodate the forecast growth in trade at the port over a planning horizon to 2040. A number of additional berths will be provided to accommodate this forecast trade increase through the construction of a new outer harbour basin (the outer harbour). Deepening and other minor modifications to the existing approach channels (the Platypus and Sea channels) will also be required to overcome constraints imposed on vessel size by the present channel geometry and allow for increased shipping movements.

This environmental impact statement (EIS) has been prepared for the PEP in accordance with the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and the *Environment Protection and Biodiversity Conservation Act 1994* (EPBC Act) and their respective final Terms of Reference (ToR) and EIS Guidelines (Appendix A). This consolidated EIS document has been prepared to address matters required by both Queensland and Australian legislation and is assembled in the following way:

Part A – Project need, description and development parameters;

Part B – Main EIS report

Part C – Environmental management (including plans with mitigations) and References

Appendices – Supporting technical documentation.

PORT EXPANSION PROJECT
EIS

Existing Port

Figure A.1.1

Legend

- Railway Line
- Townsville Port Access Road
- Channel Centre Line
- Existing Channel Limits

Port Zoning 2011-2012

- Marine Industry
- Port Buffer
- Port Industry
- Port Operations
- Special Use

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_117

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011

A.1.2 Project Proponent and Environmental Record

The following information relates to POTL and its past environmental record and performance.

A.1.2.1 Project Proponent

The proponent for the PEP is Port of Townsville Limited (POTL). As proponent, POTL is responsible for gaining all relevant approvals necessary to facilitate the development of the PEP.

POTL is a government owned corporation under the *Government Owned Corporations Act 1993*, and is declared as a port authority under the TI Act. Under the TI Act, POTL is responsible for establishing, managing and operating effective and efficient port facilities in the Port of Townsville and the Port of Lucinda.

POTL contact details are listed below:

PO Box1031

Townsville

Queensland 4810

A.1.2.2 Environmental Record

POTL has a successful history of compliance with its environmental obligations and has maintained a strong and important facility against a backdrop of the region's high-value environmental resources. POTL has successfully and efficiently managed the port's operations within existing legislative frameworks and strongly encourages all port operators to do the same. Section 88R(j) of the *Great Barrier Reef Marine Park Regulations 1983* requires applicants proposing works within the Great Barrier Reef Marine Park (GBRMP) to supply details of their current environmental record. POTL's environmental record includes:

- compliance with all Environmentally Relevant Activity (ERA) licence requirements under the *Environmental Protection Act 1994* (EP Act)
- compliance with approval conditions for dredging and placement of capital and maintenance dredge material under the *Environment Protection (Sea Dumping) Act 1981* (Cth)
- ISO 14001 accreditation for an independently certified Environmental Management System
- undertaking ongoing environmental monitoring and associated annual reporting of monitoring results
- recording and applying conditions specified through approvals (Berths 10A and 8 redevelopment, Townsville Marine Precinct, other development approvals).

A.1.3 Project Description Overview

The Port of Townsville is located in Cleveland Bay approximately 3 km east of the city centre of Townsville in Queensland (Figure A.1.2). Access to the port for large ships is via the established Sea and Platypus channels, which extend approximately 13 km seaward to the east side of Magnetic Island, as shown Figure A.1.2. An existing Dredge Material Placement Area (DMPA), or spoil ground, is located in the port waters approximately 4 km east of the Sea Channel.

The Port of Townsville has a long and lasting relationship with the development and growth of North Queensland and Townsville. The port has facilitated the expansion and prosperity of Townsville, North Queensland and Queensland. Serving as the entry and exit point for goods, minerals and resources for North Queensland, the port averaged an annual trade throughput of almost 10 Mt between 2001 and 2009, with approximately 700 vessels through the port each year. In 2005 the Port of Townsville was identified as being the most diverse exporter of base metals in the world.

As evidenced by ongoing successes in its trade base, the port is well situated to export from regional minerals and agricultural industries and serve as a regional trade hub for North Queensland. The significance of the port for the economy in a local, regional and state context is recognised well beyond the detailed descriptions provided elsewhere in the EIS. Growth is also consistent with the Commonwealth's *National Ports Strategy* (IA, 2010), with an aim to improve the efficiency of port-related freight movements and to '*drive the development of efficient, sustainable ports and related freight logistics to balance the needs of a growing Australian community and economy, with the quality of life aspirations of the Australian people'*.

A.1.3.1 Project Setting

The Port of Townsville has been significant to the history of the region and development of the city of Townsville and the wider North Queensland region. Established in 1864 to service the newly settled rural hinterland, the town that developed around the harbour was to become the largest urban centre in North Queensland and a de facto northern capital city (Blake, 1999). The place of the port in the prosperity of the region is evident.

As the most important entry point in the region, the Port of Townsville has continued to service the evolving economic, industrial and communal development of North Queensland. Additionally, the port's own evolution has reflected the changes in production from rural and agricultural production to extractive minerals, manufacturing and mineral processing and the social and urban development in and around Townsville and its hinterland. Today, the port, as shown in Figure A.1.1, comprises a harbour basin (the inner harbour) enclosed by a breakwater on the western side (western breakwater), a reclaimed area on the eastern side (the eastern reclamation), and a breakwater on the north-eastern side (northern breakwater). The inner harbour contains four land backed berths, three finger jetties; and a dolphin-type bulk liquids berth against the northern breakwater. The port also includes a bulk materials jetty with a single berth on the seaward side of the northern breakwater. This area is known as the Outer Harbour. The existing port includes some 311 ha of strategic port land that provides for materials storage and other support infrastructure to the berths, and the eastern reclamation currently being developed to support expanding port operations and materials storage.

Like all Australian ports, the Port of Townsville exists and operates at the interface of marine and terrestrial built and natural environments. Typically, these coastal landscapes have highly productive and valuable ecological, biophysical and social values, which are generally under growing pressure from human society and its myriad of derivative activities. These landscapes have a continuing and growing demand with limited coastal space and resources. Such natural and physical resources are vitally important for the economic and social wellbeing of communities as areas with high natural character, landscape and amenity values.

The Port of Townsville is prominent amongst Australian ports, being situated in a high-value natural, urban and economic setting. From the perspective of natural value, parts of the port directly occur within the Great Barrier Reef World Heritage Area, which extends along the low water mark for over 2,000 km of the Queensland coastline. While the majority of the existing port infrastructure is situated outside the GBRMP, approximately 850 m of the existing Sea Channel occurs in the GBRMP Habitat Protection Zone (around Magnetic Island to the west of the channel). Due consideration has been given, in the course of this EIS, to the nature of the factors that comprise the values of the Great Barrier Reef World Heritage Area and, where it co-exists with the PEP, the GBRMP.

Today, the port is estimated to generate 8,000 full-time jobs and provides in excess of $300 million in direct and indirect wages and salaries to the community. Since the port's foundation, the city of Townsville has grown and the port has become more than a source of economic prosperity; it has become a landmark and key identifier for Townsville and the region. Given its prominence as the gateway to the city from sea, the daily operations of the port have entwined into the daily activities of communities, employees, business and local residents of Townsville and North Queensland.

A.1.3.2 The Port Expansion Project – Its Origin

The PEP arose from the Port of Townsville Master Plan (Maunsell AECOM, 2007), which recommended that future port expansion take the form of a new facility to be constructed seaward of the existing northern breakwater. Development of that concept was based on the following strategy elements:

- provide development, in a staged manner, for vessel berths to meet the forecast trade for Port of Townsville
- include provision for future changes in shipping fleet/vessel types
- maximise the beneficial re-use of dredged material to achieve environmental and economic imperatives

- maintain flexibility in the timing of staged dredging and reclamation to allow future development to respond to trade growth
- to the extent possible, ensure that future development of the port beyond the 40-year planning horizon will not be compromised by inappropriate development in the short term.

Using these principles, the development concept was furthered in the *Townsville Port Expansion Project Preliminary Engineering and Environment Study* (AECOM, 2009). This was an 18 month study undertaken in 2008/2009 which investigated the feasibility of such an expansion and sought to minimise the environmental impact at the concept design stage. Design elements were iteratively configured during this study to address the following objectives:

- to achieve a balance in the size of project reclamation between provisions of sufficient backing land for efficient cargo operations while minimising the size of the reclamation to minimise loss of benthic habitat, minimising potential impact on coastal processes and maximising the beneficial re-use of dredge material.
- to achieve a balance in provision of sufficient additional berths to accommodate forecast growth in trade, while taking care not to make an ambient grab for additional berths that may not be realistically required.
- to determine the minimum widening and depending of the navigation channels required to accommodate the likely vessel types, sizes and numbers within the project planning horizon. In determining the minimum channel dimension required, it was recognised that there would be a trade-off between all-tide access for all vessel types and some tidal restrictions to reduce what could have been a significant environmental impact if the channels were simply widened and deepened for their entire length.

The *Townsville Port Expansion Project Preliminary Engineering and Environment Study* prepared a concept design that included the following elements:

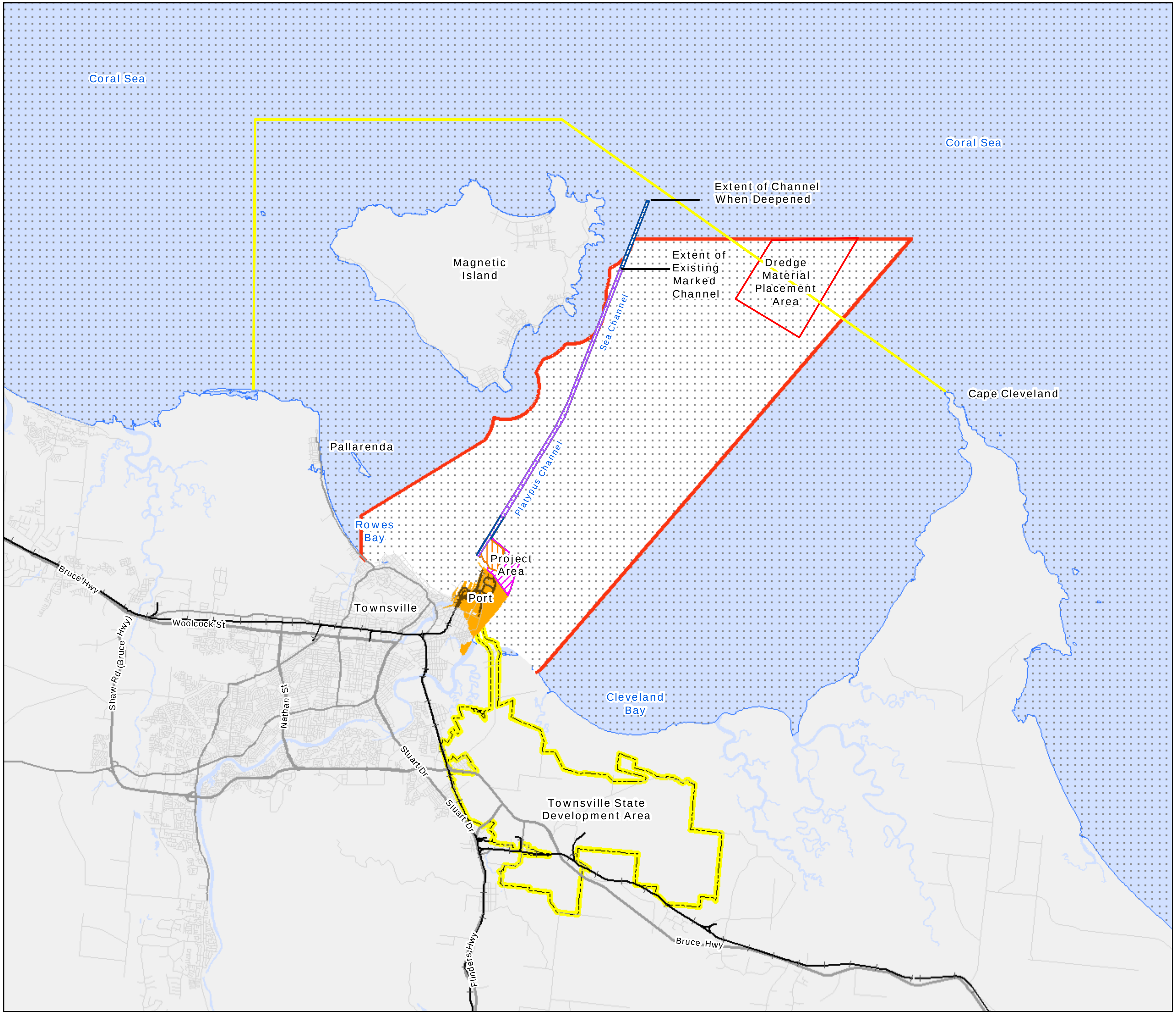
- the construction of a new deep water outer harbour formed by the construction of a new breakwater approximately 1 km seaward of the existing northern breakwater
- deepening of the new harbour basin
- construction of a new western breakwater to protect the outer harbour, which may or may not be required depending on the results of further hydrodynamic and engineering studies to be undertaken as part of the detailed design
- deepening of the existing approach channels (the Sea and Platypus channels) and a minor extension of the channel seawards
- widening of the Platypus Channel only near the outer harbour entrance
- dredged material from creation of the new harbour to be placed in tidal waters as part of reclamation works for the outer harbour, with the balance being placed in the existing DMPA
- creation of approximately 100 ha of reclaimed land backing the new berths to provide for cargo storage and a rail loop, all formed from material reclaimed from the harbour deepening. This will include internal bunds to facilitate effective land reclamation
- construction of up to six additional berths in the outer harbour (Berth 14 through Berth 19)
- installation of aids to navigation
- construction of road and rail infrastructure in the Project footprint and connection to the Eastern Access Corridor currently under construction
- installation of new services infrastructure including stormwater, water supply, power, wastewater, telecommunications.

The spatial layout of the development is shown on Figure A.1.3. The controlling parameters setting the size of the reclamation are:

- The berths have been sized for vessels with a nominal overall length of 250 m, which is the typical upper limit for Panamax sized bulk ships and a larger class of Post-Panamax vessels that could use the port beyond the PEP planning horizon.

- The reclamation area has been sized to accommodate:
  - 52 m cargo operations zone behind the wharf
  - 175 m deep cargo storage area to allow for two material storage facilities and associated equipment
  - 25 m wide road reserve
  - 25 m wide rail reserve to provide for a 200 m radius, three track rail loop behind the cargo storage area and a train length of 1,500 m in front of the train unloader.
- Space has been provided in the reclamation area for a pond for the treatment of tailwater from dredged material and for the separate containment of any contaminated material arising from the dredging during construction and maintenance. It also serves for treatment of stormwater during construction phases.

The reclamation area has been optimised to maximise the re-use of dredged material, balanced against the need to minimise environmental impacts and to size the overall footprint to be consistent with the operational requirements of the port facility.



PORT EXPANSION PROJECT
EIS

Locality Plan and Project Area
of Preferred Option

Figure A.1.2

Legend

- Highways
- Main Roads
- Minor Roads
- Local Roads
- Railway Line
- Port Limits
- Channel to be Dredged
- Existing Port Land
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- Townsville State Development Area
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary
- GBRWHA/National Heritage Place

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

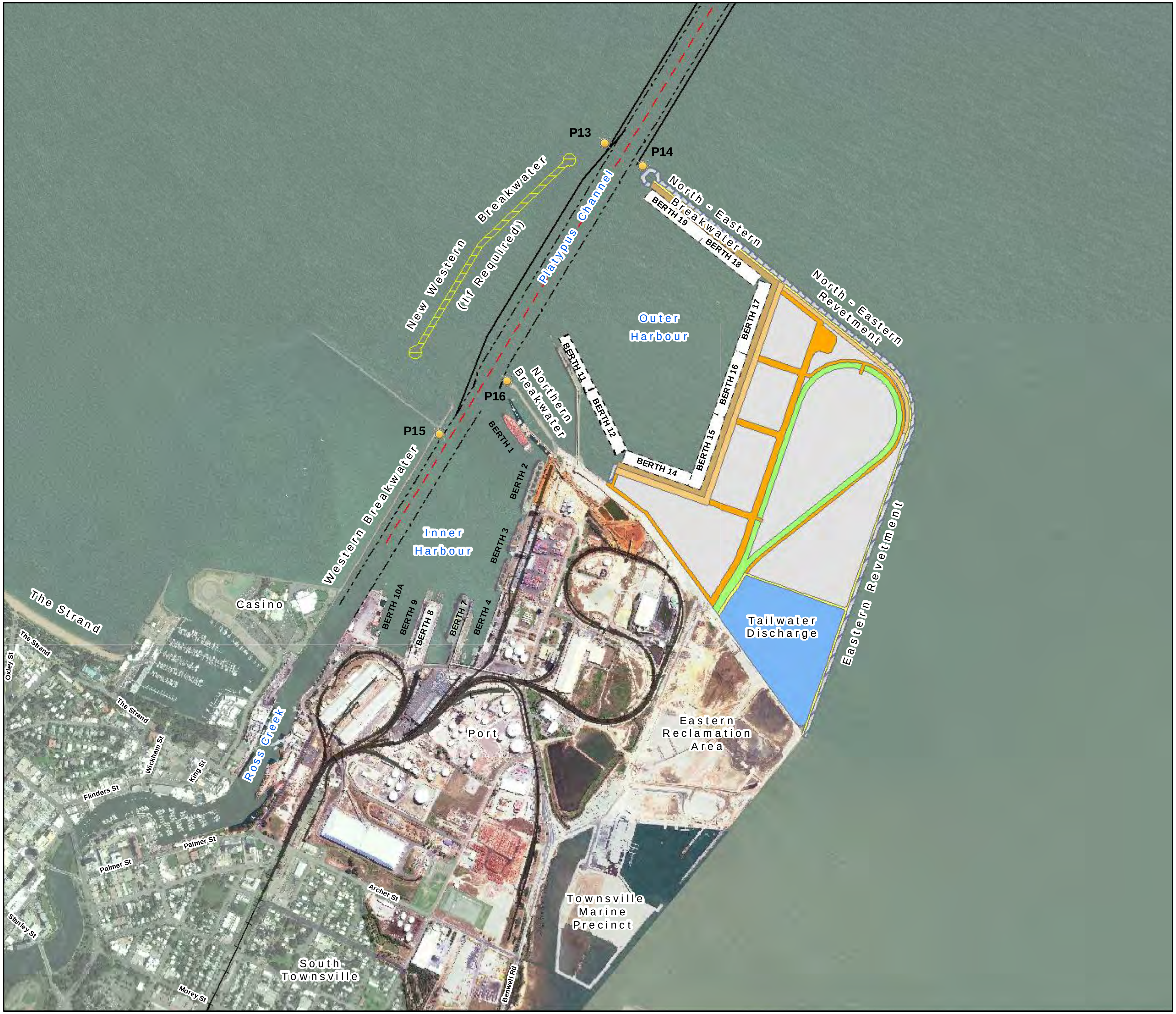
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_131

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012



PORT EXPANSION PROJECT
EIS

PEP Layout

Figure A.1.3

Legend

- Navigation Beacon
- Channel Centre Line
- Existing Channel Limits
- Railway Line
- Access Road and Service Corridors
- Berths
- Cargo Transfer and Operations
- Dredging Reserve
- Perimeter Access Road "2 Way"
- Port Operations
- Railway Corridor
- Revetment
- Western Breakwater
- Wharf

N

Scale:1:20,000(when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_132

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
PEP Layout - AECOM 2012

A.1.3.3 Port Infrastructure in the PEP

The EIS describes the development of the port infrastructure to be built by POTL for the PEP, which includes dredging, reclamation, breakwaters and revetments, wharves, access roads, rail loop, and trunk services and utilities. The development does not include infrastructure and equipment for the cargo handling operations, which may include terminal pavements, shiploaders and unloaders, materials handling conveyors, storage buildings for transhipped products, rail loaders and unloaders, stacking and reclaiming equipment, storage tanks and pipelines. This infrastructure and activity that is not included in the PEP would be provided by the port tenants who would lease POTL land and berth facilities, and construct their own operating infrastructure as and when they take up their lease. The planning, environmental impact assessment and approvals for those operations would be independently undertaken by those proponents at the appropriate time in the future.

It is recognised that in obtaining environmental approval for the PEP infrastructure, a whole-of-port view needs to be taken as there is no point in approving and constructing enabling infrastructure to support unacceptable or unfeasible future development. The presumption has been made that transport and storage activities proposed on the new expansion area are anticipated to be similar to those already undertaken in the existing port, being the import and export of bulk material, mineral concentrates and bulk liquids. These activities will be undertaken in accordance with the existing operational protocols established in the port, and whatever environmental licencing requirements are in place at the time. They are understood to be acceptable as the basis for future development.

In order to reinforce this, POTL will set lease conditions to ensure that end-use of the facilities will follow the port protocols already in place and meet the overall environmental requirements established for the port. Specific requirements for each facility may need to be established and approved through a process that would be initiated and carried through by the port tenants in order to obtain their operating lease. These requirements could include provisions such as:

- stockpiles, conveyors, receival and distribution facilities to be enclosed by dust proof infrastructure, and any material on the site be controlled to meet specified guidelines
- stormwater run-off to be handled in accordance with a stormwater plan
- wastewater and solid waste be treated and disposed in accordance with the legislation and/or specified guidelines
- noise levels at sensitive receptors not to exceed specified guidelines
- tanks, pipelines and associated facilities to be bunded and spills collected, treated and disposed of in accordance with the relevant legislation
- operational areas to be fenced and gated to prevent entry by unauthorised personnel in accordance with the Port of Townsville security protocols
- construction activity to be undertaken in accordance with Port of Townsville procedures, permits and licences
- exterior lighting to comply with specified guidelines
- buildings and equipment to comply with maximum height and visual amenity provisions established by POTL.
- relevant activities to be undertaken in accordance with licence and permit conditions.

A.1.4 Project Rationale

The following information describes the role of the current port operations and PEP in future regional growth and includes trade forecasts sourced from Deloitte Access Economics (Deloitte, 2012) that underpin the rationale for the PEP.

A.1.4.1 Role of the Port of Townsville and the Project in Regional Growth

Since being established in 1864, the Port of Townsville has been integral to the development of the economy of Townsville and the North Queensland region. The port is now Queensland’s third largest multi-commodity port, handling 14% of the total international trade export by, earned value, yet approximately only 4 to 5% of the total cargo tonnage emanating from Queensland seaports. It provides

North Queensland with a gateway for commerce and trade and it services the north-east and north-west minerals provinces of the state, handling 73% of all metals traded through Queensland ports in the 2009/10 financial year. The port is one of Queensland's more strategic assets, playing a significant role in the local, regional and state economy.

The port is well located to support the regional mineral and agricultural industries and as a regional trade hub for North Queensland. It is strategically situated to serve the Mount Isa region, and is the terminus for the Mount Isa rail line.

It is also strategically situated to serve the Townsville State Development Area (TSDA) that is located to the south-east of the port (Figure A.1.2). The TSDA was declared in 2003 to assist the Townsville region to achieve its potential as a major base metals processing centre. Its proximity to the port and the minerals rich north-west makes it the most strategically positioned industrial land in North Queensland. New opportunities for processing minerals and transport and distribution services connecting northern Australia to the Asia-Pacific region are expected to attract new industries and drive continued economic growth and employment for the Townsville region and Queensland.

The significance of the port for the economy in a local, regional and state context is recognised in the *Northern Economic Triangle Infrastructure Plan 2007-2012* (DI, 2007b) and the *Townsville Economic Gateway Strategy* (DI, 2007c). A major strategic objective of these plans is to ensure the future development and efficient operation of the port. A key contributory factor for the continued economic development of the region is achieved through the adoption and progressive implementation of the *Port of Townsville Master Plan* (Maunsell AECOM, 2007).

Such an approach is also consistent with the Commonwealth's, *National Ports Strategy* (IA, 2010). The aim of the *National Ports Strategy* is to improve the efficiency of port-related freight movements and drive the development of efficient, sustainable ports and related freight logistics to balance the needs of a growing Australian community and economy with the quality of life aspirations of the Australian people. The strategy recognises that port operators and freight distributors need certainty and predictability for commercial decision making, and require long-term plans on which to base commercial decisions. It recommends that future infrastructure requirements be identified from an analysis of a combination of forecast demand and expected levels of productivity.

The *Port of Townsville Master Plan* (Maunsell AECOM, 2007) identified the need to expand the port to satisfy forecast trade over a long-term planning horizon, based on assessment of demand and capacity requirements. The *Master Plan* incorporated the *Townsville City-Port Strategic Plan* (DI, 2007a), which seeks to protect the integrity of the port and provide for an effective and sustainable interface between Townsville's port and the adjacent city.

A significant expansion of sea-borne trade is expected in North Queensland in the next few decades and beyond. Growth at the Port of Townsville in the near-term is expected to exceed the Australia-wide average, due to new major resource projects in magnetite, nickel and fertiliser, and the potential introduction of the coal trade from the Galilee Basin to Townsville. After these projects are developed, growth is expected to return to a rate similar to the average of ports outside capital cities.

The current annual trade through the port is approximately 11 Mtpa (2010/11), and POTL's current trade forecast indicates growth to approximately 28 Mtpa by 2019/20. This will exceed the current capacity of the port; at approximately 23 Mtpa, including capacity increasing projects currently underway. By 2040 the throughput is expected to be 48 Mtpa; that is, in the order of a fourfold increase in the trade tonnage throughput.

Current trade tonnage is dominated by nickel ore imports (37%), mineral concentrate exports (12%), oil imports (9%), sugar exports (8%) and fertiliser exports (7%). By 2025, 46% is expected to come from new coal exports, 19% from additional magnetite exports, 12% from additional nickel ore imports, 8% from additional mineral concentrate exports and 7% from additional fertiliser exports. This is discussed in detail in Section A.1.4.2.

From the trade forecast, no particular commodity dominates the predicted trade spectrum, but rather the trade comprises a wide range of commodities handled in relatively small (by bulk port standards) bulk commodity parcels, up to around 10 to 15 Mtpa. The port's key strength lies in being able to provide an economic transport hub for these commodities emanating from production centres in North Queensland that would not be economically viable if they had to be handled at a major bulk material port. The port provides the opportunity for the development of projects in the region that would be unfeasible if they had to be transported to other major bulk material ports.

The *Master Plan* examined the berth requirements to accommodate the forecast increased in trade, and examined a number of scenarios for the future development of the port to meet the increase in berth capacity required, either through expansion of the existing port facility, or through the establishment of a new greenfield facility at Cape Cleveland. The *Master Plan* study concluded that the new berths should be provided through a staged program of redevelopment and rationalisation of operations at the existing site, with general cargo, cruise shipping, defence vessel and some mineral berths retained in the inner harbour, and a new outer harbour created by expanding the port seaward of the existing northern breakwater to provide capacity for the expanding bulk trades. This recommendation was adopted by POTL and incorporated into the *Port of Townsville Land Use Plan 2010* (POTL, 2010b) and *Port Development Plan 2010|2040* (POTL, 2010a).

The increase in trade is expected to require shipping by larger vessels; therefore, along with the development of additional berth space, deepening and other minor modifications to the approach channels to the port (the Sea and Platypus channels) are required to overcome constraints imposed on vessel size by the present channel geometry.

A.1.4.2 Trade Forecast

A detailed review of the underlying macro-economic conditions predicted for the region over the 2040 planning horizon and more details of the trade forecast by Deloitte Access Economics is contained in Appendix T1.

Despite the changes occurring because of the recent global financial crisis, the outlook for Australia's bulk mineral exports continues to be strong. Deloitte Access Economics predicts that global commodity consumption is expected to rise by 42% to 82% over the next 20 years, with iron ore (including magnetite) and coal projected for the largest increases in demand. Nickel and copper are also expected to see considerable demand compared with the non-resource sectors of the economy.

Over the next five years, the International Monetary Fund expects economic growth in emerging and developing countries to exceed the growth in advanced countries by more than 4% per year. Strong emerging growth, particularly in China and India, will continue to benefit Australia. Economic growth and development in China is expected to continue over the coming decade. The twin process of industrialisation and urbanisation will support strong demand for Australian resources. India's industrial and economic growth is also likely to offer increased export opportunities for Australia. This is evident in part from the strong interest being shown by Indian industrial companies in participating in Australian minerals projects, especially in Queensland. In 2015, the share of Australian exports to China is predicted to increase to 33.1%, up from 25.0% in 2010. The share of Australian exports to India is projected to increase to 11.3% in 2015, up from 7.2% in 2010. This supports a positive outlook for the development of new and existing bulk minerals projects in North Queensland, which underlies the trade predictions supporting the PEP.

Trade volume through the port is expected to increase to over 48 Mtpa by 2040. A comprehensive trade forecast has been prepared by POTL for the purposes of the EIS. Two methods were used to generate the trade forecast:

- A short to medium-term forecast based on a project by project assessment of known or proposed resources sector developments. This method was used because growth in overall tonnage at the port is largely 'project-driven' rather than due to 'endogenous growth'. For example, the growth in port tonnage experienced in the 1990s was a result of the Yabulu Refinery commencing nickel ore imports, rather than by compounding growth in existing trades.
- A medium to long-term trend growth rate of 5.5% per annum until 2029/30, based on the actual growth between 1967/68 and 2010/11, and 3% thereafter based on the long-term underlying historical growth rate in the port.

The final forecast is a combination of the above two methods, giving more weight to the detailed project based forecasts in the short to medium-term, and giving more weight to the trend growth rate based forecasts in the longer term, and by 2024/25 the forecasts are based only on the trend growth rate.

High, medium and low forecasts were prepared for the PEP. The high-case scenario has been adopted for the purposes of the EIS as the most appropriate as it produces the largest development footprint and thus the largest potential environmental effects. The high-case trade forecast is presented in Figure A.1.5. The graph shows the split between imports and exports in the trade forecast.

The trade forecast has been reviewed by Deloitte Access Economics (Chapter B19 Economic Environment) who conclude: 'based on our review of the POTL forecasts, economic factors and global outlook, the forecasts are a reasonable basis for planning purposes and for the EIS purpose of estimating impacts'.

The trade forecast indicates that the main growth in cargo tonnages will be as a result of the mining related commodities (Table A.1.1 and Figure A.1.4). A characteristic of mining projects is that they ramp up quickly to the operating capacity of the mine, and continue to ship a relatively constant tonnage each year during the lifespan of the mine, until it is depleted or extended. Throughput at the port tends to step rapidly upwards then plateau, until the next major project commences. This causes the tonnage history and forecast charts for the port to visually reflect the 'staircase' pattern of project-driven growth, rather than the 'smooth' pattern of compounding, endogenously-driven growth.

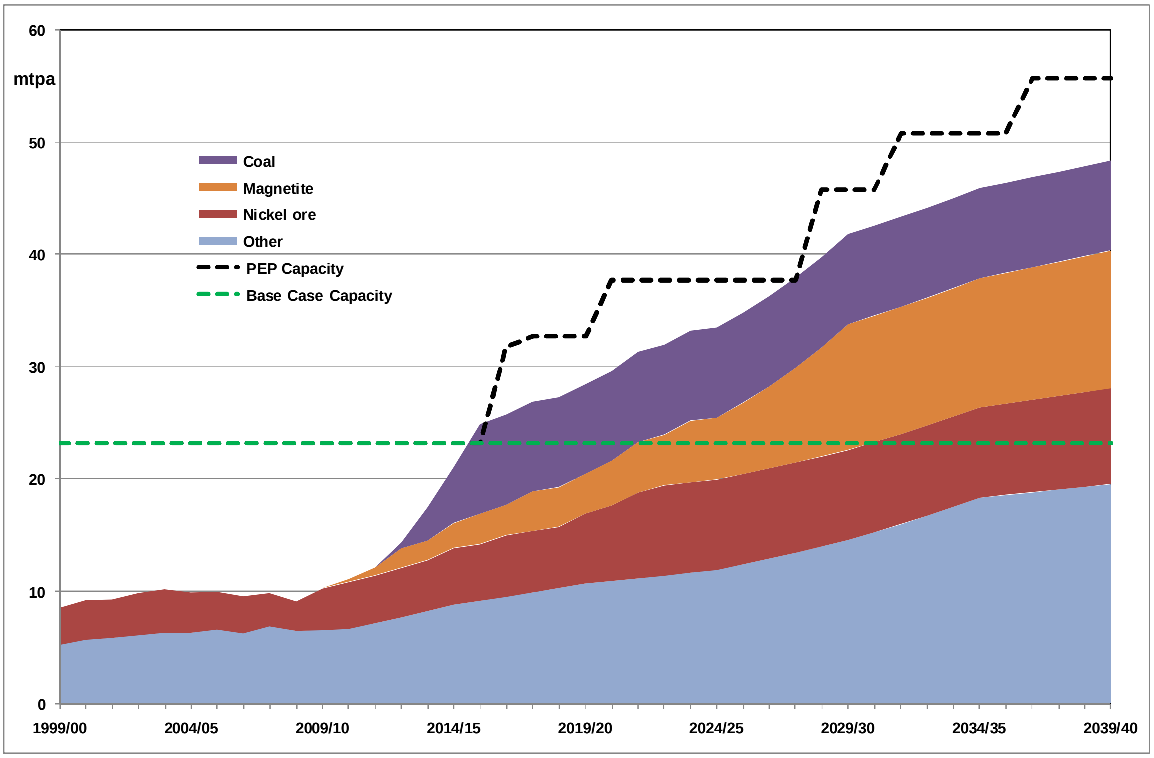
The key projects driving the trade growth are:

- the introduction of the coal trade, which is expected to start in 2013 and ramp up quickly to 8 Mtpa by 2016, resulting in a total trade throughput of 33.4 Mtpa by 2024/25
- throughput expansion to nearly 7.5 Mtpa from Yabulu, which is planning to more than double in size and diversify into magnetite
- a further 16.5% of the growth from two other magnetite projects – Ernest Henry and Mount Moss
- Legend Paradise (fertiliser) and Ivanhoe Merlin (copper) contributing a further 20%.

These projects are either underway or going through a feasibility process.

Table A.1.1 Portion of total trade growth for high growth commodities

Commodity	Proportion of Total Trade Growth (%)	
	2010 to 2020	2020 to 2040
Nickel ore (import)	12	12
Coal (export)	46	0 (stable)
Magnetite (export)	19	44
Other new dry bulk (export)	0	9
New liquid bulk (export)	0	13



Note: Base Case Capacity is the estimated maximum capacity of the existing port and proposed Berth 12

Figure A.1.4 Trade forecast showing major commodities

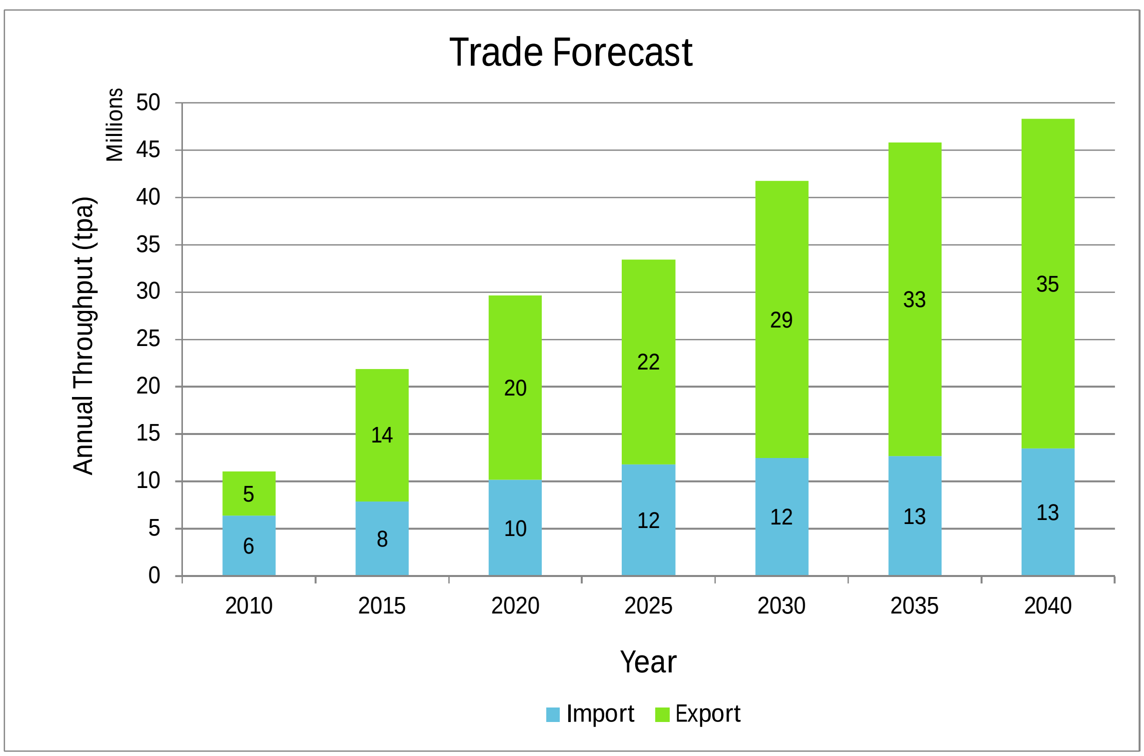


Figure A.1.5 Long-term trade forecast import/export split

Table A.1.2 Summary of long-term trade forecast by commodity

	Commodity	Forecast Trade Throughput (Mtpa)						
		2010	2015	2020	2025	2030	2035	2040
Import	Dry Bulk							
Import	Cement	0.5	0.5	0.6	0.7	0.7	0.7	0.7
Import	Fertiliser	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Import	Nickel Ore	4.1	5.0	6.7	8.0	8.0	8.0	8.5
Import	Sulphur	0.1	0.3	0.5	0.5	0.5	0.6	0.7
Import	Mineral concentrates	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Import	Bulk Liquid							
Import	Ammonia	-	0.1	0.2	0.2	0.2	0.2	0.2
Import	Bitumen	-	0.1	0.1	0.1	0.2	0.2	0.2
Import	Oil	1.0	1.0	1.1	1.3	1.9	1.9	2.0
Import	Sulphuric acid	0.0	-	-	0.0	0.0	0.0	0.0
Import	Break Bulk/Non-Containerised/Containerised							
Import	Copper anode	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Import	General cargo	0.2	0.2	0.3	0.3	0.3	0.4	0.4
Import	Motor vehicles	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Import	Nickel oxide cake	-	0.1	0.1	0.1	0.1	0.1	0.1
Import	**Total Imports**	**6.4**	**7.9**	**10.1**	**11.8**	**12.5**	**12.7**	**13.5**
Export	Dry Bulk							
Export	Fertiliser	0.8	1.4	2.0	2.6	3.0	3.0	3.2
Export	Geothite	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Export	Magnetite	0.3	2.7	4.0	5.5	11.2	11.5	12.2
Export	Mineral concentrates	1.4	2.4	3.0	3.0	4.0	4.0	4.2
Export	Sand/gravel/coke	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Export	Sugar	0.9	1.2	1.2	1.2	1.2	1.2	1.3
Export	Zinc ferrite	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Export	Coal	-	5.0	8.0	8.0	8.0	8.0	8.0
Export	New dry bulk (e.g. phosphate ore, wood chips)	-	-	-	-	-	1.6	1.7
Export	Bulk Liquid							
Export	Contaminated oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Export	Molasses	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Export	Sulphuric acid	-	-	-	-	-	-	-
Export	New bulk liquid (e.g. bio-diesel)	-	-	-	-	0.5	2.5	2.7
Export	Break Bulk/Containerised							
Export	Cattle	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Export	General cargo	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Export	Meat and by-products	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Export	Mineral concentrates containers	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Export	Refined copper	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Export	Refined lead	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Export	Refined nickel	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Export	Refined zinc	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Export	Timber	0.1	-	-	-	-	-	-
Export	**Total Exports**	**4.7**	**14.0**	**19.5**	**21.6**	**29.3**	**33.2**	**34.8**
Total Imports and Exports		11.0	21.9	29.7	33.4	41.7	45.8	48.3

A.1.4.3 Summary - Economic Growth

The strong demand from China and India for North Queensland's resource exports is driving the development of new mines along the Townsville-Mount Isa corridor, which are serviced by the Port of Townsville. While the forecasts imply a high average per annum growth rate, the growth is generated by several major new mine developments, rather than organic growth in existing trades.

POTL's trade forecast growth, while rapid, is underpinned by a number of real projects. The implied compound growth rate of 8.2% per annum between 2009/10 to 2024/25 is consistent with a high-case long-term outlook for the commodities in the Townsville-Mount Isa corridor served by the port.

A.1.5 Relationship to Other Projects

A number of other developments are planned or underway in the Port of Townsville in addition to the PEP. These are shown on Figure A.1.6. The relationship of these projects to the base case for the PEP EIS is described below.

- The Townsville Marine Precinct is a small vessel facility adjacent to Benwell Road on the eastern side of the port. Stage 1 has recently been completed and forms part of the base case for the PEP EIS.
- POTL is also proposing other port development projects:
  - Construction of Berth 12, a new bulk handling berth outside the inner harbour adjacent to Berth 11, with possible bulk material storage facilities supporting this new berth located on the eastern reclamation. The proposed Berth 12 is approved and does not form part of the PEP. For the purposes of assessing the PEP, it is assumed that its construction will be completed prior to the PEP commencing and it forms part of the base case.
  - Minor channel improvement works to increase the bend radius at the junction of the Sea and Platypus channels and minor channel widening between beacons P13 and P15. These channel works are approved and therefore are not being assessed as part of the PEP, but are considered as being completed for the purpose of the base case.
  - Various berth modifications and rationalisation in the inner harbour are not being assessed as part of the PEP and will be considered as being completed for the purpose of the base case:
    - the reconstruction of Berths 8 and 10a, which was underway at the time of writing the EIS
    - the reconstruction of Berth 4, which was being planned at the time of writing the EIS
- Potential new Berths 10b and 10c (with land backed reclamation) and dredging of a navigation diversion channel for Ross Creek craft, being investigated by POTL and at an early planning stage at the time of writing the EIS. This does not form part of the base case.
- The TSDA is a 4,900 ha land parcel located east of the Townsville CBD, which was declared for heavy industry use in late 2003. A new Eastern Access Corridor (EAC) to the port has been included in the Materials Transportation and Services Corridor Precinct under the TSDA scheme and provides for port access to benefit existing and future industries including access for existing and future heavy vehicles from the Flinders and Bruce highways. The Townsville Port Access Road (TPAR, within the EAC) was under construction at the time of preparing the EIS. The TSDA and the Materials Transportation and Services Corridor Precinct will be catalysts for industrial development underpinning port trade. They anticipate future expansion of the port as provided by PEP and will be developed under their own approvals.

The PEP evolved from comprehensive master planning in the port and surrounds, involving key stakeholders. Consideration has been given to the supply chain activities and planning of land transport systems. The PEP design recognises existing port infrastructure and future port activities, and seeks to integrate the development of all port components to achieve an optimum path of development. The design has considered the cumulative spatial and capacity planning requirements of cargo handling facilities, road, rail and shipping.

The EIS assesses broader regional planning issues and demonstrates the PEP's consistency with:

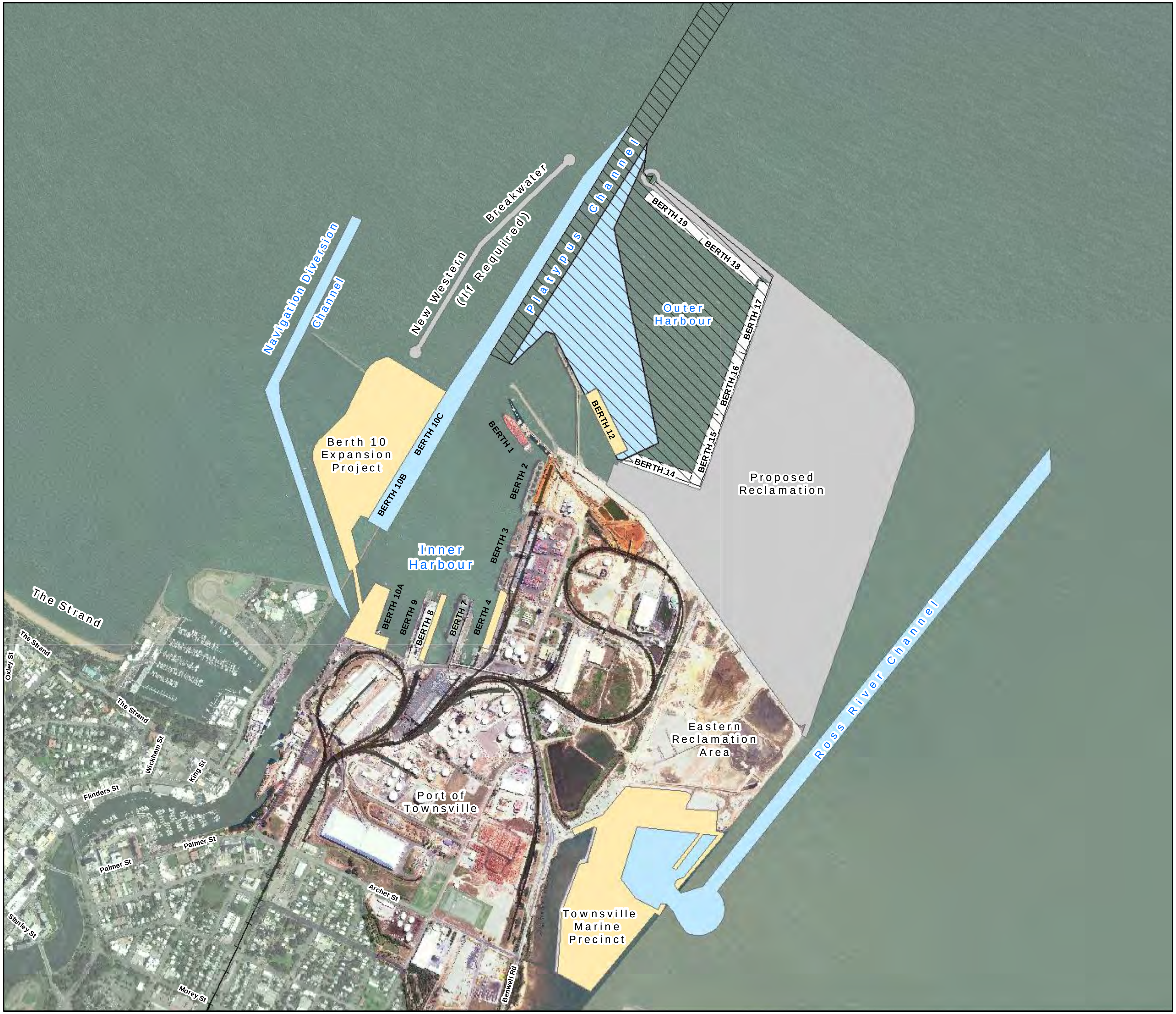
- *Port of Townsville Master Plan 2007* (Maunsell AECOM, 2007)

- *Townsville City-Port Strategic Plan* (DI, 2007a)
- *Port Development Plan 2010|2040* (POTL, 2010a)
- *Mount Isa System Rail Infrastructure Master Plan 2012* (QR, 2012).
- *Northern Economic Triangle Infrastructure Plan 2007-2012* (DI, 2007b)

PORT EXPANSION PROJECT
EIS

Other Port Development Projects

Figure A.1.6



Legend
- Railway Line
- PEP Works
- PEP Deeping
- Other Port Dredging
- Other Port Development Project (seperate to the PEP)

N

Scale: 1:20,000 (when printed at A4)

0 100 200 400 600 800
Metres

PROJECT ID 60161996
LAST MODIFIED CFS 05-Oct-2012
FILE NAME 60161996_PLN_133

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
Berth 10x - AECOM 2012
PEP - AECOM 2012

A.1.6 Project Alternatives

The following section discusses the options and alternatives to the proposed form of the PEP to demonstrate that the form selected though the Master Plan process - a new outer harbour on the seaward side of the existing inner harbour - is the most appropriate from both an environmental and an operational standpoint.

A.1.6.1 The Need for Additional Port Infrastructure

The port's existing inner harbour is fully developed, as seen in Figure A.1.1. The only space available for new berths is in the vicinity the western breakwater adjacent to Berth 10. A possible inner port expansion is being planned by POTL and would result in the development of land backed Berths 10b and 10c, as shown in Figure A.1.6. This development is required for handling of general cargo, defence vessels and cruise ships. This location is unsuitable for new bulk material berths as it is adjacent to recreational and residential land uses, and there is no suitable access for transport of cargo by rail.

The existing berths in the port are fully committed to other uses, either through long-term lease arrangements with specific exporters/importers, or through the requirement to provide intermittent berth allocation for general cargo. It is not possible to handle the increased trade on a large-scale across the existing berths.

Many of the existing berths are not suitable for export of dry bulk trades in Panamax sized vessels on a regular basis. At the least this would require deepening of the existing harbour and channel, for which the existing berth structures are not designed.

A.1.6.2 The 'No Action' Option

There will not be sufficient capacity within existing port infrastructure to accommodate the forecast increase in trade unless POTL substantially increases the capacity of the port to handle bulk materials. The forecast trade also relies on the availability of an efficient transport network and export/import facility for its economic viability. Many of these development projects can be classified as small to medium and their viability is critically linked to minimising transport costs. If the port is not expanded, opportunities for future economic growth will be constrained as the increased trade will need to be handled at another Queensland port. This could have a significant adverse economic impact for the development of regional trade and, in particular, may affect the viability of future projects, particularly in Queensland's North and North West regions.

The development of additional port infrastructure is required to provide the increased capacity to service the projected increase in trade and contribute to increasing the prosperity of the region. The 'no action' option is therefore seen as untenable.

A.1.6.3 Port Expansion Options for Berths and Land

Additional port capacity could be provided through the provision of new port infrastructure, either through major redevelopment of the existing facilities or developing new facilities.

In arriving at the PEP layout to provide this additional port infrastructure, several options and alternatives have been examined (mainly in the Port of Townsville Port Master Plan 2007 (Maunsell AECOM, 2007) to test that the proposed layout is the most effective option available. These are briefly discussed below and shown in Figure A.1.7.

A.1.6.3.1 A new harbour to the west of the existing harbour (Option A)

This is shown as Option A in Figure A.1.7. Development of new port facilities on the west side of the existing port, outside the existing port limits and immediate port environs towards Rowes Bay, Cape Pallarenda and beyond, is not considered practical for bulk port facilities. The seabed is shallow and there is no existing port land available. Such development would not be suitable because of sensitive environmental effects, the close proximity to residential, commercial and recreational facilities, the difficulties in providing bulk materials storage areas, the difficulties in providing shipping channel access, which would require dredging of a major new shipping channel, and the cost in providing road and rail access. Land access would be through Townsville Town Common and/or Bohle floodplain with consequent risks associated with flooding, drainage and environmental protection of significant wetlands.

Such a port site would also fragment and duplicate the port facilities and, being a stand-alone port site, would involve very high capital expenditure for its establishment. A port development in this area would not be cost effective and would appear to have significant negative environmental impacts.

A.1.6.3.2 A new harbour to the east of the existing harbour (Option B)

This is shown as Option B in Figure A.1.7. On the eastern side of the existing port, there is a section of shoreline to the east of Ross River within the existing port limits that could be the site for a new harbour. It is adjacent to the TSDA, which would provide a future advantage of separating harbour and TSDA activity from the Townsville urban areas. However, the area, on the shores of the Ross River Southbank reserve, has significant environmental attributes that could be compromised by port development. The site is disconnected from existing land and sea access infrastructure, and would require a major new approach channel to be dredged. The site is also in very shallow water, which would require a substantial dredging program to establish a deep water port. Such a port site would also fragment and duplicate the port facilities and, being a stand-alone port site, would involve very high capital expenditure to establish. A port expansion in this area would not be cost effective and would appear to have significant environmental impacts.

A.1.6.3.3 Provide additional berthing outside existing harbour using exposed port berths (Option C)

This is shown as Option C in Figure A.1.7. While it would be possible to provide additional berth space along the northern edge of the existing reclamation area and adjacent to Berth 11, these berths would be fully exposed to the sea and, as such, would not be suitable for dry bulk material imports, bulk liquids handling nor for general cargo handling, all of which require the vessel to be in calm water alongside the berth for the unloading operation. There is also limited space for new berths in this area, and only one or two additional berths would be possible, which would not provide the future capacity required.

Further, there would be substantial dredging required for these berths and, without reclamation, there would be no viable beneficial use available for the dredged material. This option is considered unsuitable largely from capacity and operational perspectives.

A.1.6.3.4 A new protected harbour without reclamation – remote land cargo storage (Option D)

This is shown as Option D in Figure A.1.7. The option of transferring cargo by conveyor and pipeline between berths in a new outer harbour and a remote storage area (such as the TSDA), rather than to an adjacent reclaimed area (thus no requirement for reclamation), is feasible in principle. It is not preferred from an operational and capital cost standpoint for the relatively modest sized commodity parcels contemplated in the trade forecast.

This option would not provide opportunities for beneficial re-use of the substantial quantities of dredged material to be produced from the harbour basin dredging required for ship access to the new berths. All dredged material would have to be relocated to an offshore spoil ground. Studies have shown that the existing DMPA will not have sufficient capacity for all of the channel and basin dredging spoil, and it would be necessary to develop a new offshore DMPA to accommodate the excess spoil from this option. As there is insufficient space within the port waters for such a requirement, a new spoil ground outside port waters would be required which would necessarily need to be within the GBRMP. This would have additional environmental impact on the GBRMP, and could not be justified, especially as there is no compelling operational or economic reason to pursue this option.

A.1.6.3.5 A New Harbour at Cape Cleveland (Option E)

This is shown as Option E in Figure A.1.7. The option of siting a new port facility at Cape Cleveland was considered in a number of earlier studies [notably *Port Plan Review – Cape Cleveland Comparison 1994* (SKM, 1994) and *TPA Port Development Plan 1999* (TPA, 1999). The conclusions in the *Port of Townsville Master Plan* (Maunsell AECOM, 2007) were that the capital cost (including the provision of road and rail access infrastructure) and the adverse environmental effects were far in excess of those applying to the development of berth space in the environs of the current port site and could not be justified.

A.1.6.3.6 Preferred Port Expansion Option

The preferred option is in the same area as Option D above but with land reclamation. It provides additional berthing outside the existing inner harbour with protected berths and reclamation to provide land for cargo storage and transfer.

The layout for port expansion proposed in the Port of Townsville Master Plan involves the creation of a new protected outer harbour seaward of the existing port with a significant reclaimed area for cargo storage, and is the most feasible arrangement. It offers sufficient berth space and cargo storage areas for the next 30 years in manageable proximity to each other, provides calm water for port operations, provides better protection of port infrastructure in extreme (cyclone) events, and provides a solution for the beneficial use of part of the quantum of dredged material (that would be generated by all of the options considered above), so minimises certain environmental effects.

The proposed layout is shown in further detail in Figure A.1.3 and its attributes are discussed in detail in the subsequent sections of the EIS. In summary, it:

- provides the advantage of protected berths
- does not require new land and sea access infrastructure; making use of the existing shipping channels and the EAC now under construction
- minimises the additional channel dredging required as it uses the existing channels
- minimises the amount of dredged material disposal by placing it in reclamation
- has the least overall capital cost of the alternative options considered
- minimises port infrastructure duplication and operating costs by being an extension of the existing port facility
- will be built in an already disturbed port area with manageable wider-field environmental effects.

Table A.1.3 sets out a qualitative multi-criteria analysis comparing these port options and reinforces the choice of the preferred option as the optimum approach. The multi-criteria analysis scores for options in the table range from 5 (best) to 1 (worst).

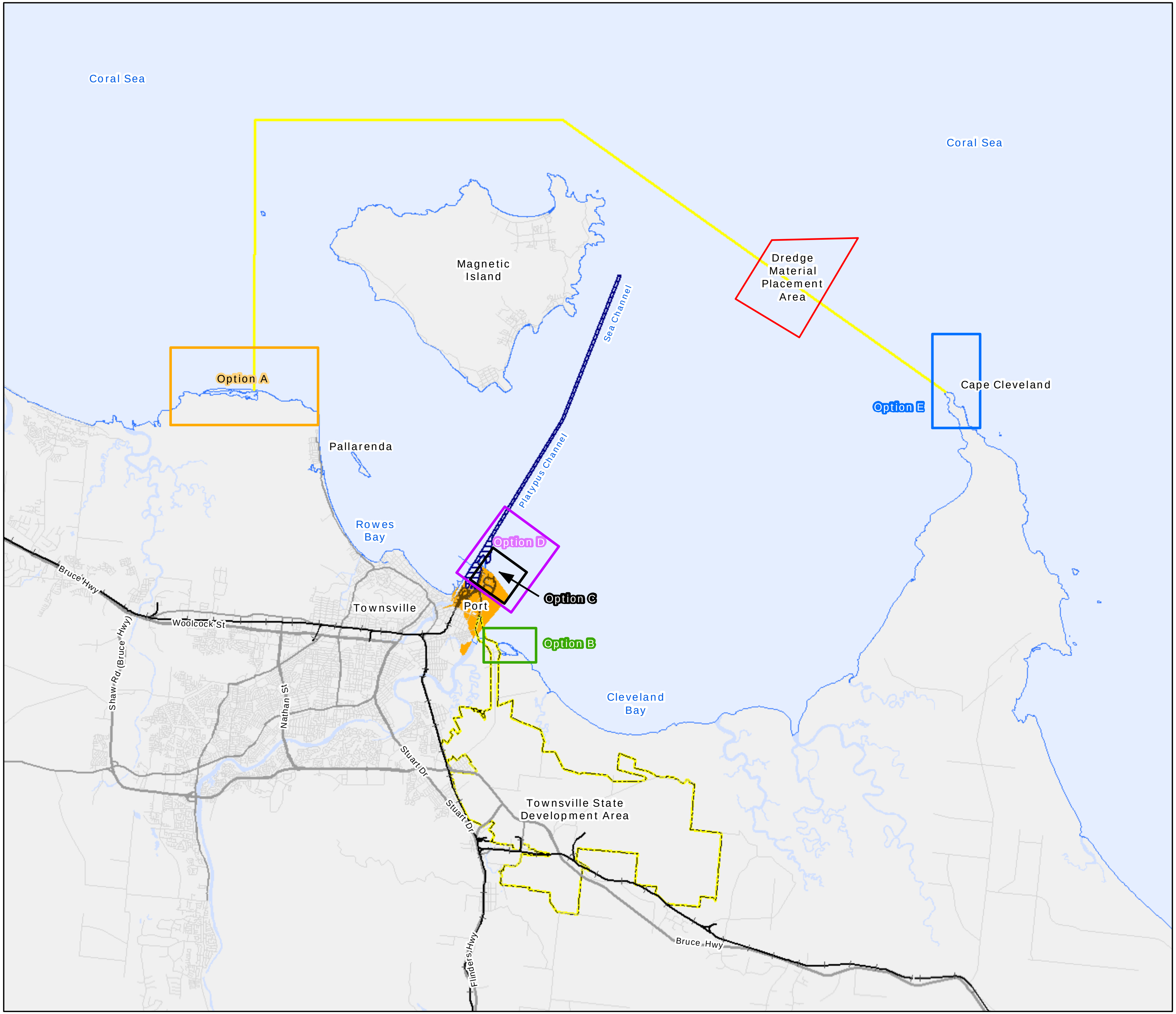
Table A.1.3 Multi-criteria analysis of port options

Criterion	Option A New harbour west of existing		Option B New harbour east of existing		Option C Exposed berths off existing harbour		Option D New harbour without reclamation		Option E New harbour at Cape Cleveland		PEP Option New harbour with reclamation	
Access channel	New channel required	1	New branch channel required	2	No new channel required; deepen and widen existing channels	4	No new channel required; deepen and widen existing channels	4	New short channel required	5	No new channel required; deepen and widen existing channels	4
Road and rail access	Poor; major new infrastructure required	1	Uses existing road and rail; future EAC	5	Uses existing road and rail; future EAC	5	Uses existing road and rail; future EAC	5	Poor; major new infrastructure required	1	Uses existing road and rail; future EAC	5
Dredged material disposal	Reduced by reclamation; large amount of channel dredging to offshore DMPA	2	Reduced by reclamation; large amount of excess soft and channel material to offshore DMPA	2	Berth pockets, turning basin, channel deepening and widening all to offshore DMPA	3	New harbour basin, channel deepening and widening all to offshore DMPA	1	Reduced by reclamation	5	Reduced by reclamation; channel deepening and widening to offshore DMPA	5
Environmental effects	High environment al value area disturbed involving large greenfield site; close proximity to existing residential areas	1	High environment al value area disturbed involving large greenfield site	1	Lower environment al value area disturbed adjacent to existing disturbed area; channel dredging minimised	4	Lower environment al value area disturbed adjacent to existing disturbed area; channel dredging minimised	4	High environment al value area disturbed involving large greenfield site	1	Lower environment al value area disturbed adjacent to existing disturbed area; channel dredging minimised; beneficial use of basin dredging as reclamation	5
Port operations	Split port operations; remote; new road and rail supply lines	3	Split port operations; good location to TSDA and EAC	5	Berth capacity limitation	3	Large materials conveying infrastructure requirement; limited flexibility in operations	1	Split port operations; remote; new road and rail supply lines	2	Efficient operation layout	5
Berth protection	Harbour	5	Harbour	5	Unprotected	1	Harbour	5	Harbour	5	Harbour	5
Capital cost		1		2		5		4		2		3
Maintenance dredging	Long exposed channel	2	New short channel; minimal siltation in new harbour	4	High siltation area	2	Existing channel; minimal siltation in new harbour	5	Short channel; minimal siltation in new harbour	4	Existing channel; minimal siltation in new harbour	5
MCA total		16		26		27		29		25		37

PORT EXPANSION PROJECT EIS

Port Development Options

Figure A.1.7



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Channel
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

Port Development Options

- Additional Berthing Outside Existing Harbour Using Exposed Port Berths
- New Harbour West of Existing Harbour
- New Harbour East of Existing Harbour
- New Harbour at Cape Cleveland
- New Protected Harbour without Reclamation

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_134

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012

A.2 The EIS Process

A.2.1 The Purpose of Environmental Impact Assessment

A.2.1.1 Background

An extensive study program for the port, including the *Townsville Port Preliminary Engineering and Environmental Study* in 2009 (AECOM, 2009), identified demand responsive expansions of the existing port to meet North Queensland's growth. The port's development strategy relies on a seaward extension of the port and its infrastructure into Cleveland Bay to cater for increases in demand for trade and port capacity, including a greater emphasis on bulk goods handling, especially for high value, low volume mineral products (compared to other bulk products).

The location of the PEP, the multiple approval jurisdictions that apply to the Project, its potential significance to the State of Queensland as a major form of infrastructure investment, its location adjacent to a number of sensitive environmental areas and recent decisions regarding a number of other projects led to a referral of the Project to the Queensland Coordinator-General as a prospective 'significant project' under the SDPWO Act. The location of the PEP in the GBRWHA and its proximity to other matters of national environmental significance (MNES) under the Commonwealth EPBC Act also led to the Project being referred to the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (DSEWPC) seeking a decision as to whether it would constitute a 'controlled action' under that Act.

Key events associated with the Project, to date, are:

- On 13 April 2011, POTL lodged an Initial Advice Statement for the Project with the Coordinator-General under the SDPWO Act. The Initial Advice Statement provided an outline of the Project, including its rationale and potential impacts.
- On 23 May 2011 the Coordinator-General declared the PEP a 'significant project' for which an EIS is required, under s. 26(1)(a) of the SDPWO Act.
- A Draft ToR prepared by the Coordinator-General underwent public consultation for the period between 29 October 2011 and 25 November 2011.
- Submissions made by the public were considered by the Coordinator-General and the final ToR for the PEP was prepared in February 2012.
- On 26 May 2011 the Project was also referred to the Commonwealth for a determination as to whether the Project would constitute a 'controlled action' under the EPBC Act.
- The PEP was determined to be a controlled action (EPBC 2011/5979) by the Commonwealth on 1 July 2011. The controlling provisions under the Act are:
  - ss. 12 and 15A - world heritage properties
  - ss. 15B and 15C - national heritage place
  - ss. 16 and 17B - wetlands of international importance
  - ss. 18 and 18A - listed threatened species and communities
  - ss. 20 and 20A - listed migratory species
  - ss. 23 and 24A - Commonwealth marine areas
  - ss. 24B and 24C - Great Barrier Reef Marine Park.
- The decision to require a separate assessment process involving the need for the preparation of an EIS under the EPBC Act was made by the Commonwealth on 21 July 2011. A separate assessment report will be completed by both state and Commonwealth jurisdictions respectively.
- In April 2012, EIS Guidelines under the EPBC Act were finalised for the EIS, including assessment requirements for the consideration of specified MNES and for a decision whether or not to grant permission in relation to the application in the GBRMP under the provisions of the *Great Barrier Reef Marine Park Regulations 1983* (GBRMP Regulations).

A.2.1.2 Requirement for an EIS

The PEP EIS has been prepared under two separate sets of ToR, being:

- Coordinator-General's Townsville Port Expansion Project Terms of Reference for an Environmental Impact Statement, February 2012 (ToR) (CG, 2012)
- The Commonwealth DSEWPC and the Great Barrier Reef Marine Park Authority (GBRMPA) Guidelines for an Environmental Impact Statement for the Port of Townsville Port Expansion Project, Queensland, Port of Townsville Limited (EPBC 2011/5979/GBRMPA G34429.1), April 2012 (EIS Guidelines) (DSEWPC, 2012h)

The Project includes an extension of the main navigation channel to the port partly within the GBRMP, which requires an approval under the GBRMP Regulations. The referral under the EPBC Act is taken to be an application under the GBRMP Regulations. The EIS will form the basis of an integrated assessment under both the EPBC Act and the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act).

The PEP EIS is not being undertaken as part of the bilateral agreement between the Commonwealth and Queensland governments for compliance with EPBC Act requirements. The EIS for the PEP fulfils the requirements of both the ToR and the EIS Guidelines, and forms the basis for the two separate assessments by the Coordinator-General, under the SDPWO Act, and DSEWPC, under the EPBC Act. The Commonwealth and state EIS processes are illustrated in Figure A.2.1.

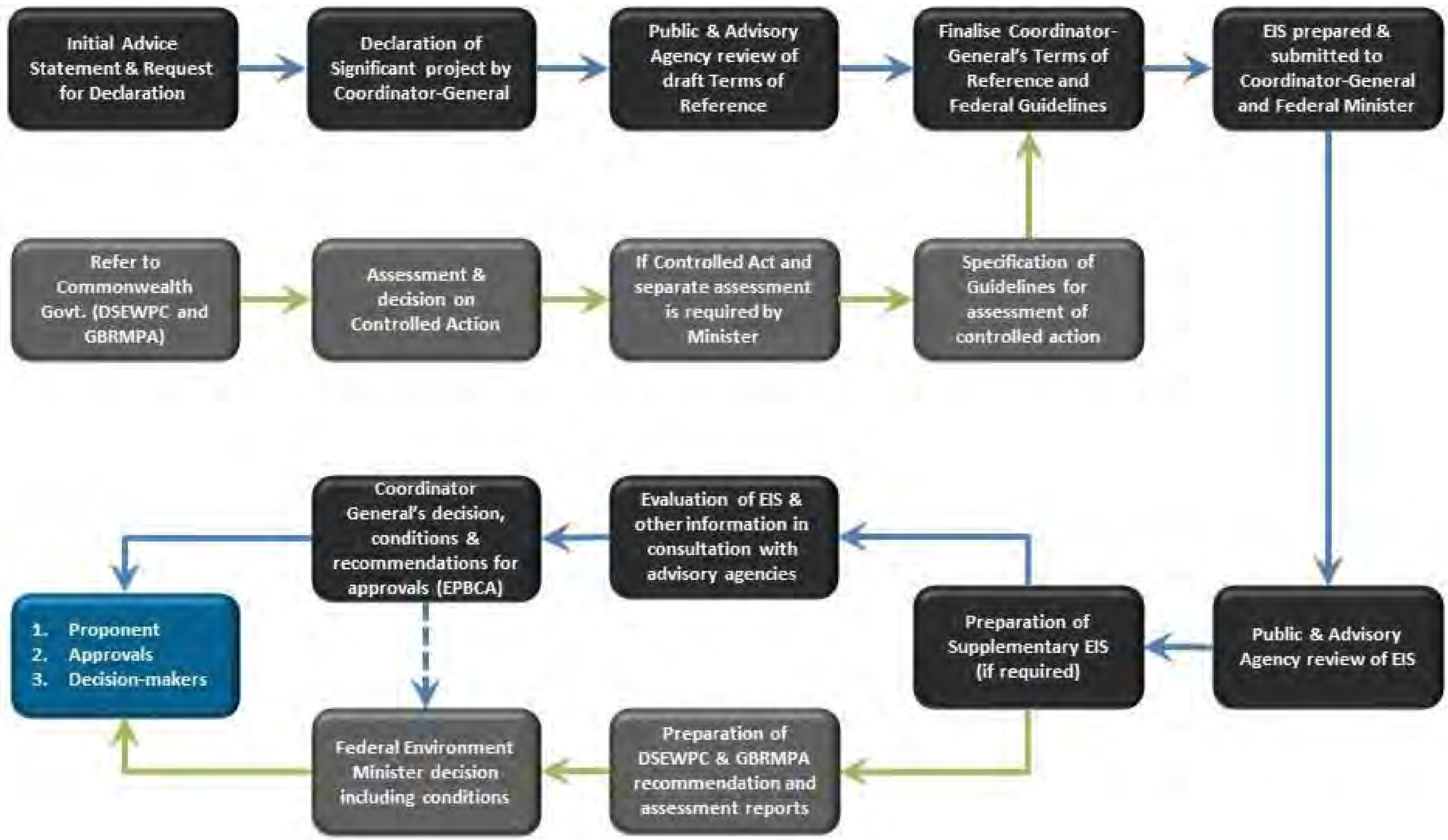


Figure A.2.1 EIS process for PEP

A.2.1.3 EIS Public Consultation and Consideration of Submissions

The draft EIS is required to undergo separate public notification periods, inviting public comment, under Section 103(1)(c) of the EPBC Act and Section 33 of the SDPWO Act. Details specifying the contents of the notice inviting public comment under the EPBC legislation are contained in Regulation 16.04 of the EPBC Regulation 2000, whereas the details specified under the SDPWO Act are contained under Section 34 of the SDPWO Regulation 2010.

The notice containing the above information was approved by the Secretary of DSEWPC in accordance with the requirements of Regulation 16.03(7) of the EPBC Regulations on 17 April 2012. The notice from the Coordinator General enabling the EIS to be published for comment under the SDPWO Act was issued on 16 February 2012.

Viewing or Obtaining Copies of the EIS

The EIS can be viewed or downloaded online at websites for:

- Port of Townsville:

  www.townsville-port.com.au

- Department of Sustainability, Environment, Water, Population and Communities:

  www.environment.gov.au

- Department of State Development Infrastructure and Planning website (Coordinator General's page):

  http://www.dsdip.qld.gov.au/assessments-and-approvals/significant-projects.html

Hard copies of the EIS are available for viewing at the Department of State Development Infrastructure and Planning Office, Townsville; the Townsville City Council local libraries and other accessible locations that have been advertised in subsequent newspaper advertisements.

Making Submissions

People intending to make submissions under the provisions of the EPBC legislation are required to provide such comments to the designated proponent (POTL). The address for submissions under the EPBC Act is:

Secretary of DSEWPC

GPO Box 787

Canberra ACT 2601

Submissions that are intended to be provided under the SDPWO Act are required to be sent to the Coordinator General under Section 34 of the SDPWO Act. Section 35 of the SDPWO Act specifies a minimum public consultation period of 28 days. The address to send a submission under the provisions of the SDPWO Act is:

Coordinator-General

Department of State Development, Infrastructure and Planning

Attention: Project Manager, Port of Townsville – Port Expansion Project

By post: PO Box 15517, City East, Qld, 4002

By facsimile: (07) 3225 8282

By email: tpe@coordinatorgeneral.qld.gov.au

The Coordinator-General must accept all properly made submissions and may accept written submissions even if they are not properly made. A properly made submission is one that:

- is written and signed by, or for, each person (signatory) who made the submission
- states the name and address for each signatory
- is made to the Coordinator-General
- is received on or before the last day of the submission period

Submissions will be forwarded to POTL, as the proponent, for consideration and provision of a response to the Coordinator-General under the provisions of the SDPWO Act.

A.2.1.4 Assessment of EIS after Public Consultation Stage

After the close of the submission period, POTL is required under Section 104 of the EPBC Act to take into account all submissions received and prepare a final EIS document. The final EIS must contain a summary of all comments received and how they have been addressed. Copies of the received comments must be provided to the Minister with the finalised EIS.

A recommendation report will be prepared by DSEWPC. GBRMPA will also prepare an assessment report for components of the proposal requiring permission under the GBRMP Regulations. Following this and in accordance with Part 9, Division 1 of the EPBC Act, the Commonwealth Minister for DSEWPC will decide whether to approve the proposal and attach any conditions to the approval. GBRMPA may subsequently grant permission for actions requiring permission under the GBRMP Regulations, if the minister has decided to approve that component of the proposal under the EPBC Act.

An amended (supplementary) EIS is only required under the SDPWO Act if so directed by the Coordinator General. After the close of the submission period, the Coordinator-General will consider the submissions and the EIS, and prepare a report evaluating the EIS under s. 35 of the SDPWO Act. The Coordinator General may ask the proponent for additional information or comment. This can be included in the form of a Supplementary EIS, if required necessary. The Coordinator-General’s report will include an assessment and conclusion about the environmental effects of the Project and any required mitigation measures. The report may recommend refusal, approval or approval with conditions of the Project. A copy of that report will be forwarded to the proponent and assessment managers for the Project’s development. Depending on the outcomes of the public and advisory agency review and the Coordinator-General’s consideration of the outcomes of the submissions and comments received, the proponent may be required to prepare a Supplementary Report to the EIS that addresses specific matters raised in submissions on the EIS.

Material that will be assessed by the Coordinator General will include:

- the EIS
- properly made submissions and other submissions accepted by the Coordinator-General
- any other material the Coordinator-General thinks relevant to the Project, such as the Supplementary Report to the EIS, comments and advice from advisory agencies and other entities, technical reports, and legal advice.

The Coordinator-General’s report will be publicly notified on the website of the Department of State Development Infrastructure and Planning at www.dsdip.qld.gov.au. The report will also be presented to:

- the proponent
- any prospective assessment manager for any assessable development that is a part of the EIS proposal and as required by the Integrated Development Assessment System (IDAS) under the provisions of the Sustainable Planning Act 2009 (SP Act); this may include POTL and state government assessment managers under Schedule 6 of the Sustainable Planning Regulation 2009 (SP Regulation)
- other Ministers of the Queensland Government as determined by the Coordinator-General.

Subject to the comments from both DSEWPC and the Coordinator General which will be received at the end of the public notification period, POTL intends to submit the finalised EIS to both jurisdictions simultaneously once completed for final assessment and decision.

The PEP has the potential to trigger a variety of legislation, conventions and policies that operate at different levels of jurisdiction. These include:

- legislation, conventions and agreements which operate at a Commonwealth level and have particular relevance to the Project
- state legislation and policies

- local government policy documents and planning instruments where associated development is to occur on land that is not in strategic port land and the land is in the local government planning area, or where local laws may apply under the *Local Government Act 2009*.

Section A.2.6 of the EIS sets out the details of government policy, legislation and associated licence or permit applications relevant to the PEP.

A.2.1.5 Rights of Appeal

The SDPWO Act does not convey specific rights of appeal that relate to the Coordinator General's evaluation of an EIS or a report prepared under section 35 of the SDPWO Act. A right of appeal relating to a development that has been declared a significant project by the Coordinator General, undergone an EIS process and has been the subject of a report under section 35 of the SDPWO Act only applies to such development which requires impact assessment under SPA. In such circumstances, the information and referral stage and the notification stages of IDAS no longer apply to such an application under section 37 of the SDPWO Act.

Submitter rights of appeal only apply to a submitter who has made a properly made submission during the EIS public notification stage. Only such a submission is regarded as a properly made submission with respect to a subsequent impact assessable development application under SPA for which the submitter maintains a right of appeal.

There are no rights of appeal for a development application referred to in the Coordinator General's report which only requires code assessment or which is self-assessable as is specified under the provisions of SPA. Appeal rights by an applicant are preserved under SPA regardless of whether a subsequent application is code or impact assessable. In general, the PEP does not include any aspects of development that are expected to constitute impact assessable development on strategic port land under the provisions of SPA.

Section 27AD of the SDPWO Act precludes judicial review proceedings to be taken against a decision of the Coordinator General under Part 3 of the JR Act as well as precluding certain writs from being issues by the Court regarding mandamus (i.e. an order against a public agency), prohibition (i.e. stopping something that the law prohibits) or certiorari (i.e. an order setting aside a decision) as referred to in section 41 of the JR Act.

There is no submitter right of appeal that applies to a decision made by a port authority for development that has been assessed under a land use plan for strategic port land under the *Transport Infrastructure Act 1994* and which may have been the subject of a report by the Coordinator General under section 35 of the SDPWO Act. The provisions of the JR Act do not apply to a decision of a transport government owned corporation (i.e. which includes the Port of Townsville).

In addition to submitter and applicant rights of appeal with respect to development that is the subject of an EIS and a report by the Coordinator General under section 35 of the SDPWO Act, subsequent development that is assessed under SPA is also subject to the call in powers of the Planning Minister under Division 2, Part 11 of SPA. In this regard, the Planning Minister is able to use the call powers and decide a development application under SPA where the development involves a state interest. This can include consideration of any representations received from interested persons where such interests involve a matter of state interest.

A.2.2 Assessment Methodology Used in the EIS

An overview of the impact assessment process used in the EIS is provided in Figure A.2.2. This is the general approach adopted for each of the technical studies of the EIS. Key risks, impacts and mitigations are summarised. Cumulative impacts are identified and assessed separately. The conclusions and recommendations of the technical assessments and specific data collected as part of the EIS process have established the environmental management parameters and plans for the construction and operational phases of the PEP that are recommended by the EIS.

Risk assessments have been undertaken utilising a standard approach adopted for the EIS, which is discussed in greater detail in Section A.2.4.2. Specialist technical reports that provide detailed descriptions of environmental, social, economic and design information have also been used to support the assessments referred to in the EIS and are included as appendices. The risk assessments, where required, have specified mitigation measures for adverse impacts and the predicted residual impact that is likely to remain, if any, afterwards. In some cases there are impacts that could be considered beneficial. Mitigation measures have been incorporated into the Project's environmental management plans contained in Part C. Where mitigation has not been able to be specified for adverse impacts, and those impacts have been considered to be potentially significant on the natural environment, offsets have been recommended in accordance with Commonwealth and state policy provisions.

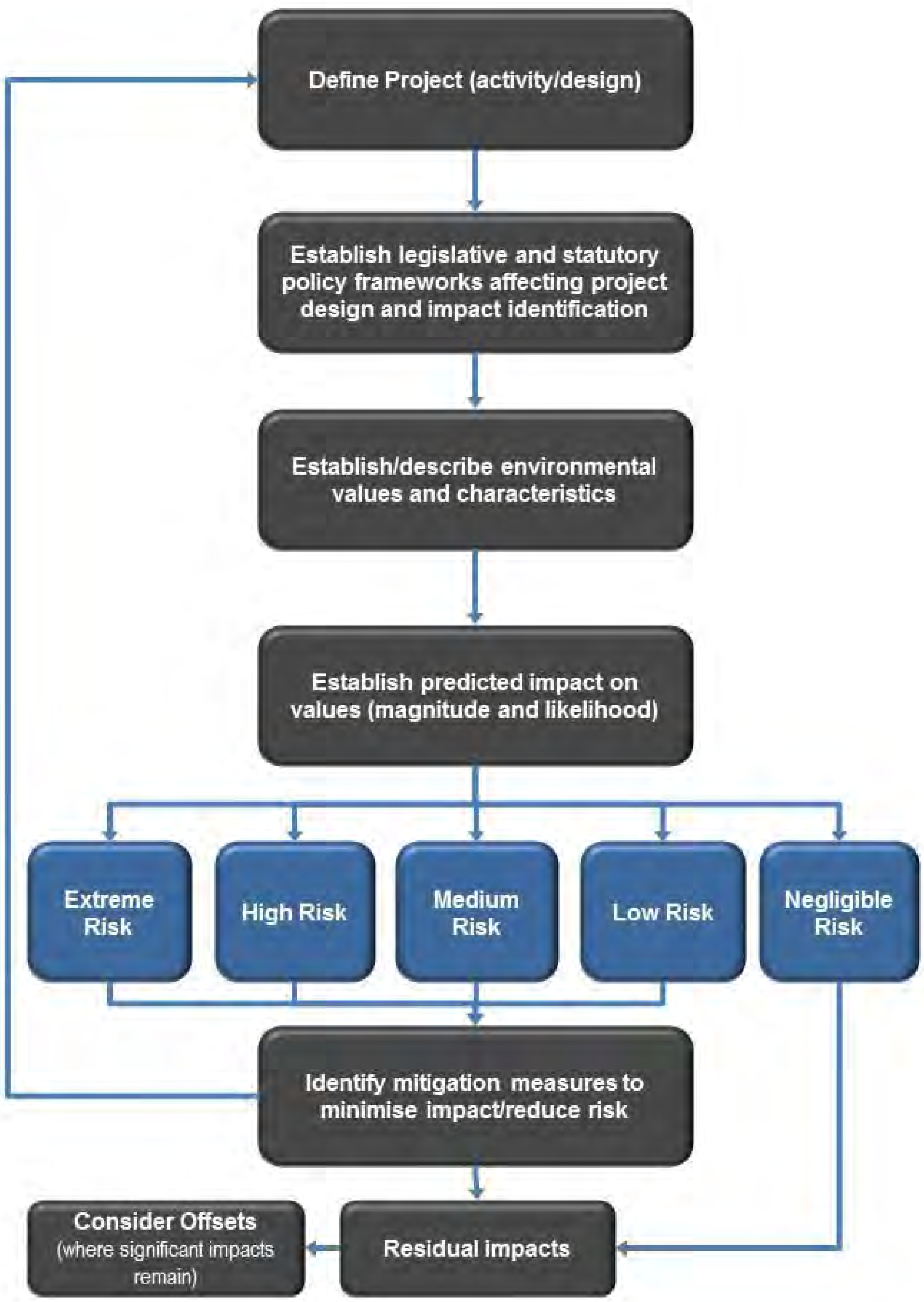


Figure A.2.2 Project impact assessment process

A.2.3 Objectives of the EIS

The environmental assessment of the PEP is influenced by a range of factors including those relating to:

- state, regional, district and local economic and social drivers that focus on economic growth and the port's position and unique role in facilitating such growth
- POTL's mandate and vision for growth of its port facilities in an environmentally sustainable manner, consistent with Commonwealth and state policy and legislative requirements
- strategic opportunities and planned growth capability of the port as identified by POTL
- the port's location in the GBRWHA and its interaction with other MNES
- legislative requirements for detailed and thorough environmental impact assessment under Commonwealth and state legislation (i.e. the EPBC Act and SDPWO Act respectively)
- public opinion and comment in the context of the EPBC Act and the SDPWO Act

The PEP forms a key development outcome of POTL's Port Development Plan 2010-2040 (POTL, 2010a). The plan's vision is to ensure:

Sustainable planning and development of strategic port land that promotes the economic growth of the port and ensures efficient port services while integrating with and enhancing the surrounding community.

POTL's stated vision, in its Port Development Plan 2010-2040, is to be the leader in the provision of innovative, efficient and effective port services, which it strives to accomplish by:

- acting commercially and competitively to promote a sustainable economic future for the port
- providing best practice facilities and services to meet the needs of existing and future tenants
- identifying and securing commercial opportunities
- delivering critical infrastructure to ensure timely and sustainable development of the port
- maximising utilisation of existing resources
- enhancing environmental performance in all aspects of the its operations.

POTL seeks to be a driver of sustainable growth in the region through the delivery of trade, port services and development solutions, while obtaining better utilisation and efficiencies from existing port infrastructure. The PEP forms a significant part of POTL's rationalisation and expansion of operations to provide for enhanced bulk cargo handling capability and overall efficiency of port operations. It is anticipated that as global demand for minerals and other products from the region increases, the PEP will ensure that the region is well placed to effectively realise this trade potential through modern, market responsive, and environmentally sustainable port facilities, available ahead of expected demand and without compromising Townsville's established relationship with its natural environment.

The overall objectives of the EIS are to provide:

- a basis to understand the PEP, the environmental, social and economic values, the potential impacts that may occur as a direct or indirect result of the PEP, and the measures to mitigate adverse impacts
- a framework for assessing the impacts of the Project and associated development in view of legislative and policy provisions
- a mechanism to establish sustainable environmental protection outcomes for the Project, control measures and strategies to be implemented during the construction and operational phases of the Project through environmental management plans
- a basis to establish compliance with Commonwealth and state legislative requirements, including enabling DSEWPC, GBRMPA and Queensland's Coordinator-General to prepare statutory reports enabling formal decisions to be made about the future of the PEP in terms of the Commonwealth EPBC Act and GBRMP Act and the Queensland SDPWO Act..

A.2.4 EIS Format

The EIS consists of three parts intended to provide the following information:

Part A:	Background information about the Project and the proponent to assist in setting spatial, environmental, economic, social and legislative contexts for the PEP
Part B:	Detailed impact assessments of a range of environmental, economic and social risks including residual and cumulative risks as well as recommended mitigation measures for impacts
Part C:	Detailed description and specification of recommended environmental management requirements through specific environmental management plans to be implemented at different stages of the Project using prescribed standards or recommended best practices.
Appendices	Specific technical reports used to support assessments and management recommendations in Parts B and C respectively

The EIS specifically addresses the requirements outlined in the ToR and the EIS Guidelines, including:

- an overview of the proponent and its operations
- a description of the PEP's objectives and rationale, as well as its relationship to strategic policies and plans
- a description of feasible alternatives capable of substantially meeting the Project's objectives
- a description of the entire Project, including associated infrastructure requirements
- descriptions of the existing environment, particularly where this is relevant to the assessment of impacts
- an assessment of direct and indirect, combined, short- and long-term, beneficial and adverse impacts, as well as cumulative impacts in combination with other known activities
- measures for avoiding, reducing, managing and monitoring residual impacts, including a statement of commitment to implement the measures
- an outline of the various approvals required for the Project to proceed
- a description of the stakeholder consultation undertaken and responses to issues that were raised during the stakeholder consultation.

Information contained in the main text is supported by appendices containing relevant data, technical reports and other sources of the EIS analysis. Where appropriate, the main report is supported by maps and aerial photography contained throughout the text of the document.

A.2.4.1 EIS Document and Chapter Layout

The chapters of the EIS address elements of the environment, including land, water, air, noise, nature conservation, cultural heritage, waste, health and safety, as well as social and economic conditions. In presenting this information, these chapters:

- describe the existing environmental values of the area that may be affected by the Project; environmental values are described by reference to background information and studies
- describe the potential adverse and beneficial impacts of the Project on the identified environmental values including any likely environmental harm on the environmental values
- describe any cumulative impacts on environmental values caused by the Project in combination with other known projects
- examine viable alternative strategies for managing or mitigating identified potential impacts. Special attention is given to those mitigation strategies designed to protect the values of any sensitive areas and any identified ecosystems of high conservation value.

The chapters in the EIS provide a means of identifying key elements of the environment and enable specific technical topics to be assessed. Although individual assessments of technical issues form an important part of the EIS, the chapters also support each other in order to provide an integrated and holistic understanding of the environmental effects and potential impacts of the PEP and recommended environmental management requirements. This is further facilitated through the Summary of Key Risks, Impacts and Mitigation for the Project in Chapter B23 and the combined assessment of cumulative impacts in Chapter B24. The chapters, sections and supporting documentation used in the EIS are shown in Figure A.2.3.

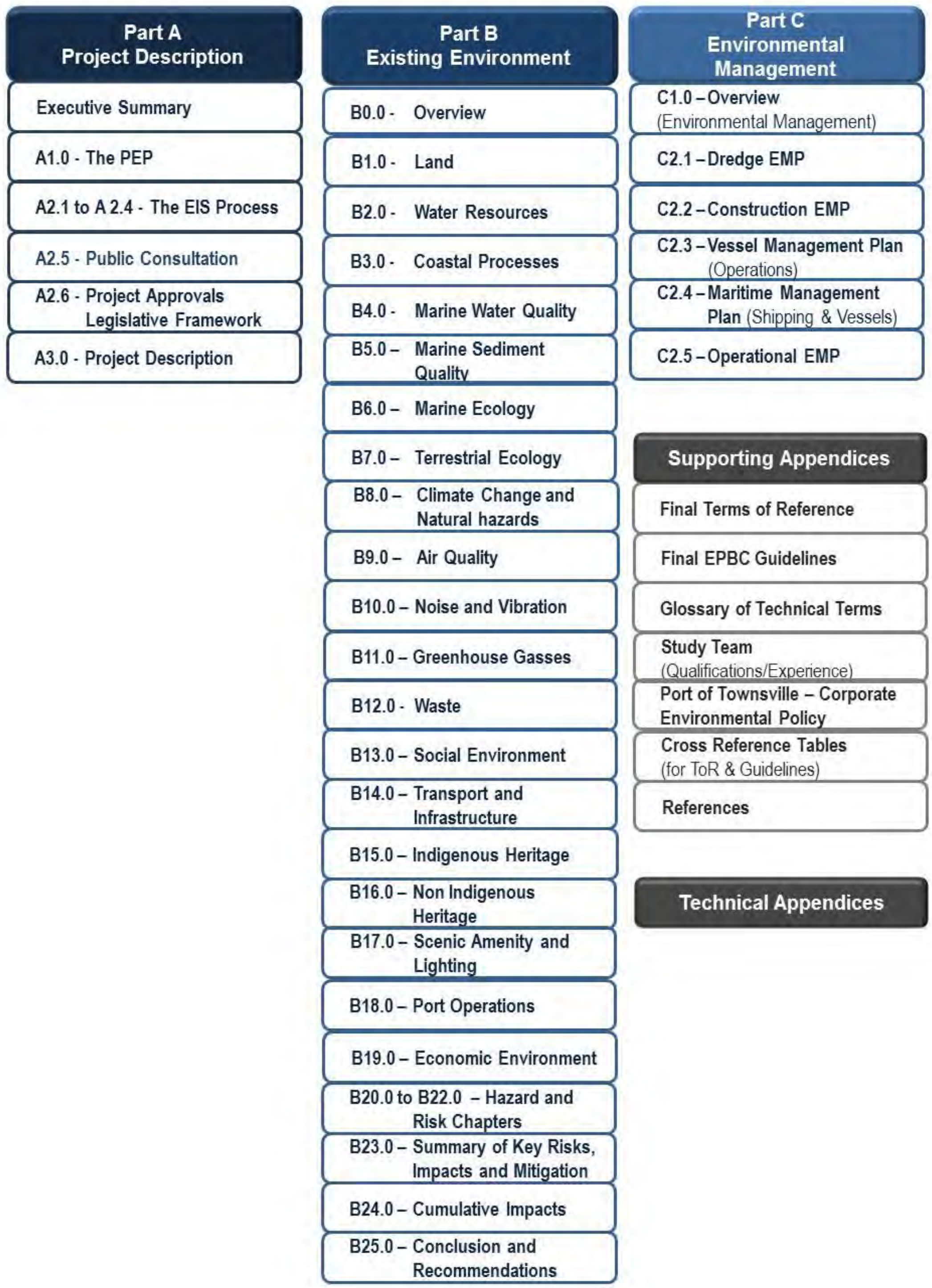


Figure A.2.3 EIS chapter layout

A.2.4.2 Project Risk Assessment Process

The EIS adopts a common risk-based approach used throughout the chapters unless a more suitable issue-specific table has been considered necessary, including where relevant standards have required specific methodologies or parameters to be addressed. The general approach used in the chapters considers:

- magnitude of impact (e.g. consequence), which includes an assessment of the intensity, scale (i.e. geographic extent), duration of impacts and sensitivity of environmental receptors to the impact
- likelihood of impact, which assesses the probability of the impact occurring.

The magnitude of the impact is generally described in terms of the classifications and their respective descriptions shown in Table A.2.1.

Table A.2.1 Magnitude of impact descriptions used in EIS

Magnitude	Description
Very high	The impact is considered critical to the decision making process due to its significance/importance at a national or international scale Impacts tend to be permanent or irreversible or otherwise long-term and can occur over large-scale areas Environmental receptors will generally be of national or international significance and highly sensitive to the impact.
High	The effects of the impact are likely to be important to decision making due to its state significance/importance. Impacts tend to be permanent or irreversible or otherwise long-term and can occur over large or medium scale areas. Environmental receptors will generally be of state level significance and sensitive to the impact.
Moderate	While important at a regional or local scale, these impacts are not likely to be key decision making issues. Impacts tend to be medium or short-term and/or occur over a medium to small (local) scale. Environmental receptors will generally be of regional scale significance.
Low	Impacts are recognisable/detectable but acceptable. These impacts are unlikely to be of importance in the decision making process. Nevertheless, they are relevant in the consideration of standard mitigation measures. Impacts tend to be short-term or temporary and/or occur at local scale. Environmental receptors will generally be of local scale significance.
Negligible	Minimal change to the existing situation. This could include impacts that are beneath levels of detection, impacts that are within the normal bounds of natural variation or impacts that are within the margin of forecasting error.
Beneficial	Any beneficial impacts as a result of the Project, for example, the creation/establishment of new habitat (e.g. rock wall) which encourages suitable substrate for coral growth.

The duration of environmental effects have generally been based on standardised duration of environmental effects classifications and related descriptions listed in Table A.2.2 or otherwise have been based on more detailed descriptions as indicated in the EIS.

Table A.2.2 Descriptions for duration of environmental effects

Duration	Period
Temporary	Days to months
Short-term	Up to 1 year
Medium-term	From 1 to 5 years
Long-term	From 5 to 50 years
Permanent/Irreversible	In excess of 50 years

The likelihood of an impact occurring in terms of any noticeable environmental effects referred to in the EIS is described in terms of the classifications and related descriptions contained in Table A.2.3.

Table A.2.3 Likelihood of impact

Classification	Description
Highly unlikely/rare	Highly unlikely to occur but theoretically possible
Unlikely	May occur during construction/life of the Project, but probability well below 50%; unlikely but not highly unlikely or rare
Possible	Less likely than not, but still appreciable; probability of approximately 50%
Likely	Likely to occur during construction or during a 12 month timeframe; probability greater than 50%
Almost certain	Very likely to occur as a result of the Project construction and/or operation; could occur multiple times during relevant impacting period

The magnitude and likelihood of adverse environmental effects assessed in the EIS have been further classified in terms of the overall likely risk of the impact occurring. Beneficial impacts have generally been highlighted in the impact assessment sections of the chapters but have not been assessed further as these impacts have not been considered as requiring mitigation or further action.

The impact assessment methodology for Matters of National Environmental Significance also considers the Significant Impact Guidelines 1.1 pursuant to the requirements of the EPBC Act.

A risk rating for adverse impacts has been generated for the key impacts to environmental values and has been summarised at the end of each chapter. Risks are based on the combination of likelihood and magnitude according to the classifications shown in Table A.2.4. The risks that are predicted for different impacts represent the risk of the unmitigated impact.

Table A.2.4 Risk matrix classifications

		Magnitude (Consequence)				
		Negligible	Minor	Moderate	High	Very High
Likelihood	Highly unlikely/rare	Negligible	Negligible	Low	Medium	High
	Unlikely	Negligible	Low	Low	Medium	High
	Possible	Negligible	Low	Medium	Medium	High
	Likely	Low	Medium	Medium	High	Critical
	Almost certain	Low	Medium	High	Critical	Critical

Impacts identified in the EIS are considered as either direct or indirect. A direct impact is the result an activity has directly on a receptor or environmental value. An indirect impact is an impact that is not a direct result of the activity, but occurs away from the original source of impact or as a result of a more complex pathway. Indirect impacts arise where impacts from one environmental element bring about changes in another environmental element. Indirect impacts are also referred to as secondary, tertiary or higher level impacts, depending on the number of steps between the original source and its impact.

A.2.4.3 Impact Mitigation

Mitigation measures are recommended actions that are intended to reduce the overall level of risk for specific adverse impacts. The measures provide the basis for the more detailed environmental management measures that are specified in Part C of the EIS. Where possible, mitigation measures have been recommended using existing implementation frameworks applying to the port or surrounding land (e.g. existing port consultation forums, environmental management procedures and practices, POTL and council planning instruments).

Mitigation measures include measures to avoid or reduce impacts as part of the design, layout, construction methods, materials to be used in the Project or otherwise through the application of best practice environmental management measures as part of environmental management plans or similar. Impacts for each chapter are summarised at the end of the chapter.

A.2.4.4 Residual Risk and Impact

Residual risks are those risks of continued environmental impact, once mitigation measures have been applied. The residual risk should be lower than the unmitigated risk. Where no change in the risk is possible or unlikely to be effective in any appreciable way and the predicted impact remains significant (i.e. ‘High’ or ‘Critical’), offsets have been proposed by the EIS where an opportunity for such to occur exists (see Section B23.2).

A.2.4.5 Cumulative Impacts

The EIS also assesses the impacts of the Project on social, economic and environmental values when considered with those of other projects in the area (cumulative impacts), especially where they are expected to overlap with the construction of the PEP. Cumulative impacts are assessed in Chapter B24 of the EIS. Key factors that have been identified as influencing the assessment of the cumulative impacts of the PEP include the scale of the Project relative to the area, the population of Townsville and the region, the region’s economic diversity and the biodiversity in Cleveland Bay.

A.2.4.6 Supporting Documentation

The EIS relies on a number of detailed technical analyses that:

- specify marine ecological and hydrodynamic baseline conditions
- model environmental effects, particularly for marine water quality, air quality and noise conditions
- predict economic or engineering outcomes based on critical assumptions
- specify or detail design drawings
- state POTL policy frameworks used for the operation of the port.

This information is provided in a series of separate reports contained in appendices to the EIS. The findings of these reports are included in the assessment of the key environmental impacts in Part B of the EIS.

A.2.5 Public Consultation

Community and stakeholder engagement facilitates community understanding of the PEP and serves the objectives of information sharing, community inclusion and reputation management.

A.2.5.1 Approach and Processes

POTL conducted consultation activities during the EIS preparation in order to understand and manage concerns raised by the community and stakeholders. This helped with framing technical studies and further planning for the Project’s planning, design and assessment. In addition to the legislative requirements of the EIS, consultation was designed to facilitate community understanding and acceptance of the PEP, and to provide opportunities for community concerns to be addressed during the EIS investigations.

Refer to Appendix E1 Section 3.0 (Community and Stakeholder Engagement Report) for more details.

A.2.5.1.1 Consultation Overview

Formal consultation (Phase 2) commenced on 16 July 2011 following Project inception (Phase 1) and the development of a Community and Stakeholder Engagement Plan to guide the consultation process (Appendix E1).

The early phase of the consultation program was undertaken to inform stakeholders of the Project and identify issues for inclusion in the EIS and concluded with the release of the Draft ToR on 29 October 2011 by the Department of Employment, Economic Development and Innovation.

Phase 3 supported the release of the Draft ToR for public comment during November 2011 and release of the final ToR on 17 February 2012. In addition to advertisements in local print media, registered interested parties and key stakeholders were contacted for awareness of the release of the Draft ToR, the resulting opportunity to make a submission and the timeframes of the submission process, including closing dates. These stakeholders were also made aware of the release of the final ToR.

DSEWPC released Draft EIS Guidelines for public comment on 30 January 2012. The final EIS Guidelines were released on 17 April 2012. A process of informing key stakeholders and registered interested parties of the release of the draft and final EIS Guidelines was undertaken.

Following the Coordinator-General’s acceptance of the Draft EIS, the document will be subject to a public exhibition period. As part of this exhibition, POTL will arrange:

- staffed public information displays in publicly accessible locations in Townsville
- advertising to promote information displays in local media
- attendance at stakeholder and regulator briefings as required
- static display(s) at Townsville City Council Library/Council
- Project hotline, email address and reply paid postal address
- updated and new communication collateral on POTL website
- email updates to registered stakeholders including elected representatives, primary stakeholders, special interest groups and the community.

Stakeholders will be advised of the outcome of the EIS process.

A.2.5.1.2 Objectives

The objectives for community and stakeholder engagement were to:

- provide a framework for engagement of and communication with the local community to mitigate risks that local community opposition could present to the PEP
- deliver an appropriate community consultation process in accordance with the requirements of the EIS process
- facilitate the building of relationships with members of the community and stakeholders through trust, transparency and mutual respect
- provide ongoing opportunities for community and stakeholder participation at appropriate intervals in the EIS process using a range of mechanisms
- openly engage to identify broad issues of concern to the local community, stakeholders and interest groups
- provide mitigation strategies for identified issues
- facilitate the Project team’s understanding of community and stakeholder issues and how these relate to the content of the EIS
- ensure the engagement mechanisms consider matters including accessibility, relevance, varying levels of understanding and participation
- build opportunities for community and stakeholder acceptance of the PEP
- manage community and stakeholder expectations about their level of influence over Project outcomes

- at the Project level, support POTL's goal to obtain approval of the EIS from the Coordinator-General's office
- facilitate the delivery of the Project within the required timeframe
- undertake engagement from Project planning through to Project completion
- close the communication loop by providing appropriate and timely feedback to participants and the broader community on both the outcomes of the engagement process and how input has been integrated into the Project and issues addressed.

A.2.5.1.3 Consultation Phases

The consultation and public comment phases of the EIS process for the Project occurred as illustrated in Figure A.2.4. The community and stakeholder consultation program fulfils the legislative requirements of the provision of adequate opportunities for engagement and public comment. The first phase shown below is reserved for internal Project establishment and alignment.

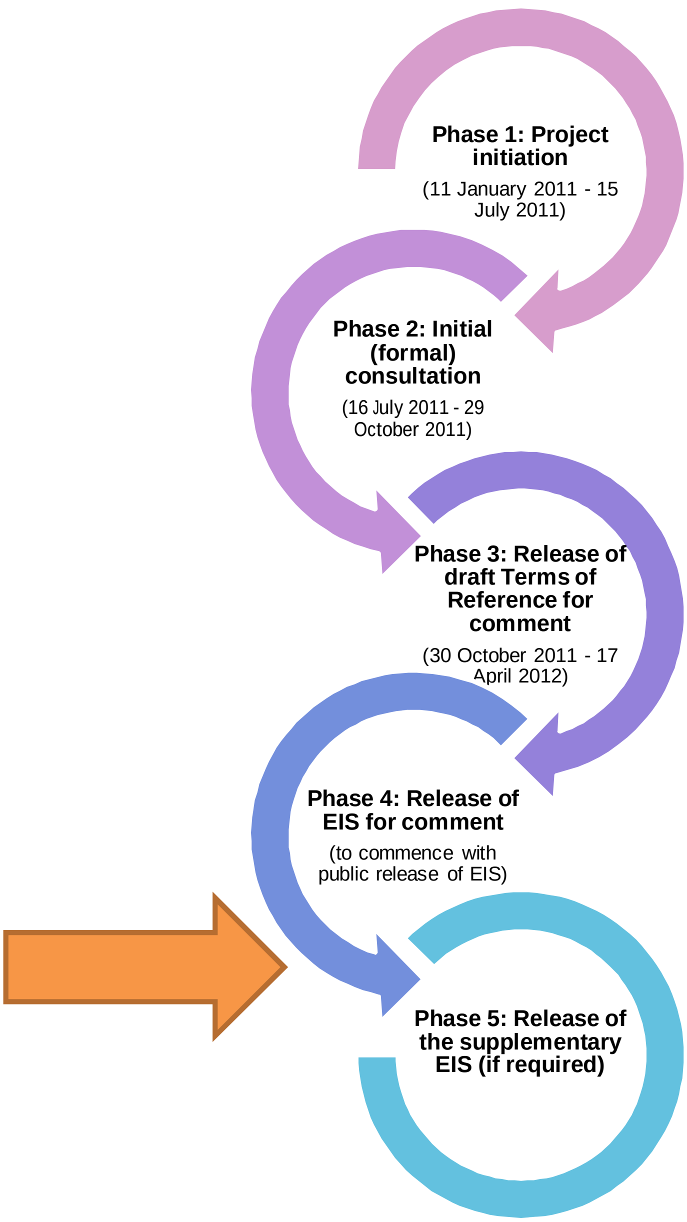


Figure A.2.4 Five phases of community consultation

The communication and engagement mechanisms, activities and objectives established for the EIS process will be maintained and will remain active throughout the construction and operation phases of the Project.

Continuity of contact points, messages and engagement will support continued Project understanding in the community and maintain and further develop key relationships with stakeholders and the community.

A.2.5.1.4 Stakeholder Identification

Stakeholders were identified by their geographical proximity to the Project, as well as those with an interest in the Project. The suburbs of South Townsville and Railway Estate are located in closest proximity to the lower reaches of the Ross River. Residents of South Townsville, North Ward and Magnetic Island generally have an interest in the activities at the mouth of the Ross River and Ross Creek from an employment, recreation and amenity perspective. Residents of the broader Townsville area have an interest in the commercial and employment opportunities extending from the port.

Identified stakeholder groups consulted as part of the consultation process include:

- residents of Townsville and wider community
- port operators and businesses
- community interest groups/environmental interest groups
- regional industry groups
- elected representatives
- local government
- state and Commonwealth agencies and departments
- regulatory agencies and authorities
- traditional owners.

In addition to those identified above, there were a number of stakeholders who contacted the Project team and expressed an interest in the Project. These stakeholders were added to the database to be included in consultation activities.

Refer to Appendix E1 Section 3.3 (Community and Stakeholder Engagement Report) for a full list of stakeholders.

A.2.5.1.5 Community and Stakeholder Consultation Techniques

A number of methods were used to provide information and gather input from stakeholders and community members. These techniques were selected as they served a number of consultation objectives and facilitated the involvement of different stakeholder and special interest groups. Table A.2.5 provides a summary of consultation activities undertaken to date.

Table A.2.5 Summary of consultation techniques and activities

Activity	Overview	Outcome
Stakeholder database	Consultation contact made through various engagement activities was recorded on the stakeholder database	277 stakeholders are registered in the Project database
1800 telephone number	A 1800 number was established for the Project to enable the community to contact the consultation team. The number was listed on Project materials and communication	Three telephone enquiries were received during the consultation period
Email	A dedicated Project email address was established and included on Project materials and communication	Thirty-two email enquiries were received during the consultation period
Stakeholder letters	Letters providing an overview of the Project and information about upcoming consultation were mailed	Forty-eight letters were mailed out to key stakeholders in September 2011 The second set of letters was sent in

Activity	Overview	Outcome
	out, accompanied by copies of fact sheets, feedback forms and contact cards. Letters were also sent out to advise stakeholders of the release of the Draft ToR for public comment, as well as to accompany a series of technical fact sheets	November 2011 Stakeholder letters were also sent in April, June and August 2012 accompanying copies of the technical fact sheets
Website	Information about the PEP was uploaded to the POTL website	
Project advertising	Information sessions were advertised in local newspapers and on local radio stations	Advertisements were placed in the *Townsville Bulletin* (five editions), the *Townsville Sun* (one edition) and the *Magnetic Island Community News* (two editions) Radio advertising was on 106.3FM and Zinc 100.7 (total 44 spots)
Reply paid post	The reply paid post service provided the community with a free and easy means to submit feedback forms and submissions	Eight pieces of reply paid mail were received during the consultation period (excluding feedback forms)
Fact sheets	Two overarching general fact sheets were developed to provide the community with general information on the Project, responses to common questions, and a summary of the outcomes of key technical assessments presented in lay terms Additionally, a series of three technical fact sheets were developed to outline important studies underway as part of the EIS	Five fact sheets were distributed (via mail and email) Fact sheets were also made available at community information sessions and on POTL website, as well as other public places
Feedback form	A feedback form was developed to ensure targeted feedback from the community and key stakeholders could be submitted and trends tracked Respondents were asked questions to ascertain their knowledge of the Project, what they thought about it, the impacts of the Project and important information about their local community	A total of 119 feedback forms were received from: ▪ neighbouring residents (45%) ▪ local community (broader public) (33%) ▪ local business (12%) ▪ port users (2%) ▪ other (visitors, anonymous) (8%)
Project contact card	Project contact cards were developed as a quick reference guide for stakeholders and community members The cards directed stakeholder contact through the AECOM community consultation team and promoted the 1800 hotline, Project email address, reply paid address and POTL website	Contact cards were available at briefings, meetings and information sessions
Group emails	Group emails were sent to inform the community and key stakeholders of consultation activities and key	Six group emails were sent to 128 addresses per email

Activity	Overview	Outcome
	milestones (such as the release of the Draft ToR), as well as to distribute collateral	
Community information sessions	AECOM organised and facilitated four community information sessions held in Townsville and on Magnetic Island in July and October 2011 The sessions provided opportunities for community members to learn about the Project and the EIS process, as well as ask questions and provide feedback	A total of 76 people attended the information sessions
Australia Post mail out	Four unaddressed mail outs were undertaken The first served to advise the community about the PEP and provide details on the community information sessions held in October 2011 The second, third and fourth mass mail outs served to distribute three technical fact sheets to the community in April, June and August 2012	The first mail out was distributed to 8,576 residences and the latter distributed to a total of 9,440 residences across ten suburbs: Belgian Gardens, Castle Hill, Magnetic Island, North Ward, Pallarenda, Railway Estate, Rowes Bay, South Townsville, Townsville City and West End
Poster distribution	A poster drop advertising the community information sessions held in October 2011 was carried out. The poster content replicated the print advertisements for the community information sessions	Posters were dropped at 54 locations in South Townsville, The Strand and on Magnetic Island
Stakeholder briefings	During consultation, key stakeholders were engaged one-on-one and through working groups to encourage meaningful dialogue about the PEP	A total of 13 briefings were undertaken with key stakeholders, including elected members and industry groups, whole of government briefings, community and environmental groups and endorsed Aboriginal parties, between October 2011 and June 2012

Refer to Appendix E1 (Community and Stakeholder Engagement Report) Section 4.0 and Appendix B for a summary categorised by stakeholder of materials produced and methods used throughout the consultation process.

A.2.5.2 Findings and Interests

The following section summarises feedback received during the first three phases of consultation. The figures and comments provided are a summary of the feedback received specifically in relation to the PEP. Other issues not related to the PEP have been forwarded to POTL for their information and action as appropriate.

A.2.5.2.1 Composition of Respondents

During consultation, POTL received 119 completed feedback forms, 32 email enquiries, 8 letters and 3 phone calls in response to the PEP. Of the responses received, 70% were from neighbouring residents or the wider public, as illustrated in Figure A.2.5.

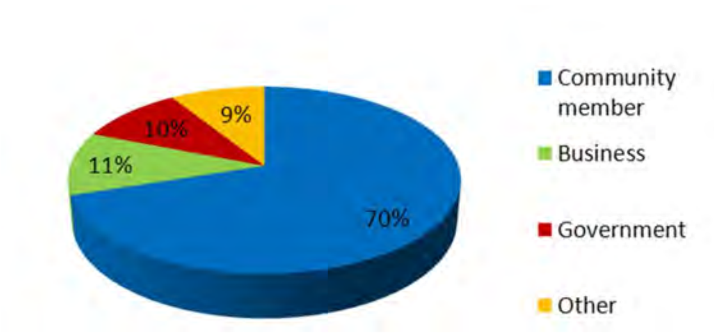


Figure A.2.5 Composition of respondents

A.2.5.2.2 Issues and concerns

Table A.2.6 provides a summary of the matters of interest raised throughout the consultation program and a cross-reference to sections of the EIS that relate to those matters. These issues and concerns informed the social impact assessment conducted and have been incorporated into other technical studies and assessments.

POTL's commitment to continued engagement with the community and stakeholders extends beyond the PEP EIS. Feedback received during the PEP EIS process will also be used to inform future POTL activities. The ongoing engagement will complement POTL regular communication practices and foster opportunities for the collection of feedback and the communication of those actions and resolutions.

Refer to Section A.2.5.2.3 for relative frequency of key matters of interest.

Table A.2.6 Summary of matters of interest raised by respondents

Matters of Interest	Relevant EIS Section
Growth and development	
Adequate consideration of the Project footprint	A1.0, B24.5
Management of current electricity infrastructure	A1.0, B21.0
Economy	
Concern over the impact of increased shipping traffic on fishing grounds and potential loss of fishing grounds	B18.0, B19.0
Economic impacts and associated employment	B19.0
Potential impact on local housing market	B19.0
Noise, dust and visual amenity	
Potential impacts on visual amenity of the foreshore	B17.0
Concern that the port is not particularly attractive already; need to ensure the PEP does not contribute further to negative visual amenity	B17.0, B24.5
Need to manage the impact of noise and dust during the construction and operational phases	B10.0, B23.0, C2.2
Concern about black dust which is believed to originate from the port and impacts on the surrounding residential area	B9.0, B23.0
Environment	
Potential impact on the marine environment	B4.0, B5.0, B6.0, B24
Potential impact on the broader Townsville environment	B1.0, B7.0, B8.0, B24.5
Potential impact on shorebird and migratory bird breeding/roosting areas	B7.0, B24.4
Potential impact on local marina fauna, in particular the Australian Snubfin Dolphin	B6.0, B24.3
Potential to contribute to the cumulative impacts port expansions may have along	B0.2, B3.0, B4.0, B5.0, B6.0,

Matters of Interest	Relevant EIS Section
the Great Barrier Reef. There is a need to assess the collective impacts from other projects	B8.0, B23.1, B24.0
EIS process needs to clearly demonstrate how impacts will be prevented, managed or mitigated	B23.0, Part C
Impact of dredging on local reefs and shoals, particularly around Magnetic Island	B3.0, B4.0, B5.0, C2.1
Level of tidal flows/hydrological impacts	B3.0, B4.0, B5.0
Adequate management of waste	B12.0
Level of impact on sea grass habitat (and dugongs and turtles)	B4.0, B5.0, B6.0, B23.1.1, B24.2.3, B24.3
Level of impact on erosion of The Strand and other beaches	B3.0, B5.0
Concern that economic benefits from the Project will outweigh the need for strict environmental controls	B13.0, B19.0, B23.1.3
Interest in exploring appropriate environmental offsets	B23.2
Uncertainty of future export/import products and the associated impacts on environmental amenity	B18.0
Transport	
Transport impacts (noise and dust) are an issue for residents in South Townsville and there is concern these impacts will worsen	B10.0, B14.0
POTL need for a transport strategy which better incorporates rail and road with port infrastructure to reduce traffic impacts (including noise and dust) on local residents	B10.0, B14.0
Concern about potential relocation of the ferry terminal as part of the PEP and the impacts this would have on residents of Magnetic Island and tourists	B13.0, B14.0
Impact on pedestrians and cyclists	B13.0
Impact on recreational and commercial boat operators	B14.0
Communication and consultation	
Need for transparency in the environmental elements of the EIS and demonstrate how water quality/ocean will be protected through an environmental management plan	Part C
Need for transparency and communication about plans for the PEP so the community can properly assess the outcomes	Part A
Lifestyle	
Protection of human health during construction and operation of PEP	B20.0

Note The table covers only issues and concerns; affirmative feedback and nature of responses have not been included here.

A.2.5.2.3 Key issues

Community and stakeholder feedback helped identify key issues relating to the PEP and their relative level of significance. Key issues have been categorised and are outlined in Figure A.2.6 below. The frequencies used in the following section represent the number of times an issue was raised, not the number of respondents; in many cases, respondents provided more than one comment or answer to a question.

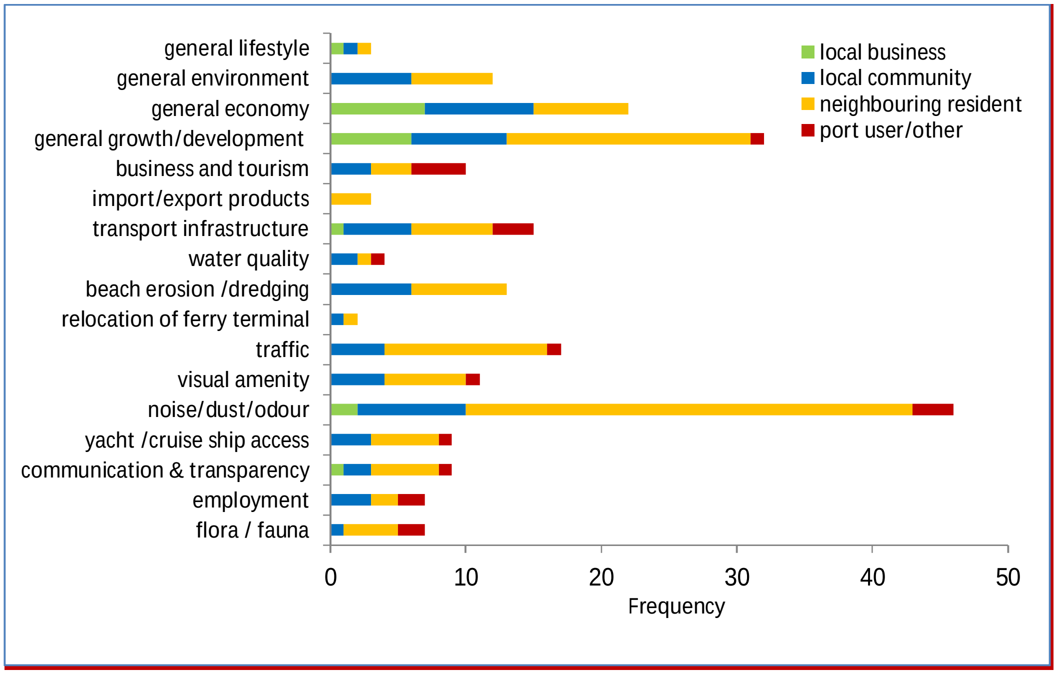


Figure A.2.6 Key issues raised by stakeholders in written feedback

Of the issues raised, 53% of responses were provided by neighbouring residents, 28% from local community members, 10% from local businesses and 9% from port users or other interest groups1.

A.2.5.2.4 Community Attitudes

Although, there was some divergence among the community about the benefits the PEP would provide to the area, the majority of respondents felt it would be 'good for the community' overall (Figure A.2.7).

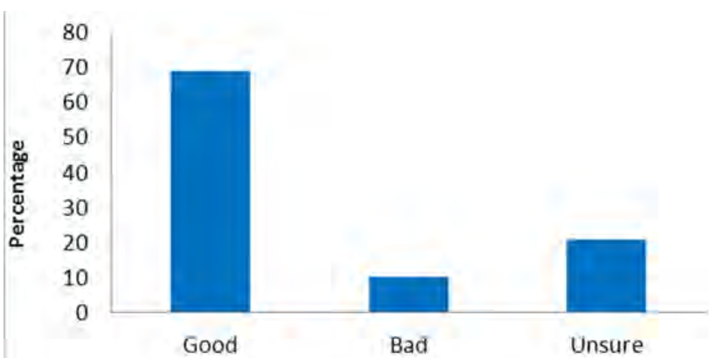


Figure A.2.7 Community attitudes toward the PEP

While 69% of respondents felt the PEP would be 'good for the community', particularly the local economy and employment opportunities, there was concern about environmental impacts (such as visual amenity and noise). Less than a quarter (21%) of respondents were unsure of the overall value of the PEP to the community, with much of the uncertainty based around potential environmental impacts, such as increases in noise, dust and heavy vehicles in the area.

[1] N.B. These frequencies are based on the number responses given (issues raised); not on the number of feedback forms received (respondents).

Just 10% of respondents felt the PEP would be 'bad for the community' overall, believing negative impacts on lifestyle, beaches and the environment outweighed any positive impacts associated with employment or the local economy.

A.2.5.2.5 Potential PEP Impacts

To ascertain the potential impacts of the PEP, feedback respondents were asked to rate the impact (varying from very positive to very negative) that they thought the Project would have on a series of categories (Figure A.2.8). Responses were rated as:

- very positive (5)
- positive (4)
- neutral (3)
- negative (2)
- very negative (1)
- unsure (0).

The two highest scoring impacts were the local economy and employment, with just over 46% of the total respondents stating the economy would be very positively impacted by the PEP and 36% stating that local employment opportunities would be very positively impacted.

The lowest scoring Project impact was the environment. In total, 21% of respondents believed the environment would be very negatively impacted by the PEP; conversely, approximately 5% of respondents stated the PEP would very positively impact the environment. Although many respondents indicated the PEP may negatively impact the environment, they believed POTL would act responsibly in managing the PEP to reduce and control the nature and extent of impacts. The two main potential environmental impacts noted were noise and dust. Other community concerns raised included the impacts on roads and rail, the potential increase in road traffic, products to be transported through the port and the impact on the Great Barrier Reef.

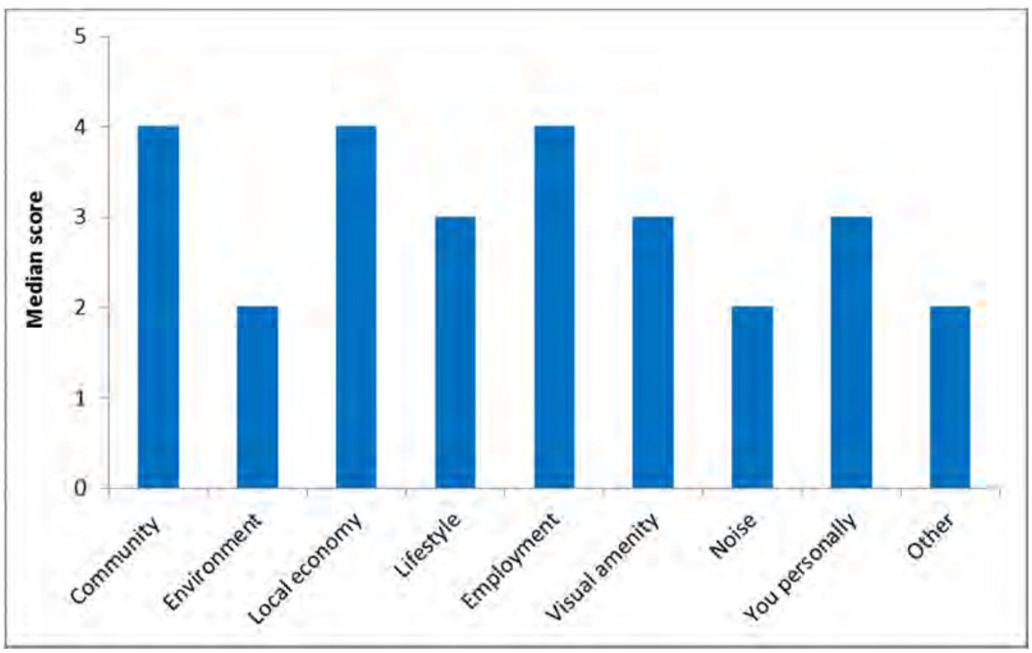


Figure A.2.8 Initial community perception of potential PEP impacts

A.2.5.3 Conclusion

Community consultation has raised interest from key stakeholders with particular regard to matters relating to the environment, the adjacent community, economic growth and employment. Consultation for the Project has also captured feedback on POTL operations from an active group of South Townsville community members. Overall, the community engagement activities undertaken during the past and recent phases of consultation have confirmed:

- there is strong support for the Project based on economic and employment indicators; however, potential environmental impacts are of concern and are expected to be managed appropriately and transparently
- the community appreciates positive action from POTL, such as the installation of park infrastructure and planting of trees, which positions it as a ‘good neighbour’
- concerns around mitigating noise, light and dust reinforce that they need to be managed
- dredging and the associated potential impacts on the Great Barrier Reef is of particular concern and need to be addressed
- there is a need to consider existing and future transport infrastructure (roads and rail) with regard to an increase in port traffic
- the community is concerned about ‘products’ that may be transported through the port.

A.2.6 Project Approvals and Legislative Framework

A.2.6.1 Overview

This section addresses the statutory approval, licensing and certain formal notification requirements (i.e. collectively referred to as ‘approvals’ in this assessment) that relate to the scope of works. Approvals for further development as part of the operational phase of the PEP (i.e. by prospective tenants once reclamation and servicing of the site has been completed) will be dealt with under separate approval processes. This will occur when the land is reclaimed and is granted tenure and will be determined by the SP Act and POTL’s Land Use Plan (POTL, 2010b). Other legislation may also provide specific requirements for approvals that may apply (e.g. EP Act in relation to any material change of use application for an Environmentally Relevant Activity – ERA).

The need for approvals is prefaced by a description of international conventions and treaties that, in part, form a basis for certain types of Commonwealth and state approvals. Approvals are considered in terms of Commonwealth, state and local government jurisdictions and deal solely with matters that are referred under specific legislation. Detailed assessment criteria associated with those approvals are not considered in this section. More detailed assessment requirements are considered in each of the technical chapters of the EIS under the section heading entitled ‘Assessment Framework and Statutory Policies’.

The legislation that applies to the PEP is discussed in terms of its general intent and operation with a separate, more detailed table (Table A.2.7) providing the likely context of the approval requirements for the PEP. The table includes:

- legislation name
- trigger – matter(s) which are likely to lead to the need for an approval
- approval name
- relevant agency/ies
- comments
- available application form/further information
- approval type (i.e. formal approval, licence/permit, notification, or other).

A.2.6.2 International Convention/Treaty Obligations

International conventions are agreements between sovereign states that may or may not be followed by more formal treaties. A treaty is a formal agreement between sovereign states that has a basis under international law. A treaty may also be dealt with by the United Nations as a collective of agreeing and representative sovereign states.

The relevance of the various conventions is reflected in legislation enacted by the Commonwealth and state government and in many instances forms a key basis for approvals and associated assessment that must be sought and undertaken. The EPBC Act is the main vehicle for conditions of environmentally-based international conventions/treaties to be adopted into national law.

Australia is party to a number of conventions that potentially affect environmental management in and around the PEP. These conventions relate to the waters within and adjacent to the boundaries of the Port of Townsville, notably Cleveland Bay and the GBRWHA; foreshore areas adjacent to Cleveland Bay that contain internationally recognised wetlands; and the protection of a range of migratory species.

A.2.6.2.1 Convention concerning the Protection of the World Cultural and Natural Heritage 1972 (World Heritage Convention)

The World Heritage Convention defines 'natural heritage' as any natural features, geological and physiographical formations and natural sites of Outstanding Universal Value (OUV). OUV is defined by the convention as '*cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity*'. Sovereign states, including Australia, that are parties to the convention agree to identify, protect, conserve, present and rehabilitate world heritage properties. They agree, amongst other things, as far as possible to the extent that values relate to the property, to:

- 'adopt a general policy that aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of that heritage into comprehensive planning programs'
- undertake 'appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage'.

A.2.6.2.2 International Convention for the Regulation of Whaling 1945

The convention establishes agreed rules for the protection of whales and other cetaceans through the International Whaling Commission.

A.2.6.2.3 Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

The convention aims to conserve terrestrial, aquatic and avian migratory species throughout their range. The convention acts as a framework for a number of other agreements, including memorandums of understanding. The protection of dugongs and their habitat is specifically mentioned by the convention. Related agreements that deal with migratory species include:

- agreement between the government of Australia and the government of Japan for the protection of migratory birds in danger of extinction and their environment (JAMBA)
- agreement between the government of Australia and the government of the People's Republic of China for the protection of migratory birds and their environment (CAMBA)
- the partnership for the conservation of migratory waterbirds and the sustainable use of their habitats in the east Asian–Australasian flyway (Flyway Partnership)
- agreement between the government of Australia and the government of the Republic of Korea on the protection of migratory birds, and exchange of notes (ROKAMBA).

A.2.6.2.4 Convention on Biological Diversity 1993

The convention has three main objectives:

- the conservation of biological diversity
- the sustainable use of the components of biological diversity
- the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

The convention acts as a framework for a number of separate protocols and targets. The Aichi Biodiversity Targets form a key component of the convention and have a number of strategic goals:

- Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
- Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use

- Strategic Goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity
- Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services
- Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building

A.2.6.2.5 United Nations Framework Convention on Climate Change

The key aim of the convention is preventing 'dangerous' human interference with the climate system.

A.2.6.2.6 Maritime and Shipping Related International Conventions

Australia is party to a number of different conventions that affect shipping activity, safety and the mitigation against adverse environmental effects. These include:

- International convention on the control of harmful anti-fouling systems on ships 2001
- International convention on civil liability for bunker oil pollution damage 2001
- International convention on civil liability for oil pollution damage 1992
- International convention on the establishment of an international fund for compensation for oil pollution damage 1992
- Convention relating to intervention on the high seas in cases of oil pollution casualties 1969
- International convention for the prevention of pollution from ships
- Protocol on preparedness, response and cooperation to pollution incidents by hazardous and noxious substances 2000
- International convention on oil pollution preparedness, response and cooperation 1990
- Protocol to the international convention on the establishment of an international fund for compensation for oil pollution damage 1992
- Convention on the prevention of marine pollution by dumping of wastes and other matter 1972

A.2.6.2.7 Convention on Wetlands of International Importance 1971 (Ramsar Convention)

The convention's mission is 'the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world'. In Australia, Ramsar wetlands are recognised as a matter of national environmental significance under the EPBC Act. The nearest Ramsar wetland to the PEP is the Bowling Green Bay Wetland. The wetland is listed as a Ramsar wetland of international importance and is located in the lowland sections of the Bowling Green Bay National Park. Although part of the wetland is located approximately 9 km south-east of the PEP in part of Cleveland Bay, the majority of the wetland is located around Bowling Green Bay to the east of the Cape Cleveland headland.

The proposed reclamation, dredging and dredge material disposal activities are not expected to adversely impact on the wetland either directly or indirectly (as is demonstrated further in the EIS).

A.2.6.3 Commonwealth Legislation

Commonwealth legislation of most relevance to the PEP includes:

- *Native Title Act 1993* (NT Act)
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Great Barrier Reef Marine Park Act 1975*
- *Maritime Transport and Offshore Facilities Security Act 2003*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act)

A.2.6.3.1 Native Title Act 1993

Native Title is regulated at a national level through the NT Act. Activities on land that may constitute a future act under the legislation must be in accordance with a native title determination by the National Native Title Tribunal (NNTT), an application before the NNTT or an Indigenous Land Use Agreement affecting the land and must be notified to the NNTT for confirmation before the activity is undertaken.

The requirement for native title notification to undertake works includes the proposed use of Unallocated State Land. This applies to the area to be occupied by the PEP.

A review of the NNTT Claimant Application Summary information and associated map for Queensland shows that there were no claims affecting the PEP at the time the EIS was prepared. POTL intends to apply for a perpetual lease for the reclamation area pursuant to section 24HA of the future provisions of the NT Act. However in the longest term, POTL would like to freehold the reclamation area and negotiate an ILUA with the appropriate traditional owners at that time. POTL has a good working relationship with local traditional owners, who have worked with POTL to develop a cultural heritage management plan for the project under Queensland Legislation (see Section A.2.6.4.3).

A.2.6.3.2 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth’s primary environmental legislation is the EPBC Act. The EPBC Act protects and manages nationally significant environmental and heritage matters by setting up a framework for assessing development and, in so doing, enables Australia to address its obligations under a number of international conventions that it is a signatory to and which affect environmental management outcomes. The listing of Matters of National Environmental Significance (MNES) identifies many of the matters for which Australia has international obligations to protect, conserve and manage.

The PEP was referred to the Minister for DSEWPC on 26 May 2011 for consideration as an action that could result in potentially significant impact on MNES. The delegate of the minister determined that the proposal constituted a ‘controlled action’ under the provisions of the EPBC Act on 1 July 2011 and on 21 July 2011 determined that an EIS would be required for the proposal. The EIS Guidelines were finalised in April 2012 and will form the basis for the Commonwealth’s assessment of likely impacts and any required mitigation measures to protect MNES in accordance with the provisions of the EPBC Act. A controlled action is not permitted to proceed without the minister’s approval following the assessment and is subject to any conditions that may be stipulated in an approval.

The stipulated controlling provisions under EPBC that affect the PEP include:

- world heritage properties (ss. 12 and 15A)
- national heritage places (ss. 15B and 15C)
- wetlands of international importance (ss. 16 and 17B)
- listed threatened species and ecological communities (ss. 18 and 18A)
- listed migratory species (ss. 20 and 20A)
- Commonwealth marine areas (ss. 23 and 24A)
- Great Barrier Reef Marine Park (ss. 24B and 24C)

The PEP is required to be assessed in accordance with the requirements of:

- Section 97 of the EPBC Act and Schedule 4 of the EPBC Regulations
- To the extent that it applies to proposed actions, ss. 88Q and 88R of the GBRMP Regulations.

The assessment process will include consideration of the EIS by both DSEWPC and GBRMPA.

A.2.6.3.3 Great Barrier Reef Marine Park Act 1975

The GBRMP Act establishes a framework for the establishment, control, management and development of the GBRMP. The Act is administered by the GBRMPA.

Section 38BA of the GBRMP Act prohibits the carrying out of an activity that requires permission without first having obtained the permission. Section 2A(1) of the GBRMP Act states “*The main objective of this Act is to provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region’*. The Port of Townsville and the port limits are exempt from the

Great Barrier Reef Region under section 14 of the *Seas and Submerged Land Act 1973*. Section 2A(1) of the GBRMP Act applies only to the elements of the project which are to occur outside the port limits. The Great Barrier Reef Marine Park Zoning Plan (GBRMP Zoning Plan) (GBRMPA, 2003) makes it a requirement to obtain permission for the proposed lengthening of the main Sea Channel to the Port where the proposed channel occurs in either the General Use or Habitat Protection zones.

Part 2A of the GBRMP Regulations specifies the general procedure for an application for permission. A referral under the EPBC Act of an activity that is proposed in the GBRMP is an application for permission under the GBRMP Act, where it undergoes an assessment pursuant to the EPBC Act.

A.2.6.3.4 Maritime Transport and Offshore Facilities Security Act 2003

The *Maritime Transport and Offshore Facilities Security Act 2003* establishes a requirement for maritime security plans for certain port facilities, including the Port of Townsville. These plans regulate contact between visiting international and other ships and the mainland. The *Port Security Plan for the Port of Townsville* identifies both landside and waterside security zones and establishes security access procedures for anyone intending to visit or work in such areas.

It is an offence to enter the port area (including waterside security zones), in a manner that is not in strict compliance with the provisions of the Act and the *Port Security Plan*. The construction phases of the PEP will comply with the existing Port Security Plan. As the PEP becomes operational, the Port Security Plan will be amended to include any such new areas.

A.2.6.3.5 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* regulates the preservation and protection against desecration of areas and objects that are of Aboriginal or Torres Strait Islander significance. It enables the government to respond to requests to protect traditionally important areas and objects that are under threat, if it appears that state or territory laws have not provided effective protection.

In general, any discovery of objects or remains that may be of such significance must be notified to the Commonwealth minister. This does not constitute an approval requirement but can influence operational aspects during the construction stages of a project if such remains or objects are discovered. No such areas have been identified in the Project Area, to date, nor are they likely given the sub-tidal nature of the area proposed for development.

A.2.6.3.6 Environment Protection (Sea Dumping) Act 1981

The Sea Dumping Act regulates the placement and incineration of materials at sea and the loading of materials for the purposes of dumping and incineration, in accordance with international obligations under the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972* (London Convention). The Sea Dumping Act applies to Australian waters, and Australian vessels and aircraft anywhere at sea. The Act is administered by DSEWPC.

A permit is required under the Sea Dumping Act for placing dredged material at sea (issued by the Minister for DSEWPC). The *National Assessment Guidelines for Dredging* (DEWHA, 2009a) provide a national framework to assess the environmental impacts from the disposal at sea of dredged material. Only 'clean' material is acceptable for disposal at sea under the *National Assessment Guidelines for Dredging*.

A permit under the Sea Dumping Act will be required to place dredged material associated with the PEP in an existing, approved offshore DMPA in Cleveland Bay. This permit will be sought following the completion of the EIS process, but prior to the proposed works being carried out. The capital dredging and approval required for PEP would be separate to any existing Sea Dumping Act entitlement and are planned to be addressed as part of the *Long-Term Dredge Material Disposal Strategy* (GHD, 2009).

A.2.6.4 State Legislation

State approval requirements have been separated into the following categories:

- development
- tenure
- environment

- heritage
- other legislation
- local government

Relevant Queensland legislation relates to:

- Development
  - *State Development and Public Works Organisation Act 1971*
  - *Sustainable Planning Act 2009*
- Tenure
  - *Land Act 1994 (Land Act)*
  - *Land Title Act 1994* (Land Title Act)
  - *Native Title (QLD) Act 1993*
- Environment
  - *Environmental Protection Act 1994 (*EP Act)
  - *Coastal Protection and Management Act 1995* (Coastal Act)
  - *Fisheries Act 1994*
  - *Nature Conservation Act 1992* (NC Act)
  - *Marine Parks Act 2004*
  - *Transport Operations (Marine Pollution) Act 1995* (Marine Pollution Act)
- Heritage
  - *Aboriginal Cultural Heritage Act 2003*
  - *Queensland Heritage Act 1992*
- Other
  - *Transport Infrastructure Act 1994 (TI Act) – including for the management of strategic port land, road and rail transport*
  - *Transport Operations (Marine Safety) Act 1994*
  - *Electricity Act 1994*
- Local government
  - *Local Government Act 2009*

Reference to legislation in this section includes a reference to any subordinate legislation (i.e. regulations and other statutory provisions that may be established by the principal legislation).

State approval requirements addressed in this assessment include approvals that may be the jurisdiction of the Townsville City Council as regulated under the provisions of the *Local Government Act 2009*. This includes the provisions of any local laws that have been gazetted under the *Local Government Act 2009*. Such requirements are only likely to apply to associated works or access to and use of council regulated land that is offsite to POTL's land. An example of this may include any works that are associated with traffic management requirements during PEP works or ongoing management of traffic in local areas as part of required mitigation responses.

A.2.6.4.1 Development

State Development and Public Works Organisation Act 1971

The Project has been gazetted as a significant project with the outcome subject to the EIS process under the SDPWO Act. The EIS must be approved by the Coordinator-General in order for the Project to proceed. The Coordinator-General's approval can be accompanied by conditions by which the proponent and other state agencies must abide.

The Project is being assessed by EIS under Part 4 of the SDPWO Act. The Act establishes the framework for environmental assessment of declared significant projects in Queensland and is the controlling legislation for the Project at the state level. The PEP was determined to be a significant project under this Act and was gazetted as such on 23 May 2011. The Draft ToR were publically notified between 29 October 2011 and 25 November 2011 with finalised ToR released after review of submissions by the Coordinator-General on 17 February 2012. Following the preparation of the EIS and subject to the approval of the Coordinator-General and subject to any conditions that may be required, the EIS will be required to be publicly notified for comment by way of formal written submissions. Following public notification and consideration of submissions that have been made, the Coordinator-General may:

- request POTL to address specific issues raised through the public notification process (through a Supplementary EIS)
- refuse the Project
- approve the Project (with or without conditions)

Once the Coordinator-General has completed the assessment process, Project approvals will be sought under other relevant state legislation, as referred to below. Subsequent approvals, particularly under SP Act or EP Act, must be consistent with any conditions of approval that the Coordinator-General may have stipulated.

The SDPWO Act includes provisions that ensure that any conditions required by the Coordinator General for a significant project have primacy over any other conditions imposed under an approval under Queensland legislation that may be inconsistent with the conditions of the Coordinator General and other processes applying to the assessment of development applications. This specifically applies to variations in the IDAS that apply to material change of use applications and impact assessable development under Sections 37, 38 and 39 of the SDPWO Act, being:

- The omission of further public notification and state agency referral stages that may otherwise apply under SP Act
- The applicability of properly made submissions during the EIS process for the purposes of impact assessment under SP Act
- Replacement of the Coordinator General’s report as the only concurrence agency report for any referrals that would otherwise need to be undertaken with a concurrence agency
- The imposition of mandatory conditions by the Coordinator General on further approvals issued through the IDAS process under SP Act
- Provision for assessment managers under SP Act to only impose conditions that are not inconsistent with conditions stipulated by the Coordinator General’s approval
- Application of other conditions by the Coordinator General that must be complied with as ‘imposed conditions’ where no relevant approvals are required under legislation
- Rules limiting the seeking of declarations in the Planning and Environment Court under SP Act other than for a declaration as to whether there has been substantial compliance with an imposed condition
- General provisions ensuring that a condition imposed by the Coordinator General for the undertaking of a significant project prevails over any other condition under any other approval under Queensland legislation that is inconsistent with a condition imposed by the Coordinator General (this applies to all prospective approvals that may apply to the PEP, including environmental authorities under the *Environment Protection Act 1994* (note; this does not apply to Commonwealth legislation including approvals required under the *Great Barrier Reef Marine Park Act 1975*, Native Title legislation, *Environmental Protection (Sea Dumping) Act 1981* or any other Commonwealth legislation) *Sustainable Planning Act 2009.*

The planning and approvals framework applicable to the development of the Project is the SP Act. SP Act requires certain developments to be assessed for their environmental effects and to be approved through the Integrated Development and Assessment System (IDAS). Schedule 3 of the SP Regulation and the relevant local planning instruments determine the types of development requiring approval.

The PEP is not assessable development under the Townsville City Council Planning Scheme, on the basis that the works are wholly outside the local government area (that is, in tidal waters) or otherwise on strategic port land, which is not subject to local government planning scheme controls pursuant to the TI Act.

Notwithstanding exemption from the Townsville City Council Planning Scheme, the PEP will require approval under SP Act for relevant assessable development listed under Schedule 3 of the SP Regulation. Further approvals for PEP related development where proposed works or activities are not on strategic port land, that are likely to apply to the PEP may include:

- works in tidal areas and in coastal management districts (chief executive of the Department of Environment and Heritage Protection
- ERA applications
- Disturbance of marine plants.

Realistically, DEHP is likely to be the only other assessment manager that is relevant to the PEP with other agencies being primarily referral agencies under the provisions of the SP Act.Should the PEP, or parts thereof including any seabed yet to be developed, be included as strategic port land under POTL's Land Use Plan 2010 (POTL, 2010b) as provided for under the provisions of the TI Act, the assessment manager for any assessable development identified by SP Act is POTL.

Where POTL is the assessment manager for further development on any land that is included as strategic port land, the provisions of POTL's Land Use Plan will apply as well as the general provisions of SP Act. This particularly applies to further development by the prospective commercial tenants wishing to construct on and use PEP land.

Apart from the SP Regulation, the SP Act also establishes the ability for the planning Minister to prepare and implement a range of other subordinate statutory instruments that can affect planning provisions for development. These may include:

- state planning regulatory provisions
- regional plans
- state planning policies
- statutory guidelines

A number of state planning policies may apply to the PEP. These primarily establish additional criteria for assessable development that may be associated with the PEP and are discussed in greater detail in Chapter B1 (Land) of the EIS. There are no state planning regulatory provisions, statutory regional plans or statutory guidelines that apply to the PEP.

A.2.6.4.2 Tenure

Land Act 1994

The Land Act provides for the allocation of tenure over state land. Land below the high water mark where dredging and reclamation is to occur is currently Unallocated State Land.

Any application for tenure under the Land Act in relation to Unallocated State Land is to be made to the Department of Natural Resources and Mines (DNRM). Further liaison will be required between POTL and DNRM regarding future assignment of tenure. Tenure may be in stages that reflect the stage of reclamation. POTL has indicated that it envisages conversion of the area to a Perpetual Lease and then to freehold title for parcels as they are to be occupied.

The creation of tenure of a lot under the Land Act does not constitute assessable development under SP Act. Reconfiguration of a lot, including the creation of a lease of land for in excess of seven years and which requires registration under the Land Title Act that is not on strategic port land may be assessable development.

Environmental Protection Act 1994

The object of the EP Act is to protect Queensland's environment while allowing development that is consistent with the principles of ecological sustainability. The EP Act prescribes general environmental duties in relation to activities that may cause environmental harm requiring that reasonable and practical measures are taken to prevent or reduce environmental harm.

The EP Act provides for regulation and approval of ERA (such as dredging) and the removal and disposal of contaminated land. Approval under the EP Act is triggered for projects under Schedule 3, Table 2, Item 1 of the SP Regulation. DEHP will be the assessment manager or concurrence agency for the approval of ERA 16 (dredging) and will assess the impacts and stipulate relevant approval conditions. The Council may also be the assessment manager for certain ERAs that have the assessment manager role devolved to the Council.

Coastal Protection and Management Act 1995

The Coastal Act, administered by DEHP, provides the framework for integrated management of the coastal zone. Approvals pursuant to the Coastal Act may be triggered for the Project under SP Act. Where such development is not located on strategic port land, DEHP will be the assessment manager for any assessable development and will be a referral agency for tidal works and other assessable works in the coastal management district where it is not the assessment manager. The assessment manager for any tidal works and other assessable development that is located on strategic port land is POTL.

Operational works under tidal water includes the removal of material under tidal water for reclamation purposes, placing dredged material elsewhere in the tidal zone. Included in the assessment process for assessable tidal works is the consideration of the allocation of water rights for access to adjoining properties. The dredging of material in tidal waters for the purposes of reclamation of land also requires an allocation of quarry material in accordance with Part 5 of the Coastal Act.

Fisheries Act 1994

The *Fisheries Act 1994* protects commercial and recreational fisheries resources and their habitats through sustainable use and conservation. Approval under the provisions of the *Fisheries Act 1994* may be triggered under the SP Act for aspects of the Project that involve:

- disturbance of protected marine plants
- constructing temporary or permanent waterway barriers.

The removal or damage of marine plants is assessable development under the provisions of Schedule 3 of the SP Regulation. Where necessary, provision exists for the disturbance of marine plants to be dealt with through adoption of environmental offsets. The chief executive of the Department of Agriculture, Fisheries and Forestry (DAFF) is the assessment manager for such development unless it is on land identified as strategic port land (i.e. in which case the assessment manager is POTL and DAFF is a referral agency or where the works are a part of a tidal works application or ERA application in which case DEHP will be the assessment manager and DAFF becomes a referral agency.).

Nature Conservation Act 1992

The NC Act declares and manages protected areas and provides for the protection of certain flora and fauna regardless of their location in Queensland. Threatened species under the NC Act and regulations are listed as extinct in the wild, endangered, vulnerable, rare wildlife, near threatened, least concern and international wildlife.

Each category of threatened species listed under the NC Act has proposed management intent as reflected in ss. 14, 19 and 24 of the Nature Conservation (Wildlife) Regulation 2006.

Approval from DEHP is required to take any flora or fauna listed under the NC Act unless one of the exemptions under the Act applies. A licence, permit or authority is not needed for taking or using a marine plant under the *Fisheries Act 1994* that is a ‘least concern’ plant if the plant is lawfully taken under that Act. The granting of a development permit by an assessment manager that has considered and may require the removal of marine plants negates the need for further permitted approval under the NC Act.

Marine Parks Act 2004

The *Marine Parks Act 2004* provides for the state’s management of the coastal marine area along the Great Barrier Reef coast. The Marine Park Act provides for the establishment of the Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004, which reflects the zonings of the GBRMP Zoning Plan. The Queensland zoning plan requires that permission be sought from the appropriate authority, presently the chief executive of the Department of National Parks, Recreation, Sport and Racing, for activities that include any activity that requires permission from the GBRMPA. Permissions are issued as a permit or licence.

Transport Operations (Marine Pollution) Act 1995

The Marine Pollution Act outlines the requirements for ship-sourced pollution management in Queensland. Pollutants covered in the legislation include oil and oily residues or mixtures (including diesel fuel, petrol and oil products), chemical and chemical residues, sewage and garbage. It is an offence to discharge pollutants (either deliberately or negligently) into Queensland coastal waters and penalties apply. Section 67 of the Marine Pollution Act requires the master of a ship to report a discharge or probable discharge without delay to the Regional Harbour Master. Although the legislation does not require any approvals to be sought in relation to pollution of coastal waters, it will have applicability to any shipping that is associated with the construction or operational phases of the PEP by imposing a responsibility to notify should a pollution event occur or appear imminent.

A.2.6.4.3 Heritage

Aboriginal Cultural Heritage Act 2003

The *Aboriginal Cultural Heritage Act 2003*, administered by DEHP, establishes a duty of care that requires a person who carries out an activity to take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage. POTL has prepared and registered a Cultural Heritage Management Plan for the Project, in accordance with the requirements of the *Aboriginal Cultural Heritage Act 2003*.

Queensland Heritage Act 1992

The *Queensland Heritage Act 1992* provides for the conservation of Queensland's historical cultural heritage. DEHP administers the *Queensland Heritage Act 1992* and maintains and manages the Queensland Heritage Register. The Queensland Heritage Register is a list of registered places, trees, natural formations, and buildings of cultural heritage significance.

Based on current registers there are no listed places of heritage significance in the PEP area. However, other potential sites not currently registered or other indirect impacts on adjacent registered heritage places will be considered as part of the EIS.

A.2.6.4.4 Other

Transport Infrastructure Act 1994

The TI Act provides a framework for integrated planning and management of an efficient transport infrastructure system. POTL is a 'port authority' under the provisions of the TI Act for the Port of Townsville, which is a declared port with defined port limits under Schedule 1 of the *Transport Infrastructure (Ports) Regulation* 2005 (TIP Regulation). The TI Act also enables the preparation of a port land use plan pursuant to s. 286 of the Act. Land defined as strategic port land in a port land use plan is not subject to the provisions of a planning scheme. The assessment manager for assessable development on strategic port land is the port authority (that is, POTL). Assessable development on other land is subject to the provisions of Schedule 6 of the SP Regulation to determine the relevant assessment manager that applies to any development applications for such development.

The preparation of a port land use plan is similar to the process of a preparing a local planning scheme in that a land use plan can contain separate zones, set levels of assessment and provide more detailed assessment criteria (codes). The PEP is currently generally identified as 'future strategic port land' in the current *Port Land Use Plan 2010* (POTL, 2010b). The PEP, as is assessed in this EIS, has undergone minor derivations in its design and proposed payout since the adoption of the Port Land Use Plan 2010. Either revision of the approved port land use plan or the preparation of a new port land use plan will need to be undertaken to account for the approved PEP to highlight and recognise its designation as strategic port land once it is reclaimed land.

The TI Act also regulates the use of state-controlled roads, including the management of traffic to ensure its safety and efficiency. Heavy-haulage road traffic that may be associated with the PEP construction phase will be dependent on the use of state-controlled roads, particularly along Boundary Street and the TPAR through the Townsville State Development Area. Any additional works, including the upgrading of the road and intersections or provision of traffic management devices or signage will be subject to the provisions of the Act. Operational works that are made assessable development under Schedule 3 of SP

Act that are to be carried out on strategic port land and which are associated with access to a state-controlled road require referral to the chief executive administering the TI Act as a concurrence agency. In the case of a state-controlled road, this would enable the Department of Transport and Main Roads (DTMR) to stipulate conditions of approval, which may require further works to the state-controlled road network.

Transport Operations (Marine Safety) Act 1994

The *Transport Operations (Marine Safety) Act 1994* and Regulation regulate the operation of commercial vessels in Queensland waters. This includes all aspects of the vessel's operation and account for its crew and any passengers. The legislation includes requirements for passenger verification and the reporting of any marine incidents including serious or danger of serious damage to a ship, stranding or collision of a ship and identification of dangers to navigation. The legislation bestows a responsibility to promptly notify the occurrence or likelihood of any occurrences of incidents. The legislation also has a requirement for an owner or master of a ship operating on a local marine service to notify the port authority (i.e. in this case POTL) within 48 hours of any handling of dangerous goods by way of a Dangerous Cargo Report.

Electricity Act 1994

The *Electricity Act 1994* provides the framework for the supply of electricity in Queensland. The supplier of electricity for Townsville customers is Ergon Energy. The Project Area is presently under tidal water and until reclamation takes place will not require electrical services. In order to maintain future supply to its customers, Ergon Energy will need to manage and plan for the increase in capacity generated by the Project. Under the *Electricity Act 1994* Ergon Energy can negotiate the supply of electricity to the Project. It is a requirement under the Act to notify the electricity supplier when works are taking place near Ergon infrastructure. Consultation with Ergon Energy will take place to ensure that the electricity provider is able to respond to the PEP development opportunity.

A.2.6.4.5 Local Statutory Instruments

Local approval requirements primarily relate to land use planning and environmental licensing requirements. Land use approval requirements get their head of power through SP Act and can be translated through local planning scheme provisions that are administered through the Townsville City Council. Schedule 4 of the SP Regulation makes development on strategic port land exempt from the provisions of a local planning instrument, including the council's planning scheme. Land outside of strategic port land where it is above low water mark may still be subject to the provisions of the local planning scheme. In the case of land adjacent to the port, the relevant planning scheme is City Plan 2005 (TCC, 2005a). There are no works proposed as part of the PEP that involves the use of land that is under the jurisdiction of the council's planning scheme.

The council also has a number of functions that may involve the need for further licences. These may include the exercise of delegation under the EP Act in approving ERA and issuing of licences that may be a requirement of local laws under the provisions of the *Local Government Act 2009*.

Local laws can affect the management of pests, animals, tidiness and cleanliness of property, litter, local area traffic and car parking, and the use of council land, including reserves. Licence requirements for such matters are generally administered through local laws that are adopted under the provisions of the *Local Government Act 2009* and which can refer to the provisions of other specific legislation, including: *Pest Management Act 2001* and *Vegetation Management Act 1999*. POTL will liaise with the Townsville City Council prior to commencing any development to establish the need for licences or permits under applicable local laws, especially where there is a likelihood of requiring the use of land outside of the port's limits.

POTL infrastructure also connects to the council's reticulated sewer and water systems. Connection fees may need to be negotiated between POTL and Townsville City Council for any new connections that may arise out of PEP works or for increases in the capacity of existing connections. Additional headworks may also need to be negotiated with the council for any increased capacity in waste water and potable water treatment plants. This may need to be undertaken through separate agreements and may also be facilitated through the negotiation of a formal Infrastructure Agreement between POTL and Townsville City Council.

A.2.6.4.6 Monitoring, Enforcement and Review

POTL aims to achieve high standards of environmental performance for port operations. A framework has been developed to deliver the successful implementation of management and mitigation measures, and appropriate monitoring and assessment of onsite environmental management. The intent of the framework is to achieve successful whole-of-project environmental performance as detailed in section (C1)1.2.

Objectives as identified in the Environmental Management Plans will be checked and tracked through regular onsite monitoring and reporting, initially by the construction contractor and then by POTL (for POTL controlled and common areas) during operations. If performance objectives are not being met, corrective actions will be undertaken so the Project can be delivered with no greater than the residual predicted effects and risks set out in the EIS.

Any detailed monitoring and reporting requirements will be stipulated at the finalisation of the EIS process through the Coordinator Generals report under Section 35 of SDPWO Act. In addition, the Project will be subject to more detailed approval processes identified in Table A.2.7. These approvals also provide opportunities for specific monitoring and reporting conditions to be stipulated.

The PEP is required to be compliant with conditions of approval at all times. Enforcement of conditions is the jurisdiction of approving agencies prescribed under the relevant commonwealth and state legislation referred to in Table A.2.7.

Table A.2.7 Key Approvals/Notifications Required for the PEP

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Commonwealth						
Native Title Act 1993	Proposed use of land that is still potentially subject to a native title claim	Not an approval but a mandatory requirement to notify under s. 24KA of the Act	NNTT DNRM	The use of land or proposed use of land that is not freehold title land or land which is the subject of an ILUA (i.e. which contemplates the proposed use in an agreed manner) may be subject to a claim of native title under the Act by a Traditional Owner who can establish an Indigenous association with the land in accordance with the requirements of the Act. Any proposed use of Unallocated State Land (as is the case with the PEP), including the creation of different title, is subject to native Title clearance by the state in conjunction with the NNTT.	http://www.nntt.gov.au/Pages/Government.aspx	Notify
Environmental Protection and Biodiversity Conservation Act 1994	Determination as a 'controlled action'	EIS	DSEWPC	Currently being assessed against controlling provisions of the relevant sections then through the EIS process.	http://www.environment.gov.au/	Approval;Approval with conditions; Refusal
Great Barrier Reef Marine Park Act 1975	Dredging of material in a zoned area that requires permission for the activity or extended mooring of a vessel	Permission to dredge	GBRMPA	A referral to DSEWPC for an activity under the EPBC Act that is in the GBRMP and for which a formal assessment process is required is deemed to be an application under the GBRMP Act. This also applies to an approval for an activity under the EPBC Act where the activity is in the GBRMP as is the case for a small part of PEP.		EIS process currently being undertaken

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Maritime Transport and Offshore Facilities Security Act 2003	Any activity in an area affected by a maritime security plan in a prescribed port (i.e. including the Port of Townsville)	No direct approval required. Compliance with POTL's Port Security Plan is a mandatory requirement.	Department of Infrastructure and Transport	Any vessel operating in the port area has an obligation to operate in the requirements of POTL's Port Security Plan. Activities associated with the construction phases of the PEP will be required to comply with the existing Port Security Plan. As areas of the PEP are to become 'operational', the Port Security Plan will be amended to include those areas and compliance with the new Plan will be mandatory.	Nil	Direct liaison with POTL
Aboriginal and Torres Strait Islander Heritage Protection Act 1994	Discovery of remains requires notification to the Commonwealth minister	No approval but a duty to notify exists	DSEWPC	Devolution of most cultural heritage requirements to the state. The minister can make a declaration under this Act that overrides any decision made under another Act if it is determined that there is a specific threat from an activity to the cultural heritage.		Notify
Environmental Protection (Sea Dumping) Act 1981	Placement of dredged material at sea	Sea dumping permit	DSEWPC	PEP to pursue once EIS approval has been obtained from the Minister for DSEWPC.	http://www.environment.gov.au/coasts/pollution/dumping/publications/pubs/dredge.pdf (PDF) http://www.environment.gov.au/coasts/pollution/dumping/publications/pubs/dredge.doc (Word)	Permit
State						
Development						
State Development and Public Works Organisations Act 1971	Declaration of a significant project	EIS approval process under Part 4	Coordinator-General	The EIS forms part of the Part 4 process under the SDPWO Act as a declared significant project.	Coordinator General current EIS projects status: Townsville port expansion project	Approval

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Sustainable Planning Act 2009	Assessable development resulting from the Project as defined by Schedule 3 of the SP Regulation.	The SP Regulation determine that the following are assessable: ▪ tidal works ▪ ERA ▪ disturbance of marine plants (if required).	POTL where development is to be on strategic port land, otherwise assessment manager is as prescribed by Schedule 6 of SP Regulation (DEHP, DTMR and DAFF are most relevant agencies).	The Act provides the planning framework for integrated and coordinated assessment of new development. Under the SP Act POTL is the assessment manager for development applications on strategic port land.	Queensland Government Legislation portal: Sustainable Planning Act 2009 and subordinate legislation Form 1 - Application Form 8 - ERA 16 and other ERAs as required Form 23 - Tidal Works Form26 - Removal of marine plants etc.	Required
Tenure						
Land Act 1994	Requirement for tenure over Unallocated State Land	Lease application. Applications are subject to native title clearance.	DNRM	Prior to application being made for resource allocation for the reclamation area, application must be made to lease the Unallocated State Land. Once the land is reclaimed, the port can apply for ownership of the land	Guide to land tenure	Application

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Environment						
Environmental Protection Act 1994	Dredging of the sea bed Storage handling of chemicals or other substances or practices that may cause environmental harm	ERA as required	DEHP or Townsville City Council [2]	Assessed as per the SP Regulation and EP Act specified codes. Potential ERA include: ERA16: extractive activities. ERA 6: asphalt manufacturing; where there may be a need to produce asphalt on site for hard stand construction ERA 8: chemical storage ERA 33: crushing, milling, grinding or screening; where processing of rock and fill is required on site before use in the reclamation ERA 43: concreting batching; where there may be a need to produce large amounts of concrete on site for reclamation and berth construction purposes.	ERA Forms as specified by DEHP at the time.	Application (IDAS)
Coastal Protection and Management Act 1995	Works in the tidal zone (including quarrying of material for reclamation) Interruption of watercraft navigation or access to land Dumping of dredged material in the tidal zone	Tidal works permit Preparing a water allocation area for tidal works Disposing of material in tidal water Construction of berths/wharves on submerged land	DEHP	These approvals are assessed as per the SP Regulation. Works in a port's strategic land tidal area are assessed by the port. Works outside of the tidal area will be assessed by DEHP Resource entitlement or resource allocation is required for works in the tidal zone over state land.	Refer to SP Act application forms	IDAS application

[2] Where the council has delegation to determine applications and the works are not on strategic port land but on land over which the council has planning jurisdiction.

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Fisheries Act 1994	Disturbance of marine plants Permanent waterway barriers	Operational work for the removal, destruction or damage of marine plants	No DAFF	The disturbance or removal of marine plants includes mangroves, sea grasses and marine algae that may be present in the PEP development area. Assessment is undertaken as per the SP Regulation and *Fisheries Act 1994* specified codes.	Form 26 - Removal of marine plants etc.	Approval (IDAS)
Nature Conservation Act 1992	Impact on flora, fauna or habitat of species listed by this Act	Damage mitigation permit (removing or relocating wildlife) Clearing permit (for taking native vegetation)	DEHP	This form of permit is very unlikely to be required.	Plants and animals - Application forms Information sheets	Permit
Marine Parks Act 2004	The Queensland provisions for coastal areas of the Great Barrier Reef align with the provisions of the GBRMPA	Permission/permit to dredge	Department of National Parks, Recreation, Sport and Racing	A permit to dredge is required subject to Coordinator-General approval. Prior to applying for a permit, a Resource Entitlement must first be obtained to enable the permit to be processed.		Permit
Transport Operations (Marine Pollution) Act 1995	Pollution incidences	Notification	DTMR	Notification is required of occurrences or likely occurrences of pollution into Queensland coastal waters.		Notify

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Heritage						
Aboriginal Cultural Heritage Act 2003	If the Project may cause harm to Aboriginal Cultural Heritage, consultation with the Traditional Owners is required.	No formal approval is required but there is a legislated Duty of Care and a Duty to Notify.	DEHP	There are legislated guidelines to assist in complying with the Act. For instance, permission under the Act would relate to disturbance to discovered objects.	http://www.derm.qld.gov.au/cultural_heritage/legislation/duty_of_care.html	Notify
Queensland Heritage Act 1992	Impact on listed places or buildings Impact on potential heritage items or places	No formal approval required but there is a legislated Duty to Notify under the Act if heritage items are found	DEHP	No registered items were found on the state heritage database.		Notify
Other						
Transport Infrastructure Act 1994	'Unzoned' land in POTL's area	Land use plan amendment	DTMR	Amendment of the Land Use Plan to ensure that there is a planning framework for development on the newly acquired land. The amendment or preparation of a new land use plan requires a direction from the minister and follows a prescribed process under the TI Act. Authorisations to alter or access state-controlled roads must be sought from the chief executive of DTMR. These administrative processes do not entail detailed assessment.		Other (i.e. land use plan amendment) Approval (to alter or access state-controlled roads)

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Transport Operations (Road Use Management) Act 1995	Use of heavy vehicles on routes not intended for the vehicle or load	Application for approval to operate (various); approval of Compliance Scheme	DTMR (State Controlled Road); Local Council (non-State Controlled Road)	Mandatory requirement to operate vehicles in compliance with designation of route. Approval requirement can vary depending on nature of vehicle and proposed load relative to road designation. Approval requirements would be expected to be obtained by contractors and sub-contractors prior to any heavy vehicle operation on the road network to and from the Port. This includes operation between the Port's quarry and the Port.	As per DTMR requirements at the time of application	Approval.
Transport Operations (Marine Safety) Act 1994	Commercial shipping incidents involving crew, passengers, vessels or other structures	Notification	MSQ	Mandatory requirement to report any incidences of death or harm to crew or passengers, serious damage to or loss of a ship or damage to a structure by a ship; hazards to navigation.		Notify
Electricity Act 1994	Works near or connection to electrical infrastructure	No formal approval is required for works, other than those which involve connection to electrical infrastructure. Notification to the owner is required for all other works.	Ergon Energy	POTL relies on Ergon Energy supplied power transmission infrastructure. The provision of adequate power infrastructure will be negotiated in advance of the actual demand to ensure that connections can be approved when required.		Notify

Legislation	Trigger	Approval Name	Agency	Comment	Application Form/Further Information	Type
Local						
Local Government Act 2009 including local laws and subordinate local laws	Use of council controlled land including reserves and local roads as part of ancillary activities associated with the construction of the PEP.	Local law permit or licence	Townsville City Council	To be determined through discussion with Townsville City Council in advance of any major PEP activity. This form of application does not involve any detailed assessment.		Notification; application

A.3 Project Description

The key components of the PEP are outlined in Table A.3.1.

Table A.3.1 Summary of PEP components

Component	Description
Construction of breakwaters and land perimeter revetments	
North-eastern breakwater and revetment infrastructure (around reclamation perimeter)	▪ A new north-eastern rubble mound breakwater with rock armouring will be constructed approximately 1 km seaward of the existing eastern breakwater. ▪ Revetments with rock armouring will be constructed to protect the north-eastern and eastern edges of the reclamation area. ▪ The breakwater and revetment layouts will be configured to provide a protected outer harbour basin and the structural design will address extreme wave and water level events for the port infrastructure and land reclamation.
Western breakwater (if required)	▪ Contingent upon detailed analysis, construction of a new western breakwater for additional outer harbour protection without affecting the port design and operations.
Dredging works for augmentation of channels and development of outer harbour	
Augmentation of existing Sea and Platypus channels	▪ Approximately 4,100,000 m³ of marine sediment will be dredged to deepen the existing port access channels (including minor widening of the Platypus Channel). ▪ Channels will be deepened (to accommodate larger Panamax sized vessels) to an ultimate average dredged depth of –14.5 m CD (chart datum). ▪ The channel deepening will result in the extension of the Sea Channel seaward along the existing alignment by approximately 2,700 m. ▪ Minor widening of the Platypus Channel near the outer harbour entrance will be undertaken to increase the area to manoeuvre vessels at slow speed. ▪ The preferred dredging method for the channel deepening is for one medium-large sized trailer suction hopper dredger (TSHD), while the channel widening will likely be undertaken using a mechanical dredger. The material from the channel dredging will be placed in the existing offshore DMPA.
Seabed preparation for breakwater and revetments (plus areas in bunded reclamation area)	▪ Select soft marine sediments in the bunded reclamation area footprint and beneath the breakwater structure and perimeter revetment structures will be dredged using a mechanical dredge with hopper barges prior to rock emplacement. The in situ volume of the dredged material is approximately 750,000 m³.
Outer harbour basin	▪ Approximately 5,100,000 m³ of in situ marine sediment material will be dredged to create a new outer harbour basin. ▪ The basin has been designed and sized for safe and efficient vessel manoeuvring and berthing operations. ▪ The preferred dredging method is for one small-sized TSHD to remove surface sediments (approximately 750,000 m³) and place them in the DMPA. The subsurface materials (approximately 4,300,000 m³) will be dredged by a cutter suction dredge (CSD) and pumped directly to the reclamation area. ▪ The harbour basin dredging campaigns will match the stages of berth development, and will achieve an ultimate average dredged depth of –13.6 m CD, while the berth pockets will achieve an average dredged depth of –15.5 m CD. ▪ The harbour will provide a minimum 3-hour window at high tide for navigating fully laden large Panamax vessels to and from the berths and transit the channel.
Handling and placement of dredged sediments	▪ Approximately 4,300,000 m³ of dredged marine sediments from the outer harbour basin will be placed in bunds in tidal waters as part of land reclamation activities. ▪ Dewatering and ground improvement of emplaced sediments on tidal lands will be undertaken. ▪ Approximately 5,600,000 m³ of sediments unsuitable for land reclamation

Component	Description
	because of the material characteristics and rendered unsuitable because of the dredge process will be placed in the existing offshore DMPA, comprising: ▪ approximately 1,500,000 m³ sediments from the outer harbour basin, the reclamation footprint and breakwater footprint ▪ approximately 4,100,000 m³ of sediment from the Sea and Platypus channels. ▪ Material will be placed in the DMPA boundary by 'bottom discharging' from a medium-large sized TSHD and hopper barges.
Development of port land	
Bunds and treatment areas	▪ A reclaimed area of approximately 100 ha will be developed on tidal lands eastwards of the existing harbour (and defined by the north-eastern and eastern revetments and the wharf alignments). ▪ Selected fill material from land sources will be used to build bunds over tidal lands, constructed as conventional earth/rock fill structures, to contain the reclamation material. ▪ Internal bunds will be constructed on the alignments of future key infrastructure (including rail and roads) as suitable foundations for heavy loading. ▪ Bund structures will be constructed and configured to retain fill in stages and provide settlement areas for the temporary management and treatment of reclamation tailwater and thereafter permanent reclamation areas for created land. ▪ Select ponds will be retained for the treatment of stormwater during construction and initial stages of the PEP development. ▪ A surface capping layer (approximately 1 m thick) and pavement layer will be applied over land-sourced fill material (approximately 700,000 m³ imported fill).
Port infrastructure	
Berths and wharves	▪ Up to six berths will be constructed in the outer harbour (Berth 14 through Berth 19) to support import and export trades and cargo handling requirements. ▪ At berths, wharves will be constructed similar to the existing wharf structures for vessel berthing, mooring, loading and unloading of general cargo, dry bulk and bulk liquid goods. ▪ Berths will be sized for vessels with a nominal length overall of 250 m. ▪ Construction will be staged to meet the demand for cargo throughput. This may be sequential on a berth-by-berth basis, or in stages involving multiple berth development. ▪ Berth pockets will be dredged to an all-tides depth of approximately –15.5 m CD.
Port navigation	▪ Installation of aids to navigation to mark extended Sea Channel dredge extents and navigable basin, relevant to each development stage. ▪ Channel beacons will be piled channel markers similar to the existing Sea Channel beacons. ▪ Existing buoys marking the outer harbour basin will be relocated to mark boundary of expanded extent of the newly dredged basin. ▪ Two existing leads (used to assist vessel turning for Berth 11) to be removed.
Development on port land and ancillary services	
Backing land for cargo storage and handing areas	▪ Land area of approximately 100 ha to accommodate: ▪ cargo operations, from approximately 52 m behind the quayline ▪ cargo storage area approximately 175 m wide ▪ road and rail transport corridors ▪ cargo storage area within rail loop. ▪ Final finished reclamation level nominally +7.5 m CD (+5.6 m AHD (Australia Height Datum)) adjacent to the wharf structures and falling to the eastern revetment to accommodate drainage of stormwater.

Component	Description
Road infrastructure	▪ Internal circulation road in a corridor 25 m wide on the reclamation area to access facilities and key infrastructure by vehicles ranging from cars to articulated combination vehicles. ▪ Connection via existing Benwell Road to the EAC (currently under construction). ▪ A turning area for articulated combination vehicles at northern end of the main access road. ▪ The road corridor will include a single traffic lane in each direction. Smaller access corridors along the back of wharves and from the main access road to storage areas will be built.
Rail infrastructure	▪ A rail reserve 25 m wide on the reclamation area to service bulk goods haulage. ▪ A 200 m radius, three track rail loop behind cargo storage and handling areas with provision for future train lengths of 1,500 m. ▪ Connection to EAC (when developed by others) and existing rail network.
Buildings	▪ A port administration building may be constructed. ▪ A harbour control tower may be constructed. ▪ Provision for infrastructure for cargo storage and transfer in relation to rail and road access.
Utilities and other services	▪ Installation of services infrastructure relating to stormwater, water supply (including for fire fighting), power supply, waste water reticulation and telecommunications. ▪ Below-ground services in the road corridor. ▪ Installation of a zone substation in the PEP area consisting of two (66 kV to 11 kV) transformers. ▪ Port security infrastructure. ▪ Area and road lighting.
Port and Maritime operations	
Hours of Operation	▪ The port will operate in the expansion area as it does in the existing port, 24 hours per day, 7 days per week.
Vessel movements and fuelling	▪ POTL to assign berth access to multi-purpose berths for certain cargoes and trades. ▪ POTL does not propose to conduct bunkering in the PEP. Refuelling by road tanker may occur as a requirement of tenants or vessel operators. ▪ Maritime Safety Queensland will direct and control vessel movements with vessels under pilotage.

The PEP will be developed in several stages as outlined in Table A.3.2, further detail is provided in Section A.3.3.1. Layouts of the development stages are shown on Figure A.3.11 through to Figure A.3.14.

Table A.3.2 PEP development stages

Stage	Indicative timing	Main construction works
A	2014 to 2016	▪ Development of bunded outer harbour reclamation area (entire outer harbour reclamation footprint) with revetments and north-eastern breakwater protection. (Develop western breakwater if required.) ▪ Undertake dredging works to deepen the Sea and Platypus channels (Stage 1), expand the outer harbour and land reclamation. ▪ Development of new Berths 14 and 15 and associated rail, road and other infrastructure. Landside infrastructure for cargo operations by port tenants.
B	2018 and 2019	▪ Undertake dredging works to expand the outer harbour and land reclamation. ▪ Development of new Berth 16 and associated rail, road and other infrastructure. Landside infrastructure for cargo operations by port tenants.

Stage	Indicative timing	Main construction works
C	2026 and 2027	▪ Undertake dredging works to deepen the Sea and Platypus channels (Stage 2), expand and deepen existing outer harbour, and land reclamation. ▪ Development of new Berth 17 and associated rail, road and other infrastructure. Landside infrastructure for cargo operations by port tenants.
▪ D	▪ 2030 and 2031	▪ Sequential development of new Berths 18 and 19 and associated rail, road and other infrastructure. Landside infrastructure for cargo operations by port tenants.

A summary of the drawing list (Appendix E2) is shown in Table A.3.3.

Table A.3.3 Drawing List

60161996 Series Number	Heading 1	Heading 2
SK1002	Concept Navigation Plan	Harbour Basin
SK1004	Port	General Arrangement
SK1006 TO SK1009	Channel Layout	Sheets 1 to 4
SK1010 TO SK1011	Channel	Typical Sections (Sheets 1 to 2)
SK1015 TO SK1018	Port Development Staging	Stage A to Stage D
SK1025 TO SK1028	Navigation Arrangement	Harbour Stage A to Stage D
SK1050	Concept Drainage	Layout
SK1052	Services Infrastructure	Layout
SK1100	Dredging and Reclamation	Port

A.3.1 Project Development Parameters

This section sets out the key technical parameters and criteria on which the infrastructure design for the EIS has been developed, including the likely staging of the development.

These parameters and the PEP infrastructure design are based on the preliminary design undertaken in the Preliminary Engineering and Environment Study (AECOM, 2009) and on subsequent design development work.

A.3.1.1 Vessel Forecast and Design Vessel Attributes

The key element governing the layout and design of the expanded port infrastructure is the size of the largest ships likely to use the port both on a regular basis and on an exceptional basis. The economic ship size used is in turn dependent in the main on the volumes of cargo to be shipped (and other factors such as the size of the receival port and global shipping economics). The aim of the port layout and design is therefore to provide adequately sized port infrastructure to support the economic ship size.

A.3.1.1.1 Vessel Forecast

From the trade forecast presented in Section A.1.4.2 it is anticipated that dry bulk and possibly bulk liquid trades will be the main contributors to the increases in projected cargo throughput in the port. The cargoes proposed to be handled through the PEP include trades from known new minerals projects in the region currently under development or about to get underway, the growth of existing bulk trades, and the advent of new bulk trades.

An analysis of the trade forecast shows that most trade types proposed to be handled through the PEP are high-value but low to moderate volume mineral concentrates, which are produced and shipped in quantities and parcel sizes appropriately suited to Handymax (around 50,000 deadweight tonnage (DWT)) and possibly Panamax shipping(70,000 to 85,000 DWT).

The predicted cargo tonnage is dominated by magnetite, which is forecast to peak at an annual throughput of 12.3 Mtpa under the high growth scenario, and coal, which is forecast to peak at an annual throughput of 8 Mtpa under the high growth scenario. Together these will be approximately 42% of the total trade through the port. For these volumes, the most economic ship size is large Panamax, which are generally suitable for dry bulk trades to a practical upper limit of approximately 15 Mtpa. Beyond this volume, Cape size ships become more economical. Panamax size is defined as the largest ships currently able to pass through the Panama Canal and thus having a maximum width of 32.3m.

There is no apparent economic driver to use ships larger than Panamax size on any trade through the port in foreseeable future, and it is proposed that the PEP be designed to accommodate the regular operation of large Panamax sized ships up to 70,000 to 85,000 DWT. The existing channels already handle ships of Panamax width, but will need to be deepened to accommodate the larger capacity (and therefore deeper draught) Panamax ships proposed for the new bulk trades. There is therefore no economic driver to widen until a particular trade (which cannot be forecast at present) is proposed that has a strong economic argument to use wider ships.

The resulting forecast of import and export ship traffic under a high growth scenario is presented in Figure A.3.1 and shows that the ship traffic is forecast to almost double over the planning horizon (at the same time that the cargo tonnages will quadruple). This means that the number of cargo ships calling at the Port of Townsville is expected to increase from 675 vessels per annum in 2010/11 up to approximately 1,300 vessels per annum towards the end of the planning horizon for the proposed expansion (2040). Vessel operations will continue to occur on a 24 hour, 7 day per week basis.

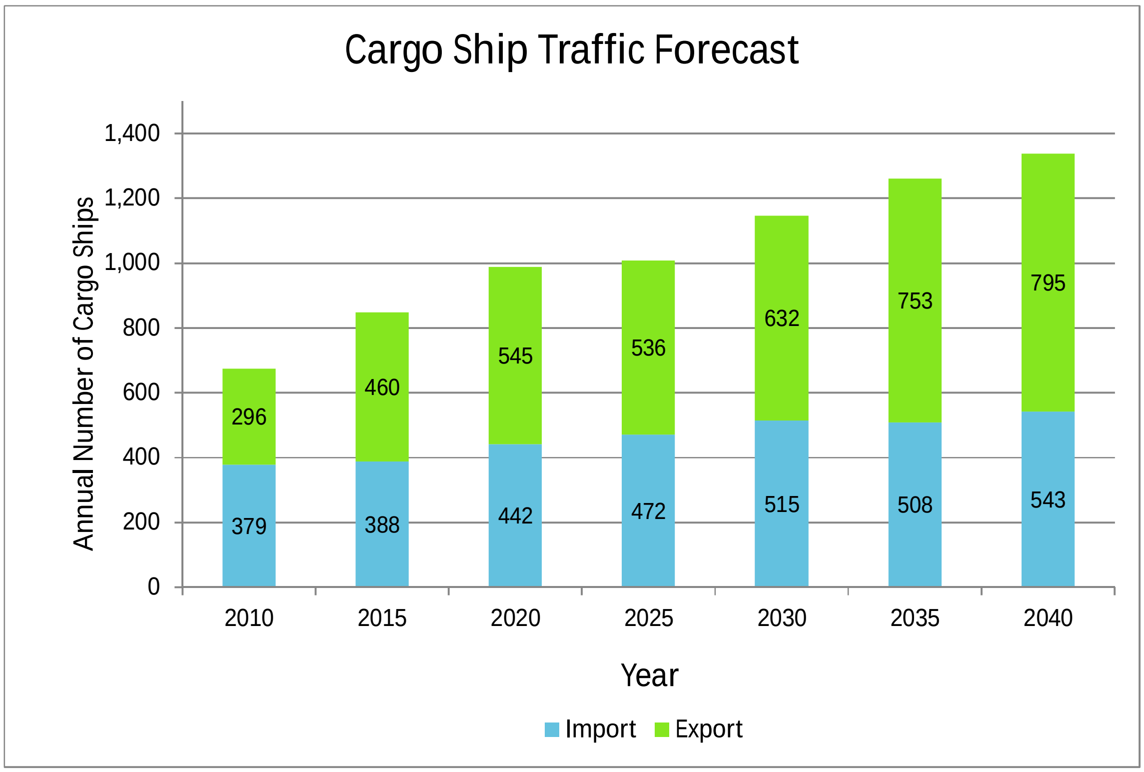


Figure A.3.1 Cargo ship traffic forecast (excludes passenger, military, ferries etc.)

A.3.1.1.2 Design Vessels and Dredged Depth

While the overall outer harbour layout and footprint will need to be configured to accommodate the ultimate design vessels over the planning period and beyond, there is scope to implement the layout in stages as the trade and shipping forecasts in Sections A.1.4.2 and A.3.1.1.1 indicate that the parcel size of the major bulk commodities will progressively increase over time, starting with ships smaller than the ultimate design vessels. This is because the mine production for each commodity will grow from smaller start-up quantities to full production quantities over several years. This means that the largest ships predicted, being the upper end of the Panamax bulk fleet at around 85,000 DWT, are not expected to become prevalent in the port until the second half of the forecast period. Consequently, the development of the channel and outer harbour can be staged to match the growth in ship size and allow progressive investment in infrastructure and dredging, rather than building the infrastructure for the maximum expected ship at the outset.

Two stages of channel development emerged from consideration of the trade and shipping forecast and the world dry bulk Panamax fleet. The histogram in Figure A.3.2 shows the distribution of the world fleet by draught and illustrates the two main groupings of small and large Panamax vessels.

- **Vessel draught of 13.0 m** - includes most Panamax ships with capacity in the range 60,000 to 75,000 DWT. This draught will accommodate the ship size requirements of the trade and shipping forecast until about the year 2025, and is appropriate for the initial stages of port development.
- **Vessel draught of 14.6 m** - includes most of the largest Panamax ships with capacity in the range 80,000 to 85,000 DWT. This draught will accommodate the ship size requirements of the trade and shipping forecast after 2025 and beyond, and is appropriate for later stages of port development.

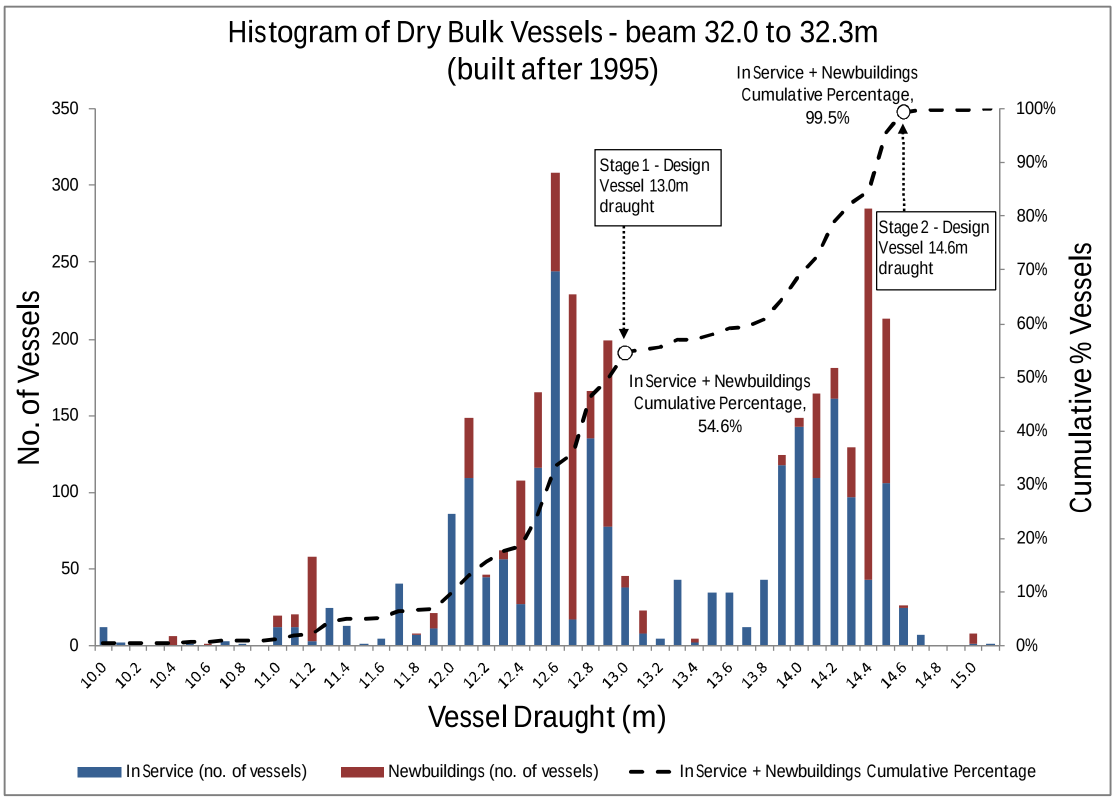


Figure A.3.2 Histogram of the draught of Panamax dry bulk carriers built after 1995 (Lloyds List ship database, 2011 (interpreted by AECOM))

The attributes of the design vessels for each stage that result from this analysis are shown in Table A.3.4. These attributes are not for a specific vessel; they are an envelope of attributes that cover most vessels in the DWT category.

The largest Panamax vessels will be able to use the port in the initial stage of development if required by a particular operator; however, access for these vessels will be restricted to high tide sailings, and hence the practical number of large vessel calls will be restricted. The berth pockets, being a relatively small part of the dredging task, will need to be dredged deep enough at the outset to cater for the large vessels.

This staged approach has the advantage of containing the immediate environmental impacts of the development only to the extent necessary for an initial stage of development, rather than for a benefit that will only be realised many years in the future.

Table A.3.4 Design vessel envelope of attributes

Dredge Stage	Typical Ship Category (Regular Ship Calls)	Draught (m)	Beam (m)	Length Overall[1] (m)	Typical Maximum DWT Range (t)	Typical Maximum Displacement Range (t)
Stage 1 Depth	Panamax (dry bulk carrier)	13.0	32.3	230	60,000 to 75,000	65,000 to 85,000
Stage 2 Depth	Large Panamax (dry bulk carrier)	14.6	32.3	230	80,000 to 85,000	90,000 to 100,000

1 The outer harbour basin layout will consider future possible use by Post-Panamax vessels with length overall (LOA) of approximately 250 m. From the stage that Berth 16 is developed, there is practically no limit to the length of vessel that can manoeuvre in the basin.

A.3.1.2 Geotechnical Conditions

The geotechnical conditions underlying the Project Area (outer harbour and channel area) are summarised in the following sections. They have been collated from:

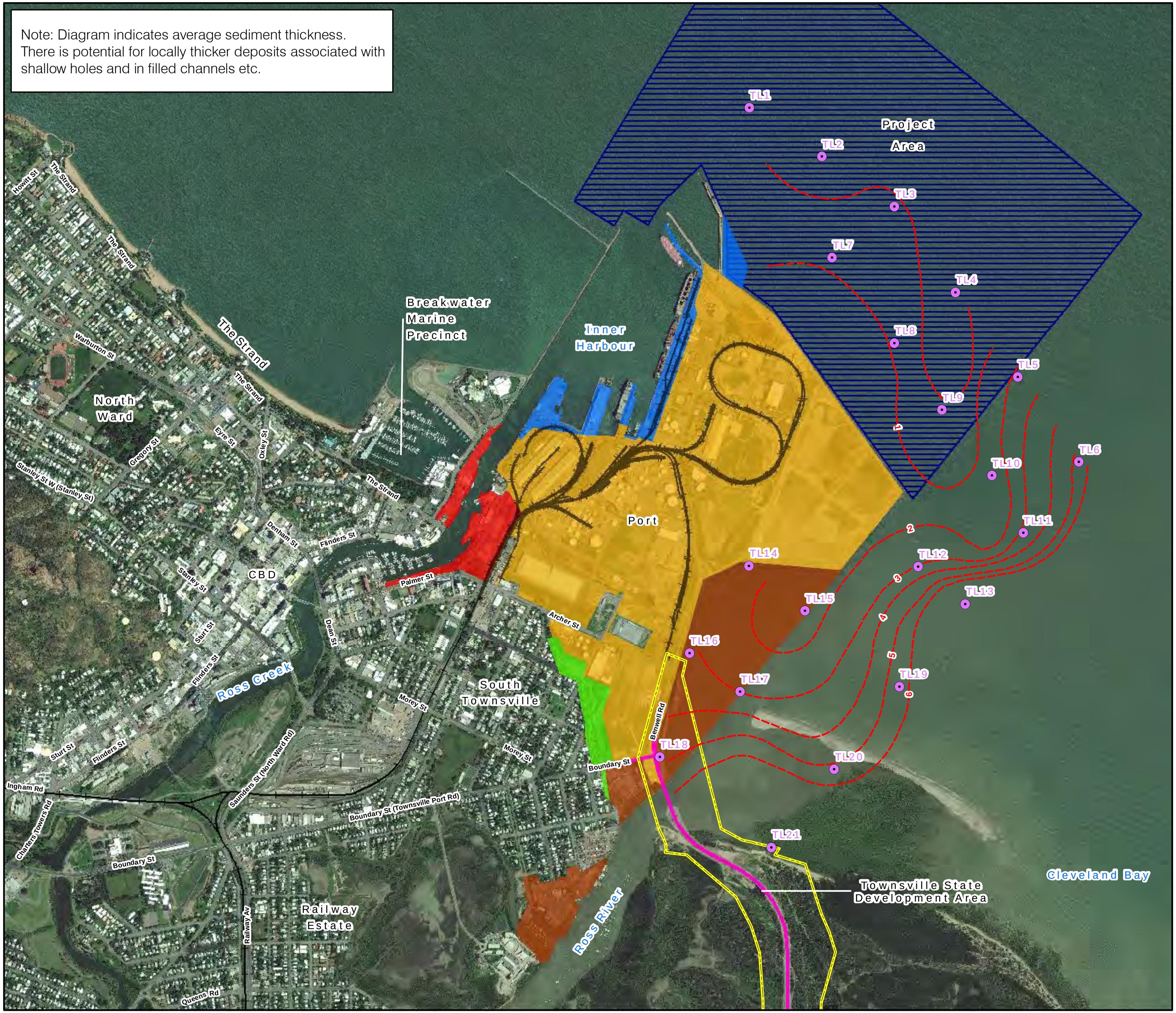
- Summary of Geotechnical Testing Undertaken in the Port of Townsville Area prepared for the Preliminary Engineering and Environment Study (Golder Associates, 2008)
- Townsville Port Expansion Project – Geotechnical Review prepared for the EIS (Golder Associates, 2012)
- Seismic and bathymetric survey undertaken during March 2011 for the EIS.

A.3.1.2.1 Outer Harbour and Reclamation Area

The soil profile in the outer harbour and reclamation area consists of a surface layer of soft and compressible marine silt overlying stiff and very stiff sandy clay/clayey sand materials. The soft material is comprised of recent marine sediments, generally consisting of a mixture of very soft to soft silty clay to clayey silt with very loose and loose sand to clayey sand. The thickness of soft surface material varies between approximately 1 m to 2 m deep in the PEP area as shown on Figure A.3.3.

The underlying material is older stiff to hard clays and sandy clays and medium to dense to very dense clayey sands and sands.

Groundwater in the adjoining port land has been measured to be between 0.9 and 2.5 m AHD. Observations have shown this to vary with the tide and major rainfall/infiltration events. The groundwater quality is saline to highly saline, and considered unsuitable for beneficial use as a potable or industrial water source.



PORT EXPANSION PROJECT EIS

Contour Diagram of Soft Surface Sediments in Outer Harbour Area

Figure A.3.3

Legend

- TL Points
- Contours
- Railway Line
- Townsville Port Access Road
- Project Area
- Townsville State Development Area

Port Zoing 2011-2012

- Marine Industry
- Port Buffer
- Port Industry
- Port Operations
- Special Use

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_140

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Imagery - Port of Townsville 2010.
Strategic/Proposed Port Land - Port of Townsville Land Use Plan
Stage 2 Alignment Proposed Rail Corridor - AECOM 2012
Townsville Port Access Road - AECOM 2012
Contours, TL - Contour Diagam of Surface Sediment Thickness, B5 - Golder Associates 2008

A.3.1.2.2 Sea and Platypus Channels

The soil profile in the Sea and Platypus channels is broadly similar to that of the outer harbour and reclamation area. Along the Platypus Channel, prior to the 1993 dredging event, the reported surface sediment thickness generally ranged from 1 to 3 m. The soft surface sediments vary in thickness, but are relatively thin and are thought to arise from tidal and seasonal movement of the marine sediments. The underlying in situ material is generally comprised of very stiff to hard grey and brown sandy clay and medium to coarse grained clayey sand.

Previous dredging campaigns and borehole investigations indicate that there are some small areas of low strength rock or cemented material in the channel, which were not able to be dredged by the small TSHD. A grab dredge was employed for excavation of these cemented materials.

A.3.1.2.3 Contamination and Potential Acid Sulfate Soils

Several land investigations have been undertaken at the Port of Townsville including geotechnical and contamination assessments of the seabed sediments at the inner and outer harbours, acid sulfate soils and soil investigation studies, and groundwater monitoring programs at the existing port. An acid sulfate soils study was completed (Golder Associates, 2012a) as part of the EIS and in view of the PEP's location adjacent to marine nearshore and estuarine coastal sediments. This study comprised a desktop review of information provided by POTL and data retrospective to field investigations undertaken in 2008.

The acid sulfate soils investigation undertaken by Golder Associates in 2008, using the pH/pHFOX screening method, demonstrated the absence of actual acidity and absence of potential acid sulfate soils or excess buffering capacity, except in four out of 31 samples. Overall, Golder Associates concluded that there is a low risk to potential acid sulfate soils at some locations in the outer harbour and reclamation areas. Generally, the potential acid sulfate soils layer corresponds with the Holocene deposits 1 to 3 m below natural surface, situated below lowest astronomical tide (LAT) and overlying benign Pleistocene sediments. The remainder of the potential acid sulfate soils layer has excess acid neutralising capacity and this is also the case for the Holocene layer as a whole. Should these soils occur, there is in most cases a natural excess neutralising capacity present. An acid sulfate reaction would only be generated if the sediment is subject to prolonged exposure to the atmosphere. No adverse impact to the environment will occur, given that it is planned to place all the dredged/excavated potential acid sulfate soils Holocene material in the DMPA below LAT (Golder Associates, 2012a). This avoids exposing this material to the atmosphere and oxidation and risks associated with this.

In the reclamation area, significant depths of filling over soft Holocene sediments will be managed to prevent heaving and displacement of residual potential acid sulfate soils oxidation products above sea level. The in situ surficial Holocene layer, high in acid neutralising capacity and with no actual acidity, will be overlain by other inert dredging material and remain entirely below LAT, so wetted by marine waters at all times. Further detail on potential for contamination and acid sulfate soils is provided in Chapter B1 (Land).

Existing contamination has been identified for some of the marine sediment adjacent to the existing Berth 11 due to screening levels that were exceeded for nickel and lead content. This contaminated material is likely to have been excavated and taken to land as part of maintenance dredging for Berth 11 and/or dredging associated with the development of Berth 12. Surficial sediments at other areas of the PEP have been screened. Chapter B5 (Marine Sediment Quality) assesses in greater detail the likely levels of existing contamination in the PEP area, the need for further detailed studies and testing to be undertaken, and plans for onshore and offshore grading of materials prior to dredging, handling and placement.

A.3.1.2.4 Implications for Dredging and Reclamation Strategy

The following conclusions were derived from the geotechnical assessment and included in the dredging and reclamation strategy:

- The soft surface marine sediments are likely to cause instability and large settlements if left in place under the reclamation and will need to be removed; they are also considered to be unsuitable for reclamation fill.
- The underlying in situ material is suitable for reclamation purposes, but if disturbed and mixed with water in the dredging process, will require significant treatment before use as structural fill.

- There is no indication of any materials that will be difficult to excavate using conventional dredging techniques.
- There is a need for further detailed studies and testing for sediment contamination prior to dredging, handling and placement.
- Provided the soft surface materials are not allowed to dry out during the dredging process and are promptly placed in the DMPA, which is always submerged, the risks associated with dredging any soft material with acid sulfate potential is low.

A.3.1.3 Environment Parameters for the Design of the Outer Harbour Structures

This section describes the marine environment parameters that influenced the design. The marine structures proposed to be constructed for the PEP comprise:

- breakwaters and revetments to protect the harbour against wave action and provide harbour calmness conditions suitable for ship loading and unloading operations
- wharf structures for the berthing, mooring, loading and unloading ships
- internal bunds and edge structures to contain fill material and serve as tailwater treatment ponds during the reclamation of land for the PEP.

The design of the marine structures considers:

- the combined occurrence of storm surge with astronomical tide (the storm tide level)
- an allowance for sea level rise due to climate change.

For unprotected structures such as breakwaters, the design level must also include an allowance for wave height.

These are discussed further in the following sections.

A.3.1.3.1 Astronomical Tide

Townsville is located between the diurnal (daily) and semidiurnal (twice daily) tide zones, and as a result the port has a complex tidal regime with a large difference in tidal range for spring (2.34 m) and neap tides (0.63 m). The semidiurnal tides are the more dominant type; the key tide levels are shown in Table A.3.5.

Table A.3.5 Tidal levels relative to Townsville Port Datum (Semidiurnal Tidal Plane)

Tidal Planes	Level to LAT (m)
LAT (port datum)	0.00
Highest astronomical tide (HAT)	4.11
Mean high water springs (MHWS)	3.11
Mean high water neaps (MHWN)	2.26
Mean sea level (MSL)	1.94
Mean low water neaps (MLWN)	1.63
Mean low water springs (MLWS)	0.77

(MSQ, 2011c)

A.3.1.3.2 Storm Surge

Storm surge is a change in the sea level associated with extreme weather systems (cyclones) and includes the influence of winds, currents and barometric pressure. A recent example of significant storm surge was captured during Tropical Cyclone Yasi when a large storm surge of 5.2 m was recorded at Cardwell. Fortunately this occurred at low tide and resulted in a storm tide only 2 m above the highest astronomical tide.

A number of previous studies were referenced to define the storm surge levels appropriate for the PEP design. These included the Queensland coastal study (JCU, 2004), a Queensland government study (Harper, 1998), and a study for the Townsville outer harbour (Lawson & Treloar, 1996) . These studies were compared with historical records of recent storm surge measurements at the port, and a set of storm surge levels most appropriate for design were extracted.

A.3.1.3.3 Sea Level Rise

The Australian Standard *AS 4997-2005 Guidelines for the Design of Maritime Structures* (Standards Australia, 2005b), recommends that port infrastructure be designed for a 50-year life. An end of life planning period of 2070 has been applied to the Project, as the design life of the port will not reach 2100. The *State Planning Policy 3/11: Coastal Protection* (DERM, 2011c) recommends a sea level rise allowance of 0.5 m by 2070 (and 0.8 m by 2100). An allowance of 0.5 m has been adopted for the design of permanent structures. For temporary works no sea level rise allowance is required.

A.3.1.3.4 Design Tide Levels

The design levels adopted are shown in Table A.3.6. The levels are presented to both the maritime LAT datum and AHD. Highest astronomical tide including 0.5 m sea level rise is 4.61 m approximately equivalent to the 10-year average recurrence interval (ARI) water level.

Table A.3.6 Design storm tide levels for Port of Townsville

Average recurrence interval – ARI years	Present day storm tide levels		2070 storm tide levels including 0.5 m sea level rise	
	m LAT	m AHD	m LAT	m AHD
10	4.1	2.2	4.6	2.7
20	4.2	2.3	4.7	2.8
25	4.3	2.4	4.8	2.9
50	4.6	2.7	5.1	3.2
100	4.9	3.0	5.4	3.5
200	5.2	3.3	5.7	3.8
250	5.3	3.4	5.8	3.9
500	5.6	3.7	6.1	4.2
1,000	5.9	4.0	6.4	4.5
2,000	6.2	4.3	6.7	4.8

The approach to selecting ARI's and design water levels (and combinations of design water levels and waves) for infrastructure types, is discussed in Section A.3.1.4.

A.3.1.3.5 Wave Climate

The dominant wave climate affecting the port is from the north-east quadrant, through the entrance to Cleveland Bay; this climate will govern the design of the north-eastern breakwater. Waves also approach the port from the north-west through a passage between Magnetic Island and the mainland, which will determine the requirement for a western breakwater. The design of the eastern revetment of the port will be governed by local waves generated in Cleveland Bay.

The design wave climate for the port was obtained by transforming offshore waves as recorded by the DEHP wave rider buoy, including consideration of Cyclone Yasi. This modelling included the impacts of diffraction and reflections off the dredged channel. The design waves obtained are shown in Table A.3.7 and Table A.3.8 for a range of ARIs, and a detailed explanation of the methodology used to obtain the design waves is contained in the Wave Analysis Report (Appendix E3).

Table A.3.7 Design nearshore north-east wave climates (channel acoustic doppler current profiler site)

Average recurrence interval ARI (years)	Adopted nearshore north-east wave climate (–5.5 m CD)		
	H_S (m)	H_{MAX} (m)	T_P (s)
5	2.3	4.1	6.0
10	2.7	4.9	6.3
20	3.1	5.5	6.8

Average recurrence interval ARI (years)	Adopted nearshore north-east wave climate (–5.5 m CD)		
	H_S (m)	H_{MAX} (m)	T_P (s)
25	3.2	5.7	7.0
50	3.6	6.4	7.3
100	3.9	7.1	7.6
200	4.3	7.8	8.0
250	4.5	8.0	8.2
500	4.8	8.7	8.5
1,000	5.2	9.4	9.0
2,000	5.6	10.0	9.3

H_s the significant wave height (the average height of the highest 33% of the waves)
H_{max} maximum wave height
T_p peak wave period

Table A.3.8 Design north-west wave climates (PEP outer harbour site)

Average Recurrence Interval ARI (years)	Adopted near port north-west wave climate (–3 m CD)		
	H_S (m)	H_{MAX} (m)	T_P (s)
5	1.3	2.3	3.8
10	1.5	2.7	3.9
20	1.7	3.1	4.0
25	1.8	3.2	4.0
50	1.9	3.4	4.1
100	2.1	3.8	4.5
200	2.3	4.1	4.7
250	2.4	4.3	4.8
500	2.5	4.5	5.0
1,000	2.7	4.9	5.4
2,000	2.9	5.2	5.7

H_s the significant wave height (the average height of the highest 33% of the waves)
H_{max} maximum wave height
T_p peak wave period

The approach to selecting ARI’s and design waves (and combinations of design water levels and waves) for infrastructure types, is discussed in Section A.3.1.4.

A.3.1.4 Design Criteria for Waves and Water Levels

The selected water levels and design waves for the concept design of marine structures consider:

- serviceability design criteria, which relate to day-to-day operations and the ability of the port to function (safe navigation, port access, mooring, loading and offloading)
- ultimate event design criteria, to ensure that the infrastructure items can perform their structural functions during extreme events.

A.3.1.4.1 Serviceability Design Criteria

Outer Harbour Calmness

Generally, for the range of vessel sizes and types expected to use the new outer harbour, the limiting wave heights for cargo operations are from 0.8 m to 1.4 m for beam seas. For head seas, the limiting wave heights are greater, ranging from 1 m to 2 m. These limiting wave heights are for waves of periods seven seconds or greater, which have a wavelength of approximately 80 m in approximately 15 m water depth. This wavelength is large compared with the vessel beam (28 m to 32 m) and could cause the vessel to roll. Waves with shorter periods and, hence, wavelengths would have a reduced impact on vessels.

For shorter wave periods, these limiting wave heights decrease. Once the wavelength becomes smaller than the ship's dimensions, the ship will no longer respond to the wave pressures. For beam seas, the limiting wavelength would be around 32 m, which is approximately the beam of the design ships (Panamax) and of the 28,000 to 55,000 DWT cargo vessels currently using the existing port (beam of 27 m to 32 m). This wavelength would correspond to a wave period of 4.5 s. Therefore, waves of period 4.5 s or less would not disturb operating conditions in the port.

The layout of the breakwaters has been configured to address ultimate design criteria during extreme wave and water level events.

Channel and Outer Harbour Basin Accessibility

Vessel access along the Sea and Platypus channels and the existing inner harbour basin is presently limited to high tides for deep draught vessels that call into the Port of Townsville. The design vessels considered for the PEP (Section A.3.1.1.2) will have a deeper draught, requiring deepening of the channel system and a new outer harbour.

The PEP has adopted tide-assisted ship access for the design vessels with the navigation design depth being determined by accessibility criteria. The rationale and methodology is discussed in Sections A.3.2.1 and A.3.2.2 for the channel and outer harbour respectively. Predicted astronomical tides were used to determine the vessel accessibility.

A.3.1.4.2 Ultimate Design Criteria for Outer Harbour Structures

The adopted design criteria for waves and water levels selected for each key infrastructure item has been based on a minimum accepted risk approach using Australian Standard AS 4997-2005 (Standards Australia, 2005b), the process for establishing these criteria involved:

- establishing a 'design life' based on the type of facility, and
- selecting an ARI based on the 'design life' and structure 'category'.

AS 4997-2005 is not specific on combined water level and waves and, although they are linked as they are both caused by cyclonic systems for Townsville, it is overly conservative to assume a perfect concurrence. A full scale metocean study undertaken as part of a future detailed design stage of a project is necessary to define combined probability of concurrence. In the absence of such data, it is common practice to establish the critical design condition from the worst case for wave and water level combinations as follows:

- maximum design wave climate with a high water level
- high wave climate with a maximum design water level
- intermediate wave and water level.

This approach to wave and water level combinations was used for a wide range of design criteria, comprising:

- ultimate design event for survivability of permanent works
- ultimate design event for overtopping of permanent works
- ultimate design event for survivability of temporary works
- no overtopping event combinations – wharf structures
- no damage event combinations for infrastructure elements that can tolerate a degree of damage

The adopted critical design combinations for wave and water levels for the design of the outer harbour are discussed in Section A.3.2.3.

A.3.1.5 Summary of Environmental Design Considerations

Planning for PEP has been guided by the principle of delivering necessary infrastructure while balancing protection of the environment. Based on current and previous investigations, the ecological and other environmental values of Cleveland Bay have been thoroughly considered in the context of both the dredge strategy and the design and layout of the reclamation. This includes the consideration of various development options and scenarios to ensure potential impacts can be accurately predicted and where possible, modifications have been made to the design to minimise impacts.

However, the nature of the proposal is such that trade-offs were necessary to achieve a balance between functional requirements for the infrastructure to address its intended use (such as the width of the reclamation to accommodate the proposed rail loop, the depth of proposed berths and the width of the shipping channel to ensure maritime safety) with sometimes competing environmental objectives (ensuring adequate volume in the reclamation area for the placement of dredged material from the creation of the outer harbour basin to minimise at sea placement of dredged material while also seeking to minimise the overall reclamation footprint).

Some of the specific measures that have been considered and incorporated into the design to protect ecological and other environmental values include:

- Re-use of competent dredged material from the outer harbour basin to be used as fill material within the bunded reclamation area. Soft, compressible surface sediments which are of poor engineering quality will be placed at the existing offshore DMPA following appropriate sediment quality testing in accordance with the National Assessment Guidelines for Dredging (NAGD) 2009.
- Design of a treatment-train approach within the proposed reclamation in order to increase settlement of sediments in dredge tailwater prior to release of those waters back into the marine environment.
- Optimise siting of the proposed tailwater release site on the eastern side of the reclamation to reduce cumulative turbidity effects on nearby benthic environments to the west of the port, such as seagrass adjacent to the Strand and Middle Reef.
- Selection of dredge plant such as CSD to control flow rates effectively and manage tailwater treatment.
- Design of stormwater drainage that collects runoff to packaged gross pollutant traps prior to outfall on the eastern side of the reclamation area.
- Inclusion of treatment measures to manage stormwater quality of runoff from port assets (operational areas, terminals, major access roads, etc.).
- In terms of accommodating potential impacts of climate change – ensuring the design finished surface height of the reclamation takes into account the projected effects of climate change on future sea level (in line with findings of the climate change study).
- As outlined in the construction staging strategy, construction of the reclamation bunds prior to the commencement of cutter suction dredging to allow controlled placement of the material and reduce dredge plume dispersal.

Significant background research and data collection has occurred both as a result of the proposal and ongoing monitoring undertaken continually by POTL. This provides a firm basis for the forward planning of the PEP. With a thorough background knowledge of environmental, social and cultural/heritage issues, potential impacts resulting from the Project have been examined and where possible designed out of the expansion plan.

Where impacts cannot be avoided, additional investigation into specific impacts have been undertaken at the project planning stage, the outcomes of which have aided the formulation of strategies to mitigate impacts as described in the relevant chapters of the EIS.

A.3.2 Port Infrastructure Layout and Design

This section summarises the proposed layout of each element of the PEP infrastructure and the physical design parameters upon which the elements have been developed.

The channel and harbour layouts for the PEP have been tested through a preliminary navigation simulation exercise in the Preliminary Engineering and Environment Study (AECOM, 2009), using input from the Harbour Master and pilots. The depths, widths and manoeuvring areas proposed were shown to be satisfactory. Some minor adjustments may be required as a result of the detailed design process, but these will not affect the Project description used for the EIS.

A.3.2.1 Channel Development

Ship access to the existing inner harbour is along the Sea and Platypus channels, and it is proposed that access to the outer harbour will be along the same channels. This section describes the requirements for channel depth, alignment, length and width to service the new outer harbour and the modifications required to the existing channels.

A.3.2.1.1 Channel Depth

The existing Sea and Platypus channels are generally maintained to achieve a declared depth of –11.7 m CD. Declared depth is the 'official' channel depth proclaimed by the Regional Harbour Master and published on navigation charts and updated in regularly published Notice to Mariners. The declared depth is less than the design depth of a channel, which is the minimum physical depth of water required to ensure that the declared depth can be maintained at all times. The existing declared depth is not deep enough for the efficient operation of the large Panamax sized vessels projected to handle the volume of trade expected through the port (Section A.3.1.1.2), and channel deepening will be necessary to accommodate them later in the Project timeframe.

The key drivers for deepening the channel are:

- the increase in the size range and number of deep draught vessels that can call at Townsville
- improving the channel capacity by increasing the transit window for vessels required to navigate using the tide
- maximising berth capacity, noting that limitations for ships to navigate the channel have knock-on effects on berth occupancy.

A.3.2.1.2 Design Depth for Navigation

The design depth for navigation purposes takes into account:

- the static draught of the vessel
- an allowance for underkeel clearance (UKC), to allow for the apparent increased draught of the vessel ('squat') when underway, to allow sufficient water under the keel for vessel heel, wave response and vessel manoeuvrability
- the minimum tide level to meet the required accessibility criteria for the design vessel.

$$\text{Design depth} = \text{design vessel draught} + UKC_{allowance} - \text{tide level for accessibility criteria}$$

All-tides access is not required for the PEP as the loading and unloading operations of large dry bulk ships will require such vessels to spend in excess of 24 hours at berth; therefore, the time-scale of operation is such that vessels can wait a few hours for an appropriate tide to arrive or leave without incurring undue economic penalty. This is common practice for large bulk ships around the world. A significant reduction in dredging is achieved by retaining a tide-assisted sailing for the deep draught vessels. Channel capacity studies undertaken in the Preliminary Engineering and Environment Study (AECOM, 2009) showed that providing a minimum 3-hour transit window on each high tide would provide sufficient transit capacity in the channels.

The channel and outer harbour basin design depths are therefore based on providing a minimum 3-hour transit window at high tide for navigating the fully laden large Panamax vessels to and from the berths in the harbour basin and transiting the channel, while allowing the majority of other vessels to sail on all tides.

The design depth includes allowances for siltation, survey tolerances and allowances for some other area-specific risk factors that taken into account in construction. Further details on the layout and design of the channel and basin are given in the sections that follow to guide decisions on channel alignment, depth, navigation requirements, channel length and width and development staging.

A.3.2.1.3 Dredged Depth

The dredged depth is the design depth for navigation, as discussed in Section A.3.2.2, plus a number of allowances as shown in Figure A.3.4, being:

- survey tolerance, to allow for the level of accuracy that is normally achieved with a hydrographic survey

- tidal residuals, being the differences between actual and predicted tides due to secondary metocean effects
- sedimentation allowance, to provide a buffer against the build-up of sediment in the channel
- dredging tolerance, or over-dredge allowance, to allow for the accuracy limitations in the dredging process, and ensure that any high spots left after dredging are below the navigation depth.

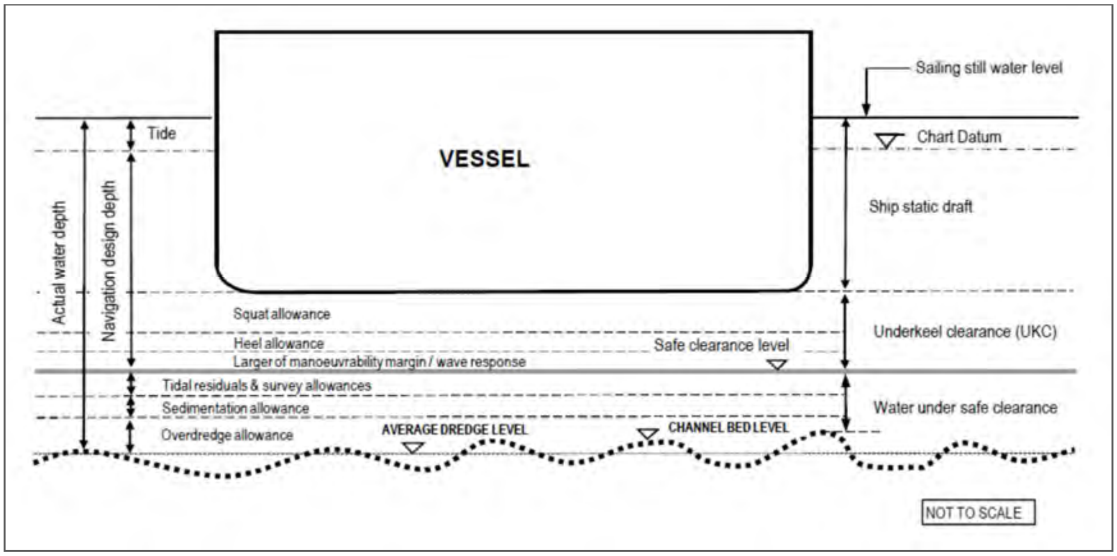


Figure A.3.4 Diagram of design depth components

A.3.2.1.4 Channel Depth Staging

A two-stage approach has been adopted for the design depth to reflect the ramp-up in trade and vessel size over the planning horizon. The aim of this approach is to optimise the channel depth and minimise dredging volumes that will need to be relocated at each stage of the development. This approach reduces cost and the dredging duration in a campaign, and therefore results in a more favourable environmental outcome.

The first channel dredging stage (PEP Stage A) design depth is based on a Panamax design vessel of 13.0 m draught with a nominal DWT in the range of 60,000 to 75,000 t. This is considered to be the largest ship likely to be using the port on a regular basis up to approximately 2025 (Section A.3.1.1). It is proposed to deepen to a depth that will allow a 3-hour sailing window for the fully laden design ship at least once every day. This equates to 95% of high tides and twice a day for most days.

Deeper draught vessels will nevertheless be able to transit the channel, albeit on a more infrequent basis. For example, a fully laden Panamax with a draught of 14 m will be able to sail on 20% of high tides.

The second channel dredging stage (PEP Stage C) design depth is proposed to accommodate deeper Panamax vessels with a draught of 14.6 m, which are forecast to be servicing the port more frequently after 2025. This design vessel represents the largest currently available Panamax dry bulk carriers with nominal DWT in the range of 80,000 to 85,000 t. Only a few high volume/low value cargoes (typically magnetite and coal) are expected to use these sized vessels, representing a low proportion of the total vessel numbers. Therefore a lower accessibility criterion is proposed for the second stage channel depth. The proposed design depth will allow the design ship (14.6 m draught) to sail fully laden with a minimum 3-hour window on the higher high tide of each tide cycle, or approximately on 50% of high tides in a year.

The navigation design depth and dredged depth allowances are summarised in Table A.3.10 for Stages A and B and Table A.3.11 for Stages C and D according to the design vessel parameters in Table A.3.9.

Table A.3.9 Parameters for navigation design depth

Parameter	PEP Stage A	PEP Stage C
Design vessel	Panamax dry bulk carrier	Large Panamax dry bulk carrier
Design vessel static draught – loaded	13.0m	14.6m

Parameter	PEP Stage A	PEP Stage C
Accessibility criteria for design vessel (% tides with 3 hour sailing window)	95%	50%

Table A.3.10 Channel navigation depth and dredge depth allowances – PEP Stages A and B

Parameter	Unit	Sea Channel and Platypus Channel (P1/P2 to P11/P12)	Platypus Channel (P11/P12 to P13/P14) Outer Harbour Approaches	Platypus Channel (P13/P14 to P16) Adjacent to Outer Harbour
Design vessel static draught	m	13.0	13.0	13.0
Underkeel clearance (UKC)	m	1.7	1.7	1.4
Depth adjustment for adopted accessibility criterion	m	1.9	1.9	1.9
Navigation design depth	m CD	–12.8	–12.8	–12.5
Tidal residuals	m	0.2	0.2	0.2
Survey tolerance	m	0.2	0.2	0.2
Sedimentation allowance	m	0.1	0.3	0.1
Dredging tolerance	m	0.3	0.3	0.2
Average dredged depth	m CD	–13.6	–13.8	–13.2

Table A.3.11 Channel navigation depth and dredge depth allowances – PEP Stages C and D

Parameter	Unit	Sea Channel and Platypus Channel (P1/P2 to P11/P12)	Platypus Channel (P11/P12 to P13/P14) Outer Harbour Approaches	Platypus Channel (P13/P14 to P16) Adjacent to Outer Harbour
Design vessel static draught	m	14.6	14.6	14.6
UKC	m	1.7	1.7	1.4
Depth adjustment for adopted accessibility criterion	m	-2.6	-2.6	-2.6
Navigation design depth	m CD	–13.7	–13.7	–13.4
Tidal residuals	m	0.2	0.2	0.2
Survey tolerance	m	0.2	0.2	0.2
Sedimentation allowance	m	0.1	0.3	0.1
Dredging tolerance	m	0.3	0.3	0.2
Average dredged depth	m CD	–14.5	–14.7	–14.1

Typical sections of the channel deepening are shown on drawings 60161996-SK1010 and SK1011 (Appendix E2).

A.3.2.1.5 Channel Alignment and Length

The existing channel alignment has been developed over time to provide acceptable navigation conditions, and there is no navigational advantage to deviate from the existing alignment for the PEP other than to make some minor improvements, such as widening the channel at the entrance to the new outer harbour, which will increase the area available for vessel manoeuvrability at slow speed. This has been confirmed through a navigation simulation exercise undertaken as part of the Preliminary Engineering and Environment Study (AECOM, 2009) where a number of arrival and departure scenarios using the forecast design vessels were tested with the participation of the Harbour Master and pilots.

The existing Sea Channel currently extends approximately to the S2 channel marker. It partly encroaches into the Habitat Protection Zone of the GBRMP east of Bremner Point for a distance of approximately 0.8 km to its end near the S5 channel marker. The deepening of the channel will involve extending the channel for a distance of approximately 2.7 km, which includes:

- deepening the 0.8 km section that already encroaches into the Habitat Protection Zone
- minor additional encroachment into the Habitat Protection Zone to the south-east of Florence Bay for a distance of approximately 0.9 km
- extending the channel seaward, 1.4 km into the General Use Zone of the GBRMP.

The channel extension will not extend beyond the existing declared port waters and will maintain the existing shipping lane alignments outside of the port in the GBRMP.

Two alternate channel alignment options were examined to assess whether other alignments are possible that would reduce the length of the extension to minimise dredging, reduce the intrusion into the GBRMP General Use Zone, and eliminate further encroachment into the Habitat Protection Zone. These options were to the east and west of the existing alignment, joining to the existing channel at the existing at S4 marker at a similar angle to the bend between the Sea and Platypus channels. These are shown in Figure A.3.5 as the western and eastern alignments.

The western alignment, while shorter than the straight alignment continuation and therefore requiring less dredging, has a significant intrusion into the Habitat Protection Zone around Magnetic Island of approximately 0.7 km, and would bring vessels to within approximately 0.5 km of Magnetic Island, which is considered unacceptable from a navigational safety aspect and closer to the Island from an overall environmental and public amenity aspect. Alignments to the west of the existing channel are therefore not preferred.

The eastern alignment, while completely outside the Habitat Protection Zone around Magnetic Island, is over 1 km longer than the straight channel extension, requiring more dredging and dredged material disposal. It extends beyond the existing declared port waters, and encroaches some 2.3 km into the General Use Zone of the GBRMP. It also introduces another bend in the channel, which is not desirable from a navigation safety aspect. It would also change the location of the shipping lane approaches in the GBRMP. Alignments to the east of the existing channel offer no advantages and have disadvantages.

The extension of the existing alignment is considered the best option navigationally and environmentally.

The additional lengths and attributes of these extension options are summarised in Table A.3.12 for the ultimate channel navigation design depth of –13.7 m CD (average dredge depth of –14.5 m CD), which is the final depth proposed for the PEP (Stage C).

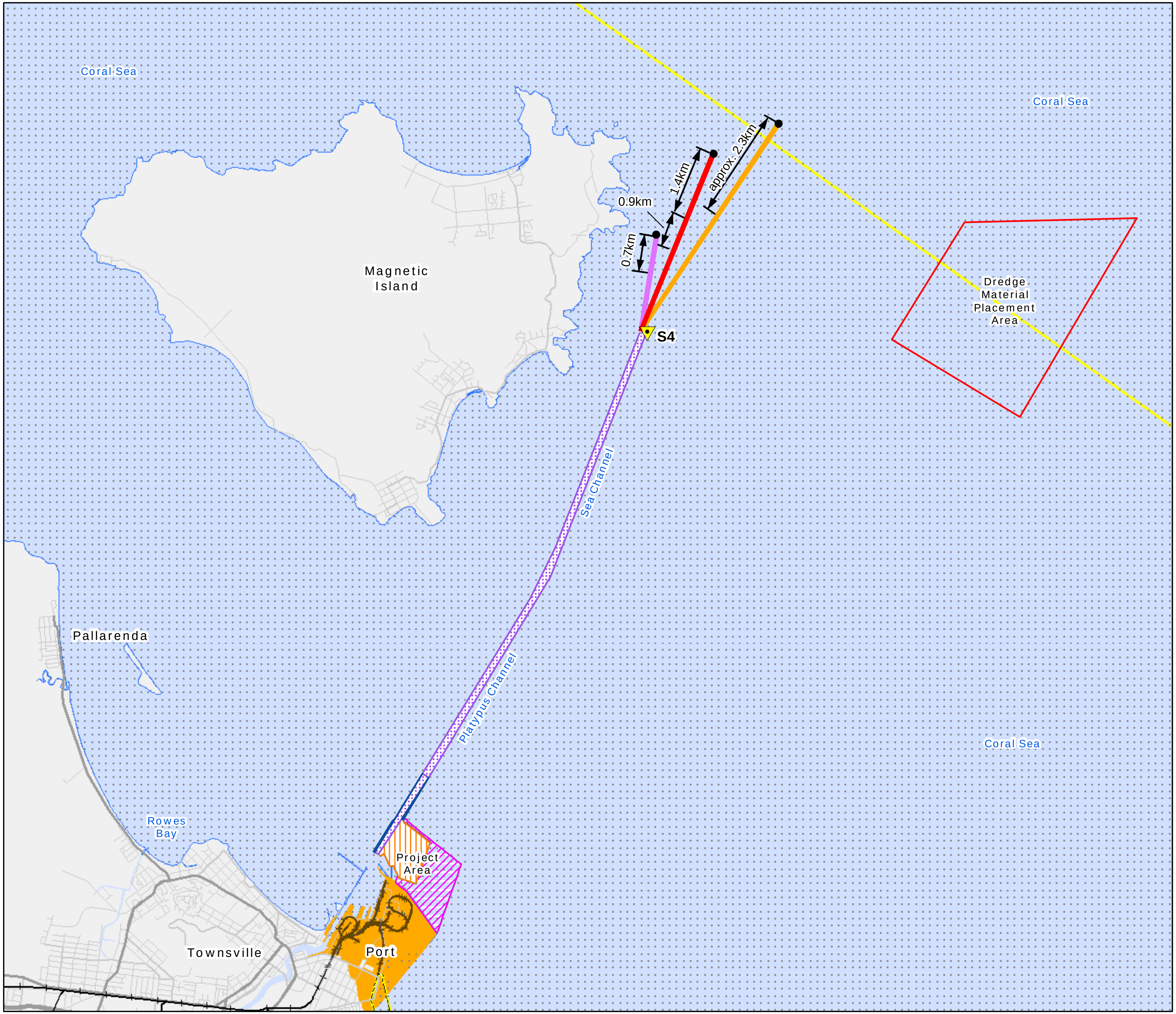
Table A.3.12 Comparison of dredge length in GBRMP zones (seaward of channel marker S4) for channel navigation depth of –13.7 m CD

Option	Preferred Straight Alignment (km)	West Alignment Option (km)	East Alignment Option (km)
Additional dredged channel length	2.7	2.0	4.9
Additional length of dredging in GBRMP Habitat Protection Zone	0.9	0.7	0
Length of dredging in GBRMP General Use Zone	1.4	0	2.3
Total length of dredging in GBRMP	2.3	0.7	2.3
Proximity of channel to Magnetic Island	1.0	0.5	1.4

PORT EXPANSION PROJECT
EIS

Channel Alignment Options
(Distances are Length in Channel in GBRMP for Stage C Deepening, Seaward of Channel Marker S4)

Figure A.3.5



Legend

- Dredge Extents
- Channel Marker S4
- Port Limits
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- GBRWHA/National Heritage Place

Channel Alignment Options

- Current PEP Alignment (Straight Alignment)
- Eastern Alignment Option
- Western Alignment Option

N

Scale: 1:100,000 (when printed at A4)

0 0.5 1 2 3 4
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_024

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
World Heritage Area - Queensland Goverment 2012
GBRMP Zones - Queensland Goverment 2012

A.3.2.1.6 Channel Width

The existing width of the Sea and Platypus channels is 92 m, which caters for vessels up to Panamax width (32.3 m, the maximum vessel width able to pass through the Panama Canal) with no passing of vessels in the channel.

An analysis of the trade forecast shows that most trades proposed to be handled through the PEP are high-value/low to moderate volume mineral concentrates that are produced and shipped in quantities and parcel sizes appropriately suited to Handymax (approximately 50,000 DWT) and possibly Panamax shipping (70,000 to 85,000 DWT). However, the predicted future cargo volume is dominated by magnetite, which is forecast to peak at an annual throughput of 12.3 Mtpa under the high growth scenario, which will be approximately 50% of the total trade through the port. Panamax ships are the most economic ship size for this volume of trade. As there is no economic driver for larger ships in the foreseeable future, it is proposed that the PEP be designed to accommodate the regular operation of these ships.

A channel capacity analysis has also shown that there is no requirement to allow ships to pass in the channel, and that sufficient capacity is available for only one ship to use the channel at any one time. As vessels wider than Panamax size are not predicted to be using the port in the forecast time horizon, no widening of the channels is proposed, other than to widen the approaches to the new outer harbour between beacons P11/P12 and P13/P14, which will provide more manoeuvring room as the vessels slow down to enter the harbour. Dredging for channel widening is proposed to occur at these locations.

Other minor channel widening is planned to be undertaken by POTL separately to the PEP to improve navigation for existing operations. This work will be completed before the development of the PEP and includes:

- widening the western side of the Platypus Channel (between beacons P13 to P15) opposite the Berth 11 departure channel to reduce ‘bank effects’
- widening at the intersection of the Sea and Platypus channels to increase the bend radius.

A.3.2.2 Harbour Basin Development

The outer harbour layout design has been guided by the requirement for safe and efficient vessel manoeuvring and berthing operations and the need for staged construction of the PEP. An important objective for the outer harbour layout is to limit the harbour size without compromising safe and efficient vessel manoeuvring and berthing, such that associated dredge volumes and construction costs and impacts can be minimised within reasonable limits.

The layout of the outer harbour basin and the number of berths contained in the *Port of Townsville Master Plan* (Maunsell AECOM, 2007) has been reviewed against the revised trade forecast and design vessel spectrum, and it has been concluded that the Master Plan berth layout provides sufficient capacity for the revised forecast and spectrum.

The Port of Townsville Master Plan layout has been adopted as the preferred layout of the outer harbour and is shown in Figure A.1.3. The key infrastructure components of this layout are:

- a protected harbour formed by a new north-eastern breakwater, north-eastern and eastern revetments
- a new western breakwater to protect the outer harbour; if required, depending on results of further optimisation of the design undertaken as part of the detailed design stage of the Project
- a dredged deep water outer harbour basin protected by the land reclamation and the north-eastern breakwater; aids to navigation will define the navigable basin areas during each stage of development
- up to six additional vessel berths inside the new harbour (Berth 14 through Berth 19) to support a range of import and export trades and cargo handling requirements.

A.3.2.2.1 Basin Size and Shape

The basin size and shape has been determined by the number of berths to be provided, vessel requirements for safe navigation, vessel swinging, and manoeuvring of vessels to and from berth. The size and layout of the basin for navigational purposes was initially established based on empirical guidelines and refined using two-dimensional navigation simulations during the Preliminary Engineering and Environment Study. The ultimate navigation layout of the harbour basin is shown in drawing 60161996-SK1002 (Appendix E2).

A.3.2.2.2 Basin Depth

The seabed beneath the outer harbour basin is currently at a level of approximately –3 to –4 m CD (chart datum). The new basin is planned to be dredged in stages to match the stages of berth development, to a depth that provides accessibility consistent with the channel depth. The method of determining the navigation and dredged design depths for the basin areas is essentially the same as that used for the channel in Section A.3.2.1, the differences being:

- the under keel clearance (UKC) requirements, which are less for the harbour basin as the vessel speed (and hence vessel squat)
- vessel heel and wave response are all very low
- lower dredging tolerances, which are related to the type of dredger and the wave climate.

The navigation design depths and average dredge depths for the outer harbour basin are shown in Table A.3.14 for the PEP stages based on the design vessel draughts and accessibility criteria in Table A.3.13. The average dredge depths include allowances for tidal residuals and sedimentation and tolerances for survey and dredging.

Table A.3.13 Parameters for navigation design depth

Parameter	PEP Stages A and B	PEP Stages C and D
Design vessel	Panamax dry bulk carrier	Large Panamax dry bulk carrier
Design vessel static draught – loaded	13.0m	14.6m
Accessibility criteria for design vessel (% tides with 3-hour sailing window)	95%	50%

Table A.3.14 Outer harbour basin navigation depth and dredge depth allowances

Parameter	Unit	PEP Stages A and B	PEP Stages C and D
Design vessel static draught	m	13.0	14.6
Underkeel clearance (UKC)	m	0.9	0.9
Depth benefit for adopted accessibility criteria	m	-1.9	-2.6
Navigation design depth	m CD	–12.0	–12.9
Tidal residuals	m	0.2	0.2
Survey tolerance	m	0.2	0.2
Sedimentation allowance	m	0.1	0.1
Dredging tolerance	m	0.2	0.2
Average dredged depth	m CD	–12.7	–13.6

A.3.2.3 Breakwaters and Revetments

Breakwater and revetment structures are required to:

- provide a suitable level of harbour calmness for shipping operations (serviceability design criteria), as discussed in Section A.3.1.4.1

- protect marine infrastructure and reclamation against wave attack and limit overtopping during cyclones and other extreme weather events as discussed in Section A.3.1.4.2 (ultimate design criteria).

The breakwaters also provide a level of protection against sedimentation processes that could compromise the navigation depth and lead to excessive maintenance dredging.

The outer harbour basin will be enclosed by a new north-eastern breakwater, a new reclamation and revetment on the east side, the existing reclamation and revetment on the south side, and possibly a new breakwater on the west side (the requirement for which will be determined during the detailed design stage).

The breakwater structures also provide a level of protection against sedimentation processes that could compromise the navigation depth and lead to excessive maintenance dredging.

A.3.2.3.1 North-eastern breakwater

A north-eastern breakwater is proposed to protect port infrastructure from the dominant wave climate from the north-east sector and limit wave heights in the outer harbour basin. A conventional, statically stable (no damage) rubble mound breakwater with rock armouring was selected as the most appropriate form of construction for the north-eastern breakwater, although other options will be examined at the detailed design stage.

A.3.2.3.2 Harbour Calmness and a Western Breakwater

Harbour calmness refers to the conditions in the harbour governing safe shipping operations, especially berthing and while at berth. Presently the port operations cease in the event of an extreme event (a cyclone), and vessels are evacuated according to a cyclone procedure. It has been assumed that for the purposes of the outer harbour design that the existing operating regime will continue and that harbour calmness does not need to consider extreme events.

The Preliminary Engineering and Environment Study gave consideration to an outer harbour basin with and without a western breakwater for protection against non-cyclonic waves from the north-west sector (between Magnetic Island and the mainland). The study recommended that the outer harbour be constructed without a western breakwater and assessed that the operational conditions at the berths are unlikely to be significantly compromised. The cost savings are expected to outweigh the additional wharf costs necessary to resist the increased wave action. Should there be a future need for extra wave protection from the north-west, a western breakwater could be constructed without affecting the port layout or operations. In recognition of this possibility, the coastal processes study has been undertaken assuming that the breakwater will be built, as this provides the worst case scenario for modelling the hydrodynamic.

For the wharf and reclamation design, it has been assumed that the western breakwater is not constructed, as this gives a worst case scenario for the hydrodynamic effects on the marine environment. Under this scenario, revetments used in conjunction with skeletal wharves will be designed to the level to limit the overtopping rate of 20 L/s/m during the ultimate design event (500-year ARI). The area immediately adjacent to the revetment will be designed to drain the wave overtopping back into the harbour basin, however the general reclamation area will slope towards the eastern revetment, so that stormwater can be treated before outflow to the sea.

For fully decked wharves, where the wave run up is limited by the soffit of the wharf deck and some overtopping is permitted in extreme events, the deck level will be determined by industry practice in Queensland, which is a ‘no overtopping event’ criterion for a 100-year ARI event.

The higher level required for the above wharf types will determine the level of reclamation. A preliminary assessment of these options indicates that the minimum reclamation level is similar for both wharf types and will result in a minimum reclamation level adjacent to the wharves at approximately +7.25 m CD to satisfy the 20 L/s/m criterion, being approximately 7.0 m water level plus 0.25 m freeboard.

A.3.2.3.3 Breakwater and Revetment Design

Breakwaters and revetments can be designed to allow overtopping to reduce the height and cost of the breakwater. Allowing limited overtopping leads to a more economical design. The Construction Industry Research and Information Association guidelines (CIRIA, 1991) were used to determine the critical values of overtopping discharge.

It is proposed to set the height of the crest of the breakwater and revetments to allow a maximum overtopping rate of 20 L/s/m during the ultimate design event (500-year ARI). Theoretically, this flow rate will not damage paved areas or protected slopes, but can damage grassed areas or buildings located near the revetment.

For ultimate design events with waves from the north-east direction, the crest level of the north-eastern revetment and breakwater will extend above the reclamation level to limit the maximum overtopping to 20 L/s/m. A channel will be used to drain the overtopping discharge from the revetment to the outer harbour to prevent inundation of land areas adjacent to the revetment. Overtopping of the breakwater will discharge directly into the harbour basin.

The concept design of the breakwaters and revetment structures (Figure A.3.6 to Figure A.3.8) considered the survivability of permanent works during extreme metocean events (structural design) and their ability to meet the overtopping criteria. A summary of the primary armour sizes and minimum levels, together with design wave and water combinations are shown in Table A.3.15 and Table A.3.16 respectively.

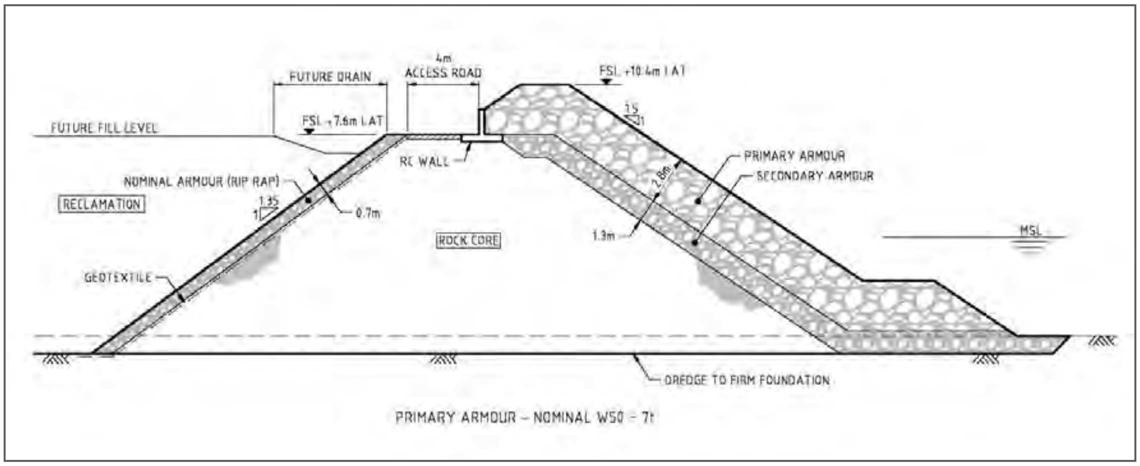


Figure A.3.6 Typical section of north-eastern revetment

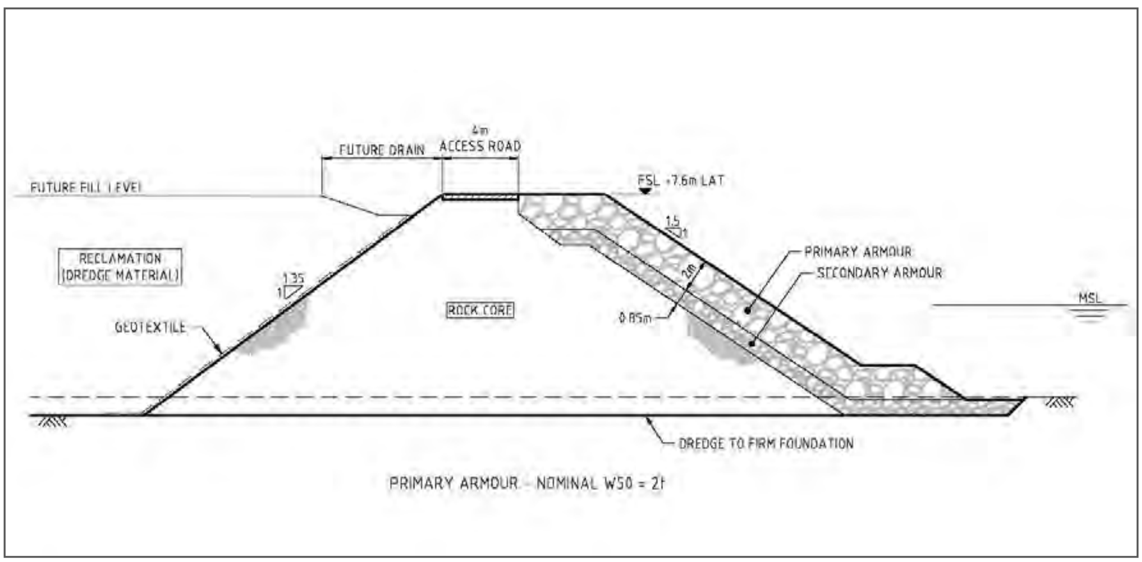


Figure A.3.7 Typical section of eastern revetment

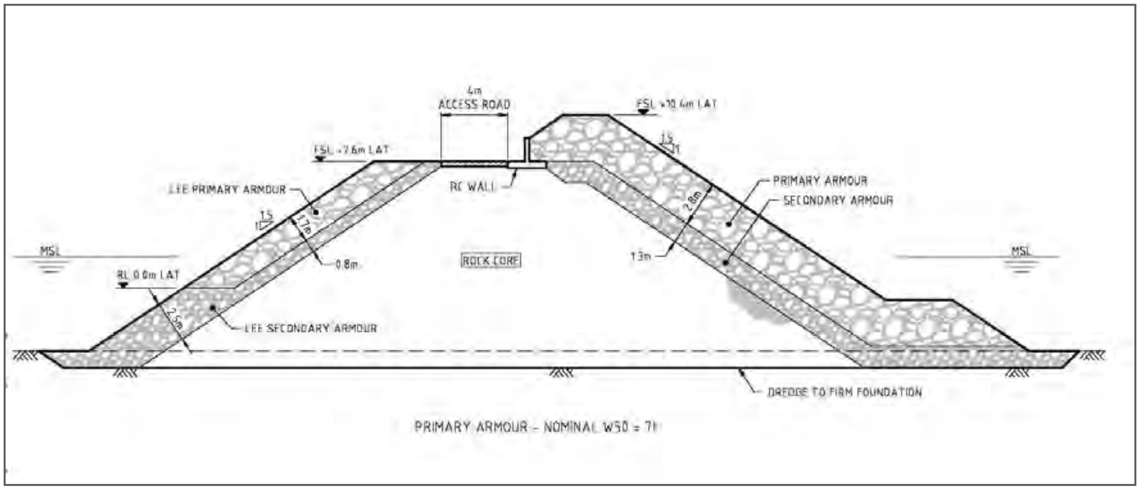


Figure A.3.8 Typical section of north-eastern breakwater (PEP Stage A)

Table A.3.15 Breakwater and revetment rock armour sizes and critical wave and water level combinations

Structure	Primary armour size	Critical design combination[1]
North-eastern breakwater and north-eastern revetment	W_{50} = 7 t (range 4.5 to 9 t)	Intermediate 250-year ARI wave and 250-year ARI water level
Eastern revetment	W_{50} = 2 t (range 1.25 to 2.6 t)	Intermediate 250-year ARI wave and 250-year ARI water level
Western breakwater (if required)	W_{50} = 3.5 t (range 2.2 to 4.4 t)	Maximum design wave 100-year ARI wave and 10-year ARI water level

1 maximum design wave / intermediate / maximum design water level

Table A.3.16 Breakwater and revetment levels and critical wave and water level combinations

Structure	Minimum Level to Meet Overtopping Criteria (m CD)	Critical Design Combination[1]
North-eastern breakwater and north-eastern revetment	Top of rock armour +10.4 Top of wave wall +9.0	Intermediate 250-year ARI wave and 250-year ARI water level
Eastern revetment	Top of rock armour +7.6	Intermediate 250-year ARI wave and 250-year ARI water level
Western breakwater (if required)	Overtopping not a critical design criteria (+8.0 adopted to allow construction from platform on rock core at highest astronomical tide +0.5 m)	n/a

1. maximum design wave / intermediate / maximum design water level

A.3.2.4 Berth Layout and Wharf Design

The number, type and size of berths required was determined in the Master Plan and confirmed in the Preliminary Engineering and Environment Study, with a total of six bulk berths (nominally four dry bulk and two bulk liquid). Each berth is sized to accommodate the design vessel.

The berths behind the breakwater and revetments will be developed in a staged manner in response to demand from increase in cargo throughput or the advent of new trades. This expansion may be developed on a sequential berth-by-berth basis or in stages involving the development of multiple berths.

While the outer harbour basin depth has been designed to meet accessibility criteria, the berth pockets will be dredged to an all-tides depth.

The wharf structure types will be determined by the cargo types and the specific handling requirements. In general it is expected that deck on piles structures, similar to the existing wharf structures, will be built.

Table A.3.17 Minimum levels for wharf structures and wave and water level parameters

Structure	Minimum Level (m CD)	Critical Design Combination[1]
Marginal wharf without western breakwater	+7.6[2]	Intermediate 50-year ARI wave and 50-year ARI water level
Marginal wharf with western breakwater	+6.8[2]	High water level 10-year ARI wave and 100-year ARI water level
Skeletal wharf without western breakwater	+7.0	Intermediate 50-year ARI wave and 50-year ARI water level
Skeletal wharf with western breakwater	+6.4	Maximum design water level 10-year ARI wave and 100-year ARI water level

1 Maximum design wave / intermediate / maximum design water level
2 Marginal wharf at this level will still have some wave impact on deck units, which will accommodated in design of structure.

Several wharf options appropriate for the site conditions were evaluated in Preliminary Engineering and Environment Study in order to identify the most suitable construction type for the PEP. These included sheet pile wall bulkheads, gravity structures, and open piled structures.

The factors taken into account were:

- the ability to provide an economical reclamation edge structure prior to berth construction
- functional requirements
- ground conditions
- hydrodynamic conditions
- availability and cost of construction materials
- construction constraints and opportunities
- durability
- construction cost.

A conventional suspended concrete deck supported on piles with a rock faced revetment underneath, similar to the more recent wharves (e.g. Berths 2, 4, 8, 9, 10) built in the inner harbour was selected. A typical section through the wharf structure is shown in Figure A.3.9.

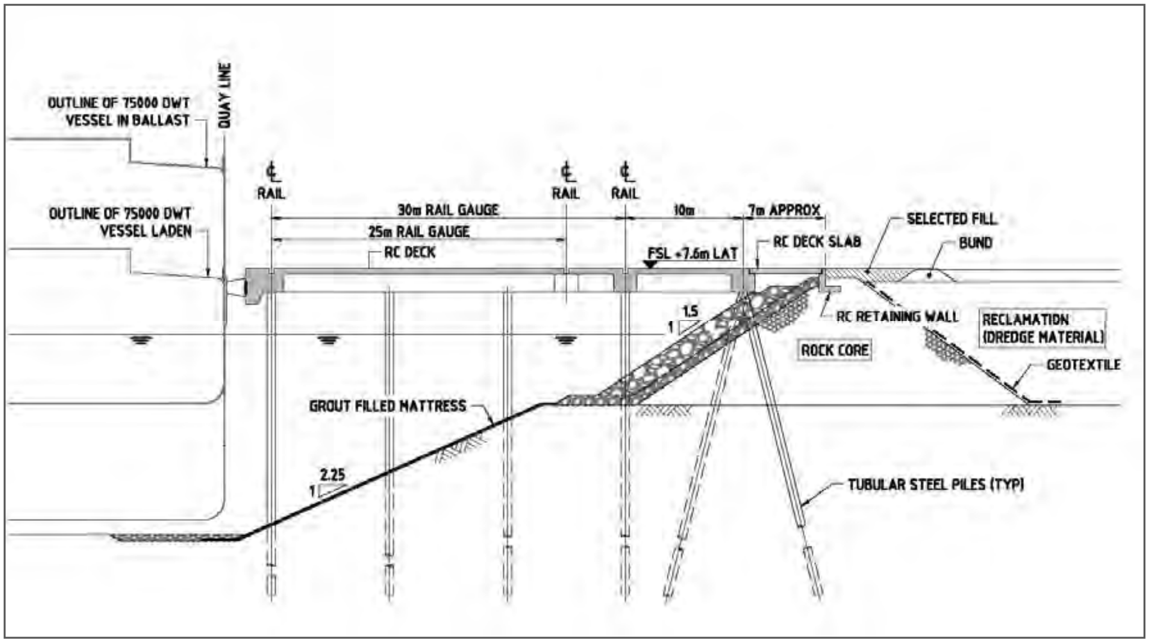


Figure A.3.9 Typical section of a wharf

A.3.2.5 Reclamation Layout

The PEP includes reclamation of land adjacent to the berths to support port operations associated with cargo handling (and support services) and transportation. The extent of the reclamation footprint has been based on the requirement for:

- providing sufficient land area for cargo operations and transport corridors, especially the area required for the rail loop to service the outer harbour
- allowing a residual pond capacity for tailwater treatment from reclamation by dredging and for long-term stormwater treatment
- maximising the opportunity for the re-use of dredged material while minimising the disturbance area
- keeping the size of the reclamation footprint to the minimum size required to meet the port's operational requirements.

The footprint for reclamation is shown in Figure A.1.3. It shows a footprint of approximately 100 ha defined by the north-eastern and eastern revetments and the wharf alignments. Internal bunds will be constructed to assist with the dredging placement and tailwater treatment processes, as well as to suit construction staging requirements. The land will be formed mainly from material reclaimed from the outer harbour basin dredging with a capping layer of land-sourced fill material to assist with the ground improvement treatment. The land reclamation will accommodate cargo storage and facilities to support the transfer of cargo between land and sea modes of transport, especially a rail loop.

In the overall reclamation footprint, discrete reclamation areas are proposed to support staged expansion of the port, in line with the staged dredging described in Section A.3.3.3 and to provide for flexibility during dredging operations. The proposed layout of the reclamation areas and bund wall configuration is shown in Drawing 60161996-SK1100 (Appendix E2). The layout aims to:

- provide a reclamation area sized to suit the staged dredging of the outer harbour area
- provide sufficient reclaimed land, both in terms of area and appropriate dimensions, for the operation of each berth
- allow land to be reclaimed sufficiently in advance of the berth being required to allow time for consolidation and ground treatment as appropriate
- provide sufficiently sized areas for treatment of reclamation tailwater for each stage of reclamation

- provide intra-area bunds on the alignment of key infrastructure including rail and road.

The final finished level of the reclamation is nominally +7.5 m CD, but will vary to satisfy the following requirements:

- a minimum level at the wharf end of +7.25 m CD to cater for overtopping criteria if a western breakwater is not constructed
- a suitable level adjacent to the north-eastern revetment to drain water from overtopping waves back into the outer harbour basin
- the drainage of stormwater to sediment basins adjacent to the eastern revetment.

This reclamation level also meets the capacity requirements for the outer harbour basin dredging quantities and reclamation tailwater treatment areas.

A.3.2.6 Aids to Navigation

Additional aids to navigation will be required to mark the extent of the lengthened dredged channel as follows:

- new channel beacons S3, F3 and F4 for the first stage of channel deepening (PEP Stage A)
- new channel beacons F1, F2 for the second stage of channel deepening (PEP Stage C)

The beacons will be fixed piled channel markers similar to the existing Sea Channel markers with locations shown in Drawings 60161996-SK1006 to SK1009 (Appendix E2).

The existing buoys, which mark the extent of the basin for Berth 11 (and future Berth 12), will be relocated during PEP Stages A, B and C to mark the expanded extent of the dredged outer harbour basin. Additionally it will be necessary to remove the two existing leads located in the basin area when Stage B is developed. These leads are presently used to assist with the turning of vessels for Berth 11. When Stage B is developed the basin will be of sufficient size for ship turning manoeuvres to be carried out without the aid of these leads.

Drawings 60161996-SK1025 to SK1028 (Appendix E2) show the development of the basin navigation arrangement in stages.

A.3.3 Proposed Construction Staging and Methodology

This section outlines a strategy for staging of the PEP development over the planning horizon based on the adopted trade forecast (Section A.1.4.2) and an assessment of the cargo capacity requirements. The staging includes two navigation design depths based on a forecast of ship sizes and ship traffic. Although the development stages are indicative, they do provide a reasonable basis for identifying likely construction methodology for each stage and to undertake an assessment of impacts.

A.3.3.1 Development Staging

It is expected that the PEP works in the new outer harbour will be undertaken progressively to match the need for additional port facilities, which will be driven primarily by the demand to accommodate the growth in existing and/or new trades. While development decisions for each stage will be made when favourable business cases can be demonstrated and will be subject to the availability of capital funding, a feasible development schedule has been prepared which the EIS is based on.

The north-eastern breakwater defining the entire footprint for the new outer harbour will need to be built at the beginning of the Project to provide the appropriate protection for the progressive development of new berths. However, the berths and reclamation areas behind the breakwater will be developed in a staged manner in response to demand from increase in cargo throughput or the advent of new trades. This expansion may be developed on a sequential berth-by-berth basis or in stages involving the development of multiple berths.

The ensuing staging of the works for marine infrastructure, reclamation and channel development will be determined by a number of factors, in particular:

- The removal of all soft material from the north-eastern breakwater footprint, bunded reclamation area and from the initial outer harbour basin dredging area will be undertaken at the outset of the Project.

- The construction of the north-eastern breakwater and revetments will be undertaken at the outset of the Project.
- The development of marine infrastructure in the new outer harbour may be undertaken on a berth-by-berth basis or groupings of two or more berths at a time.
- The dredging of the outer harbour basin will be undertaken in a staged manner to provide the vessel manoeuvring area appropriate to the staged berth development.
- The development of the reclamation area will be undertaken in a staged manner to match the berth development requirements.
- The deepening of the approach channels will be undertaken in stages to meet shipping requirements. The driving parameters will be the draught of the prevailing vessel fleet and the level of service for the vessels in terms of access criteria and the level of tide-assisted transits required. For the purposes of the EIS the channel deepening is envisaged to be undertaken in two stages.

A.3.3.1.1 Project Timetable Overview

While it is not possible to predict exactly when the new berths and associated infrastructure will be developed, an estimate of the timetable for development has been put together as a feasible development scenario to guide the preparation of the EIS, based on the long-term trade forecast prepared for the EIS. In practice the sequence and timing will be regularly reviewed and adjusted to reflect the actual demand for cargo handling capacity and shipping requirements.

The indicative timing of the main components of the PEP development is shown on Figure A.3.10 and discussed below.

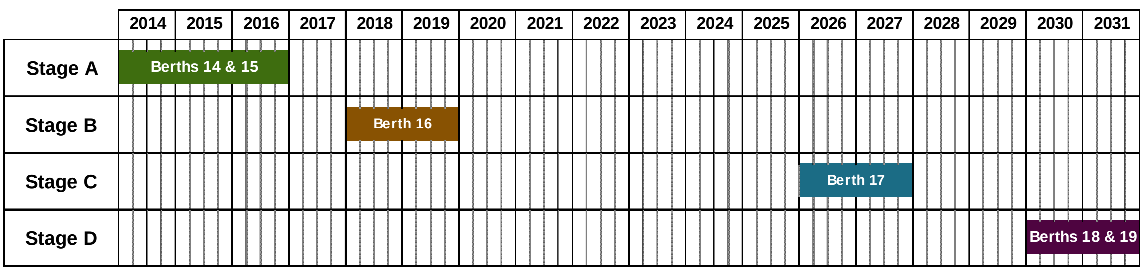


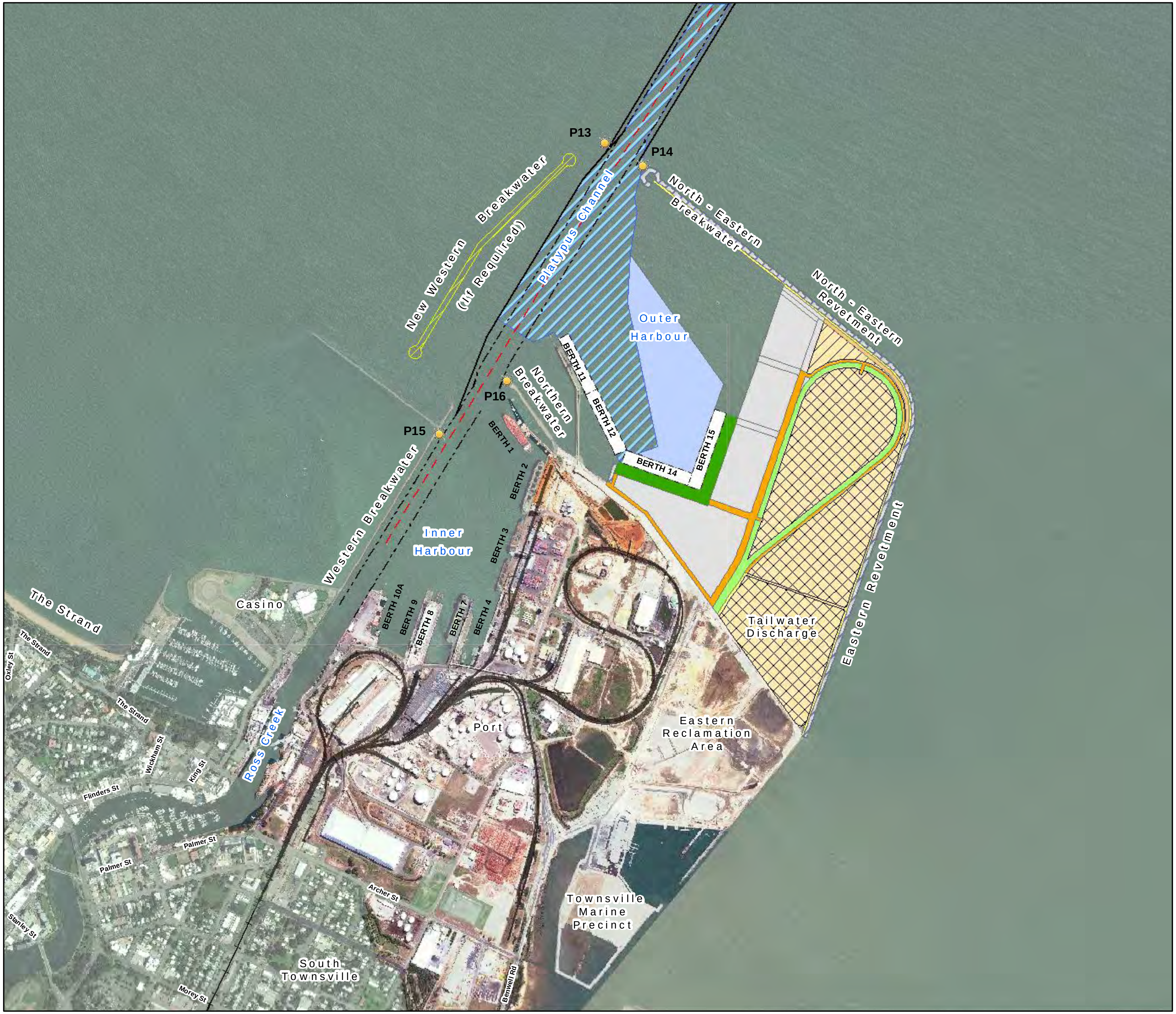
Figure A.3.10 Indicative development program

A.3.3.1.2 Stage A (2014 to 2016)

Stage A development of the PEP (refer outer harbour layout in Figure A.3.11) is planned for construction from 2014 to 2016 involving:

- develop bunded outer harbour reclamation area (entire outer harbour reclamation footprint) with revetments and north-eastern breakwater protection (western breakwater if required)
- develop new Berths 14 and 15
- undertake dredging works:
  - dredging of soft marine sediments in the footprints of the reclamation area, bund and north-eastern breakwater structures, Berths 14 and 15 manoeuvring basin with relocation of dredged material to the existing offshore DMPA
  - deepening of the basin of Berths 11 and 12, with placement of dredged material in bunded areas as reclamation fill
  - dredging of Berths 14 and 15 manoeuvring basin with placement of dredged materials in the bunded areas as reclamation fill or relocated to the existing offshore DMPA
  - Stage 1 deepening of the Sea and Platypus channels and widening of Platypus Channel (between beacons P11/P13 and P12/P14) with relocation of the dredged material to the existing offshore DMPA.
- development of a rail loop and wagon unloading/loading infrastructure required for Berths 14 and 15

- construction of landside infrastructure for cargo storage and transfer (by port tenants) required for Berths 14 and 15
- construction of road and other infrastructure to support port operations required for Berths 14 and 15.



PORT EXPANSION PROJECT EIS

Outer Harbour Layout for PEP Stage A

Figure A.3.11

Legend

- Navigation Beacon
- Railway Line
- Channel Centre Line
- Existing Channel Limits
- Access Road and Service Corridors
- Berths
- Deepening Channel and Basin Areas
- Filled Cell
- New Channel and Basin Area
- New Wharf
- Partly Filled Area
- Perimeter Access Road "2 Way"
- Railway Corridor
- Revetment
- Settlement Pond
- Western Breakwater

N

Scale:1:20,000(when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_101

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
PEP Layout - AECOM 2012

A.3.3.1.3 Stage B (2018 and 2019)

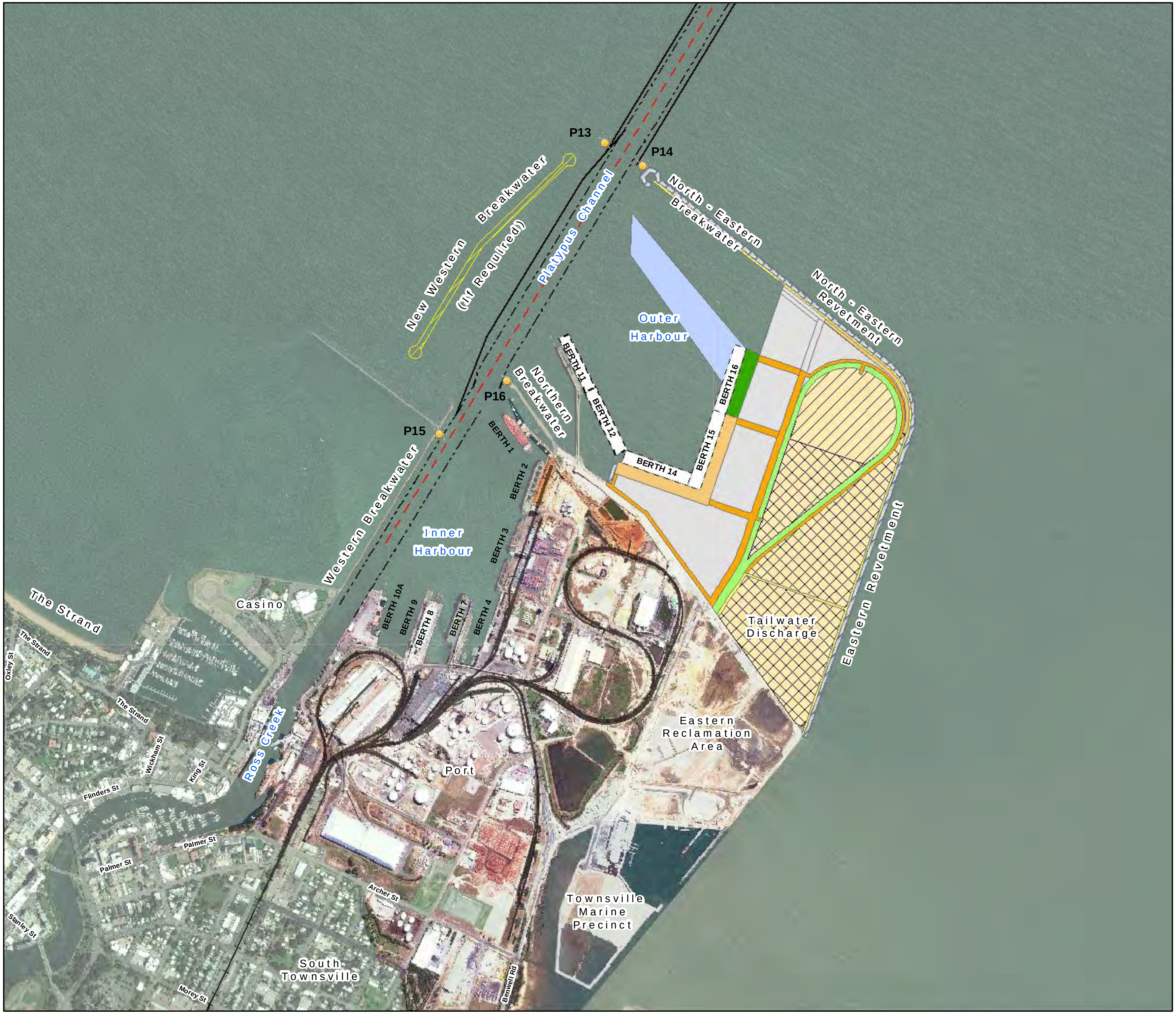
Stage B development of the PEP (refer outer harbour layout in Figure A.3.12) is planned for construction during 2018 and 2019 involving:

- development of new Berth 16
- Undertake dredging works:
  - dredging of soft marine sediments in the footprint of Berth 16 manoeuvring basin with relocation of dredged material to the existing offshore DMPA
  - dredging of Berth 16 manoeuvring basin with placement in bunded areas as reclamation fill.
- development of additional rail and wagon unloading/loading infrastructure required for Berth16
- construction of landside infrastructure for cargo storage and transfer (by port tenants) required for Berth 16
- construction of road and other infrastructure to support port operations required for Berth16.

PORT EXPANSION PROJECT EIS

Outer Harbour Layout for PEP Stage B

Figure A.3.12



Legend

- Navigation Beacon
- Railway Line
- Channel Centre Line
- Existing Channel Limits
- Access Road and Service Corridors
- Berths
- Deepening Channel and Basin Areas
- Filled Cell
- New Channel and Basin Area
- New Wharf
- Partly Filled Area
- Perimeter Access Road "2 Way"
- Railway Corridor
- Revetment
- Settlement Pond
- Western Breakwater

N

Scale:1:20,000 (when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

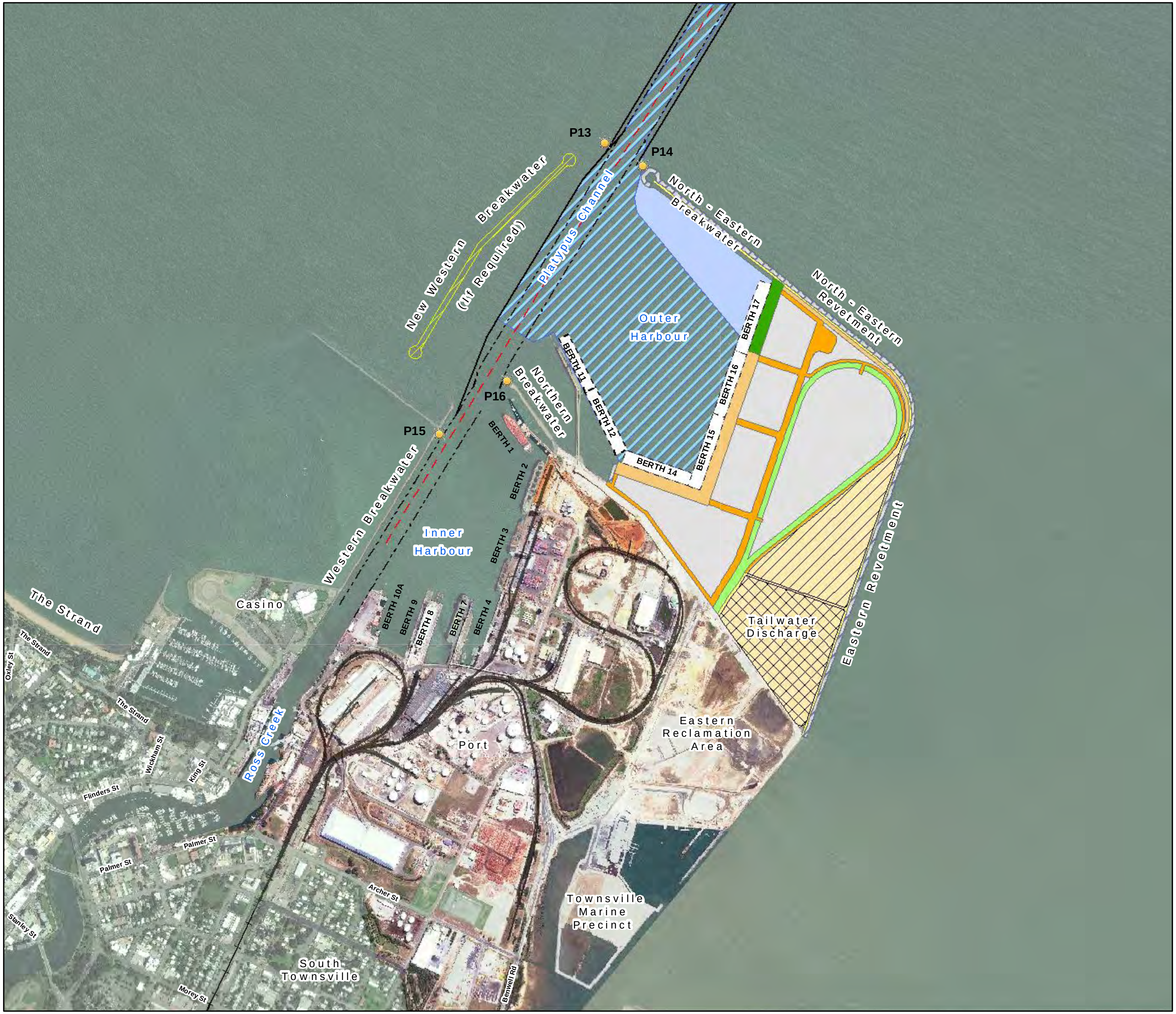
FILE NAME 60161996_PLN_102

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
PEP Layout - AECOM 2012

A.3.3.1.4 Stages C and D

Development of Stages C and D of the PEP (refer outer harbour layouts in Figure A.3.13 and Figure A.3.14) is planned for construction from 2026 to 2035 involving:

- sequential development of new Berths 17, 18 and 19.
- undertake dredging works during Stage C:
  - dredging of soft marine sediments in the footprint of new manoeuvring basin areas with relocation of dredged material to the existing offshore DMPA
  - dredging of the remaining manoeuvring basin area, plus deepening of previously dredged basin area, with placement in bunded areas as reclamation fill
  - Stage 2 deepening of the Sea and Platypus channels with relocation of dredged material to the existing offshore DMPA
- sequential development of additional rail and wagon unloading/loading infrastructure required for Berths 17, 18 and 19
- sequential development of landside infrastructure for cargo storage and transfer (by port tenants) required for Berths 17, 18 and 19
- sequential construction of road and other infrastructure to support port operations required for Berths 17, 18 and 19.



PORT EXPANSION PROJECT EIS

Outer Harbour Layout for PEP Stage C

Figure A.3.13

Legend

- Navigation Beacon
- Railway Line
- Channel Centre Line
- Existing Channel Limits
- Access Road and Service Corridors
- Berths
- Deepening Channel and Basin Areas
- Filled Cell
- New Channel and Basin Area
- New Wharf
- Partly Filled Area
- Perimeter Access Road "2 Way"
- Railway Corridor
- Revetment
- Settlement Pond
- Western Breakwater

N

Scale:1:20,000 (when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

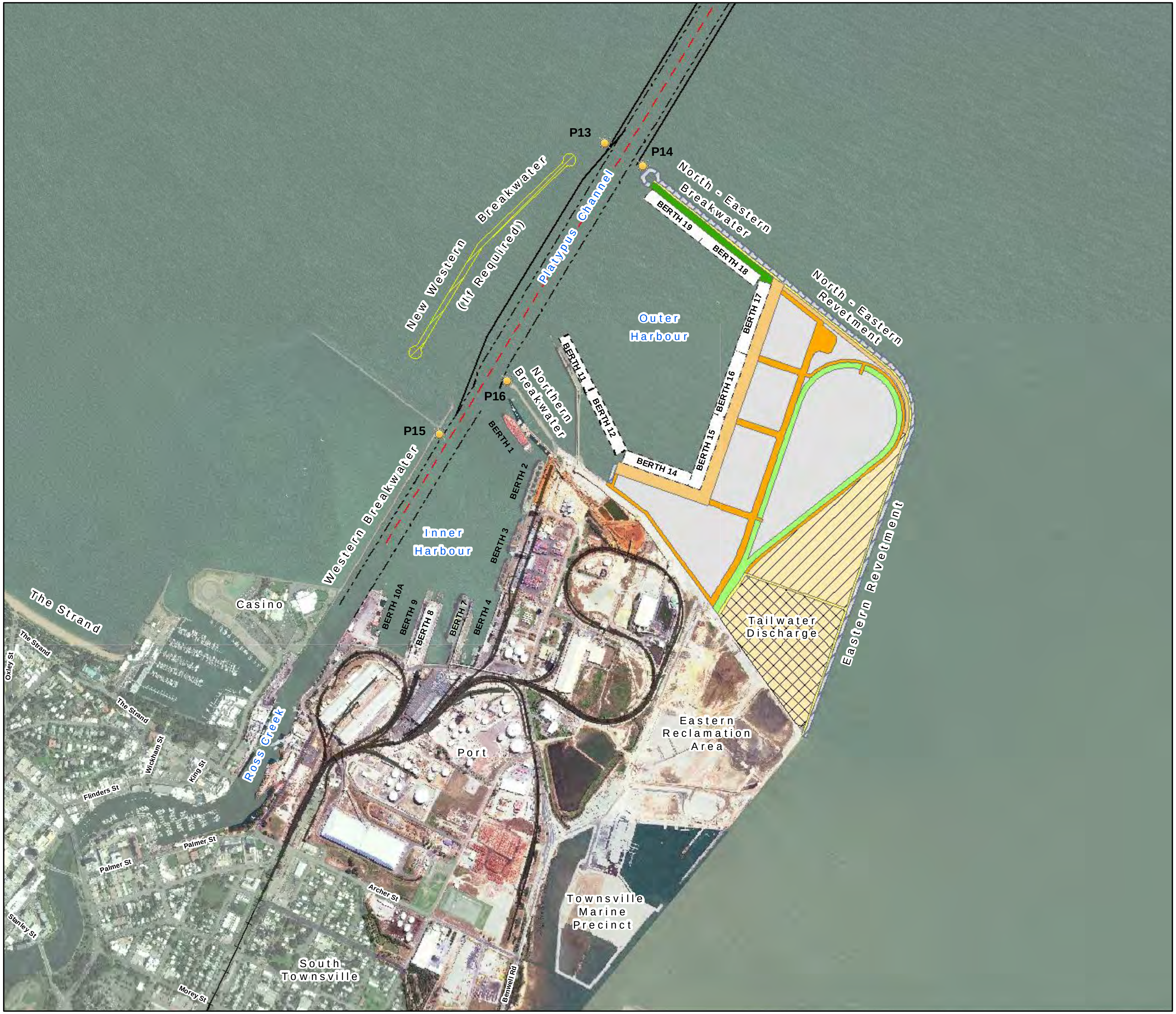
FILE NAME 60161996_PLN_103

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
PEP Layout - AECOM 2012

PORT EXPANSION PROJECT
EIS

Outer Harbour Layout for
PEP Stage D

Figure A.3.14



Legend

- Navigation Beacon
- Railway Line
- Channel Centre Line
- Existing Channel Limits
- Access Road and Service Corridors
- Berths
- Deepening Channel and Basin Areas
- Filled Cell
- New Channel and Basin Area
- New Wharf
- Partly Filled Area
- Perimeter Access Road "2 Way"
- Railway Corridor
- Revetment
- Settlement Pond
- Western Breakwater

N

Scale:1:20,000(when printed at A4)

0 100 200 400 600 800
Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_104

Data Source:

A.3.3.2 Dredged Material Handling and Placement

In order to achieve the preferred PEP infrastructure, dredging of the seabed is required to deepen the existing channels to facilitate larger vessel access and create a protected deep water harbour. It also has secondary objectives to provide fill for landside reclamation to accommodate land-based operations and materials storage and the beneficial re-use of dredge material.

This section provides an overview of the potential options for dredging, material disposal and reclamation, and the formulation of strategies for the construction phase of the PEP to service the preferred development proposal.

These dredging, materials disposal and reclaim activities are the principal construction and development activities contributing to potential marine environmental impacts, so a clear understanding of the processes involved is essential in order to evaluate environmental risks and formulate appropriate mitigation measures.

The dredging strategy outlined here describes available dredging methods, their applicability to each of the key items of infrastructure (harbour and channel deepening, and reclamation), the preferred dredging methods to be adopted, and the disposal strategy for material unsuitable for reclamation (because of its composition or the dredging process). It is based on an understanding of the application of conventional dredging techniques, the quantity and type of material to be dredged, and the suitability and end-use of dredged materials.

A.3.3.2.1 Dredged Materials Handling and Disposal Methods

This section presents a brief description of the three dredging techniques commonly used for major dredging projects and expected to be used for this Project – mechanical dredging, trailer suction hopper dredging, and cutter suction dredging - as background to the selection of the most appropriate dredging and reclamation strategy and the basis for the preferred option considered by the environmental impact assessment.

Mechanical Dredging

Mechanical dredging typically involves the use of either a backhoe dredge or a grab for removal of seabed materials. Dredging by backhoe excavator involves the use of a barge-mounted long reach excavator for the removal of sea bed material. Similarly a grab dredge lowers a clamshell grab to the seabed to excavate the material. Material is typically loaded into separate barges for transport to the disposal location, where it is placed from the underside of the barge (bottom discharge).

A schematic of a backhoe dredge and a grab dredge is provided in Figure A.3.15.

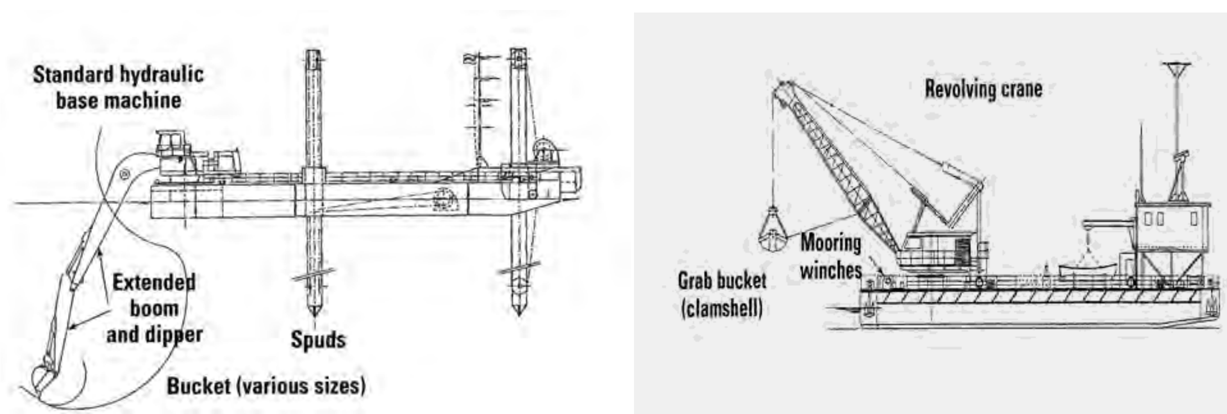


Figure A.3.15 Schematic of common mechanical dredge types

Mechanical dredging is a relatively slow process with low-productivity, and is most suitable to applications where some or all of the following apply:

- hard/stiff material is to be dredged

- access by other dredge types is not possible, typically due to water depth constraints or proximity to structures
- relatively small quantities of material are to be dredged and a high rate of production is not required
- accurate trimming and shaping of the sea bed is required
- seabed and operational disturbances must be suitably managed.

Mechanical dredging offers the least disturbance of the consolidated in situ materials during the dredging process compared with other techniques, resulting in a more compact material at the placement site. Bulking of dredged material following excavation is mainly the result of voids between grab loads of material, and bulking factors are typically in the order of 1.5 to 2.0.

Mechanical dredging is typically not suitable for reclamation above existing water levels due to the requirement for placement from the underside of the barge. However, dredged material may be placed in a temporary storage basin and reclaimed using land-based equipment such as a dragline or backhoe excavator, or by use of a cutter suction dredge (CSD). Alternatively the material can be pumped to reclamation from the hopper barges using a slurry pump. Material placement by these methods results in significant disturbance of the material and it is unlikely the compacted state of the in situ material would be maintained. Further, it is not usually cost-effective as it involves double handling.

Trailer Suction Hopper Dredging

A schematic of a trailer suction hopper dredge (TSHD) is shown in Figure A.3.16.

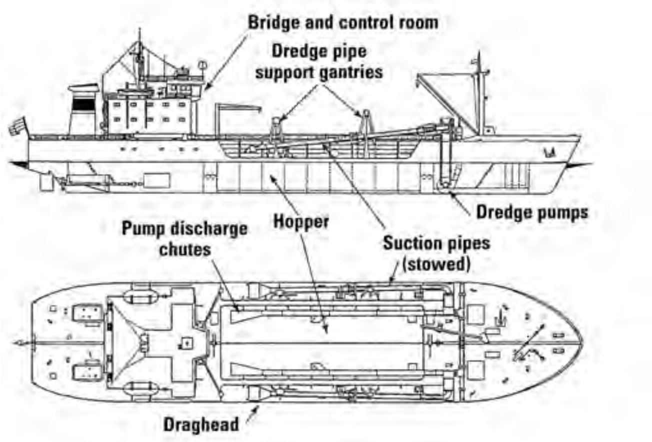


Figure A.3.16 Schematic of a TSHD

A TSHD is a mobile type of dredge that removes sea bed material as it travels using a trailing suction drag head connected by a suspended suction pipe to inboard pumps. During dredging, the TSHD is constantly moving and it is not practical to discharge materials directly to a hopper barge or pipeline during the dredging process.

Dredged materials are stored in an on-board hopper and are transported to the reclamation or disposal site by the TSHD. Because of the large volume of material that can be stored in the on-board hoppers, and the relatively high sea speed of the vessel, this type of dredge is most economically suited to dredging long lengths of seabed and for conveying material long distances to the disposal area. A TSHD is also suited to dredging in areas where non-mobile plant or anchored equipment would interrupt navigation.

Typically, the water that enters the vessel hopper with the dredged material during dredging is released from the hopper compartment through an internal overflow system with keel level discharge during loading. The dredge can be fitted with a 'green valve' that allows the water to be discharged from the dredge without air bubbles, which reduces the amount of solids suspended in the discharged water.

A TSHD may also be operated without overflow at the dredging site, whereby loading of the hopper is stopped when the overflow level in the hopper is reached. However, this method of operation results in considerable reduction of efficiency and increase in overall duration of the dredge campaign.

Given that TSHD's excavate sea bed materials by suction, the technique is best suited to dredging of unconsolidated materials. For stiffer material, the trailing suction drag heads may be fitted with ripping tools and blades to loosen and slice consolidated materials, enabling the removal by suction into the pump and discharge system.

Several techniques are used for discharging dredged material from a TSHD:

- dumping from the underside of the vessel, through valves or opening doors or split hulls
- pump-out via a pipeline, whereby the dredged material in the hopper is fluidised with water and pumped to the reclamation site (suitable for sandy materials)
- pump-out via discharge over the bow of the vessel ('rainbowing'), whereby the dredged material is fluidised in the vessel hopper and the material is discharged as a pumped 'spray' over the vessel bow (suitable only for sand placement).

Bottom discharge is the only practical method of placement of clay material, which is the material type to be dredged in this Project. Material may be placed from the underside of the vessel directly to the final disposal location, or into a rehandling basin and moved to a reclamation site using either a CSD or mechanical dredge.

Dredging using a TSHD causes considerable disturbance of the material. Where consolidated materials are dredged using a TSHD, the material is essentially turned into a slurry containing small clay lumps. Significant bulking can also result from dredging consolidated and cohesive materials (such as the materials of the proposed channel deepening).

The TSHD is a fast and economical method of dredging and is well suited to operation in busy navigation channels. When large commercial vessels are entering or leaving the port, the dredging can be temporarily suspended and the dredge quickly moved out of the channel to allow passage of the other vessel; once passed dredging can quickly be resumed.

Given that a TSHD is self-propelled and must drag the suction head constantly forward over the seabed during loading, the technique is not well suited to dredging in confined areas. Subject to the size of the TSHD, the technique is not suitable for dredging in shallow water as the loaded dredge has a significant draught.

Cutter Suction Dredging

A schematic of a cutter suction dredge (CSD) is shown in Figure A.3.17.

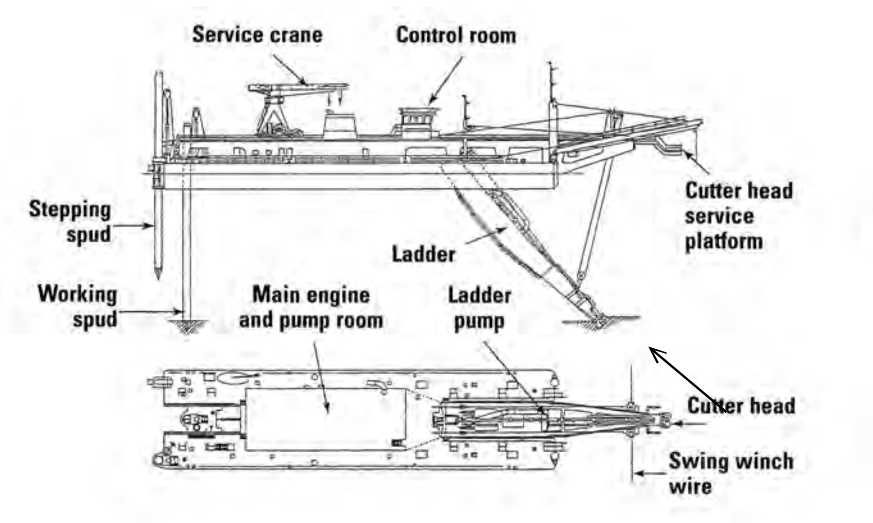


Figure A.3.17 Schematic of a CSD

A CSD uses a rotary cutter head on the end of a 'ladder' to loosen the sea bed material, and suction to remove the material from the sea bed, which is then pumped to the reclamation site via flexible floating or submerged pipelines connected to the dredge and to a system of pipelines in the reclamation area for land distribution. During dredging, the CSD is kept in position using anchors or spud poles. The main or working spud is used as a reaction point against which the dredge is pushed forward and thus pushing the cutter head into the cut. The cutter head of the dredge moves from one side of the cut to the other by winching on the anchors deployed either side of the dredge, causing the dredge to rotate around the main spud pole. By extending a large hydraulic ram on the working spud, it is possible to move the dredge forward by approximately 4 to 6 m before resetting the working spud. The stepping spud or auxiliary spud is used to hold the stern of the dredger in position during spud changes.

CSD are stationary and not as mobile as TSHD. Small CSD are towed to the dredging area by tug boats over short distances or mobilised by transporting on a barge transporter. Large CSD can be self-propelled and ocean going vessels.

The CSD technique is suitable for dredging consolidated sea bed materials, including soft rock. The technique is also well suited to dredging in shallow water where the rotary cutter head can excavate a passage in front of the dredge. The CSD technique is less suited to dredging in areas of vessel operation, as it is time consuming to move the dredge off-line and out of the navigation area to allow the passage of a vessel, and then to relocate the CSD over the progressively dredged interface.

CSD dredging results in significant disturbance of the materials being dredged. As with use of a TSHD, the CSD will cause significant bulking of consolidated and cohesive material. Transport of dredged material to the reclamation site is via pipeline and requires a fluidised material of approximately 20% solids (by volume). Accordingly, a large reclamation area is required to handle material dredged using a CSD and for settlement and treatment of dredge tailwater. In stiff clayey materials such as those that are likely to be dredged as part of the PEP, the CSD operation forms a slurry containing clay balls of consolidated clay material.

A.3.3.2.2 Dredging Options - the Criteria for Establishing a Dredge Strategy

A substantial quantity of material (10 million m³) is required to be dredged to form the new outer harbour basin and to deepen the Sea and Platypus channels. A strategy for re-use and disposal of dredged material has been developed to assist in selecting the appropriate dredging and reclamation techniques to achieve the Project aim of minimising the environmental footprint. Other possible beneficial re-uses for dredge material is discussed in Appendix E4.

The key factors that influence the preferred dredging techniques and strategy are:

- Material quantity to be dredged and the characteristics of the dredge site: some techniques are more suited to the efficient handling of large quantities of dredged material than others, and some techniques are more suited to working in confined areas.
- Proximity of dredging operations to the reclamation area and to disposal locations: some techniques are more suitable than others when short or long distances are involved from the dredge site to the reclamation or disposal site.
- Characteristics of the in situ material to be dredged: some materials are more efficiently handled by one technique over another.
- Suitability of dredging techniques to facilitate the preferred material end-use: some techniques may cause more disturbance than others.
- The end-use of the material and the location of placement or disposal: some techniques are more suited to placing in reclamation and others more suitable to placing in a DMPA.
- The available water depth for dredge equipment access: some dredging plant cannot operate in shallow water.
- Potential conflict with vessels or port operations: some types of dredging plant can be easily moved to avoid any conflict with shipping operations whereas others cannot.

The dredging strategy was also conditioned by the following:

- The material to be dredged in the outer harbour area is suitable for reclamation fill and the dredging volumes (Section A.3.3.3) are such that there is enough material available from the outer harbour basin dredging to meet the reclamation requirements. As it is not expected that any substantial benefit would result from preferential use of material dredged from the channel, the material from the outer harbour basin dredging should be placed in the reclamation in preference to material from the channel dredging.

- The close proximity of the outer harbour basin to the reclamation is conducive to adopting a dredging method that is the most suitable for transferring the dredged material directly to the reclamation area.
- The dredging method most suitable for the outer harbour basin dredging (described in the following section) is more suitable for placement to reclamation than offshore relocation.
- No alternative sources of superior fill (such as quarry material) that would be environmentally acceptable have been identified that could be economically used instead of dredged fill.

Based on this overarching strategy the appropriate dredging and reclamation strategy and techniques have been formulated for each component of the Project.

Table A.3.18 Likely dredging equipment

Dredge Location	Material Description [1]	Likely Dredging Equipment	
		Primary	Secondary
Outer harbour basin and reclamation area	Soft marine sediments	Small TSHD and large mechanical dredge (backhoe or grab dredge)	Self-propelled hopper barges for mechanical dredge
Outer harbour basin	Firm to very stiff and hard sandy clays and medium dense clayey sands	Small/medium CSD	Pipelines and booster station
Channel upgrade Stage 1 - deepening	Mostly firm to very stiff and hard sandy clays and medium dense clayey sands, but with some soft marine sediments	Medium TSHD	Backhoe or grab dredge and hopper barges if very stiff/hard material present
Channel upgrade Stage 1 – widening between beacons P12/P14 and P11/P13	Soft marine sediments, firm to very stiff and hard sandy clays and medium dense clayey sands	Large backhoe (or grab dredge)	Self-propelled hopper barges for mechanical dredge
Channel upgrade stage 2 - deepening	Mostly firm to very stiff and hard sandy clays and medium dense clayey sands, but with some soft marine sediments	Medium TSHD	Backhoe or grab dredge and hopper barges if very stiff/hard material present

A.3.3.2.3 Channel Dredging Strategy

The marine works for the PEP channel development involve dredging of the seabed to deepen the Sea and Platypus channels, and the placement of dredged material in the existing offshore DMPA. Channel widening will be done at the approaches to the new outer harbour.

The channel dredging operation is characterised by the following opportunities and constraints:

- there is a large quantity of material to be dredged in each stage of the channel development
- the material is predominantly firm to stiff but there may be small lenses of cemented materials
- there is sufficient material available from the outer harbour dredging to construct the reclamation footprint required to meet operational purposes, and material from the channel deepening is not required to be placed in the reclamation (to do so would unnecessarily enlarge the reclamation of inshore coastal waters)
- the water is sufficiently deep to allow medium to large dredging plant to operate
- use of static dredging equipment would be problematic for dredging in the operational channel

- the preferred strategy for deepening the Sea and Platypus channels is to place the material in the DMPA, as it is not required for reclamation.

The preferred dredging method is to use a TSHD for the following reasons:

- The deepening will involve dredging substantial quantities of material in an operating channel. The operation of static dredging plant such as a CSD or mechanical dredge would be constrained by the shipping operations in the channel and would result in reduced productivity and economy. A TSHD is ideally suited for this application.
- The dredging will require the spoil to be transported over relatively large distances to the DMPA, and the mechanical or CSD dredging methods would not be practical or economical. A TSHD is ideally suited for this application. Other plant may be required for shaping batters, initial dredging of shallow areas of the channel near the harbour basin, and to provide access for the TSHD to dredge shallow areas.

A medium-large TSHD dredge (10,000 to 15,000 m³ capacity) is the preferred dredging equipment for economical dredging of the material quantities associated with deepening the channels. A dredge of this size would also be required to provide sufficient power for dredging of the consolidated materials that are characteristic of the channel. A TSHD of this size will be able to dredge efficiently and achieve a suitable duration for the dredging work.

Any hard layers unable to be dredged in situ by the TSHD would be precrushed by a CSD for later removal by the TSHD.

As noted above, the material arising from the channel dredging is not required for reclamation. Further, the preferred dredging method (TSHD) reduces the dredged material to a slurry, which is unsuitable for reclamation purposes. It is proposed that the material from the channel dredging is relocated to the DMPA. A two-stage approach has been adopted for the design depth to reflect the ramp-up in trade and vessel size over the planning horizon. The aim of this approach is to optimise the channel depth and minimise dredging volumes that will need to be relocated at each stage of the port development; reducing cost and environmental considerations at each stage.

A.3.3.2.4 Harbour Basin Dredging Strategy

The outer harbour basin dredging strategy is characterised by the following opportunities and constraints:

- There is a relatively large quantity of material to be dredged during each stage of the harbour development.
- The surface materials are soft and loose to approximately 1 m deep and are not suitable as reclamation fill, and should be relocated to the DMPA
- The subsurface materials are firm to stiff and can be used as reclamation fill, provided suitable ground treatment is carried out.
- The area of dredging for the outer harbour basin is located in close proximity to the area to be reclaimed for the PEP. It would be advantageous to use dredged material from the outer harbour basin for reclamation to benefit from the minimal material transport distance. Additionally the use of dredged material in the reclamation works will reduce the amount of imported fill material required and will facilitate the staging of the reclamation.
- The water depth in the area to be dredged is relatively shallow (approximately 4 m at LAT); this would restrict the dredge equipment to types with low draught.
- Stationary dredging equipment is acceptable as it would be unlikely to conflict with port operations or result in substantial conflict with non-port operations such as recreational uses.
- The preferred strategy for dredging the harbour basin is to place the soft compressible surface materials (which are not suitable as reclamation fill) in the DMPA, and the firm to stiff material in the reclamation.

The proposed dredging method is:

- The soft surface material in the outer harbour area will be removed by a small TSHD (in the order of 4,000 m³ capacity) able to operate in the limited available draught by making use of the tide, supplemented by a backhoe or grab dredge, with the dredged material transported to the DMPA. Although a CSD would be able to dredge the material, it would not be a practical or economical means of dredging because of the long distances involved in transferring the material to the DMPA.

- The subsurface materials of the outer harbour basin will be removed and placed in the reclamation by a CSD. The CSD will excavate a passage for itself into shallow regions of the dredging area, and the material will be pumped via a floating, moveable pipeline to the reclamation area and placed to the full reclamation height. This will be a practical and economical method because of the relatively short distance from the dredging site to the reclamation area. A TSHD would not be practical because of the limited draught available. The CSD method will also allow accurate trimming/shaping of the outer harbour basin.

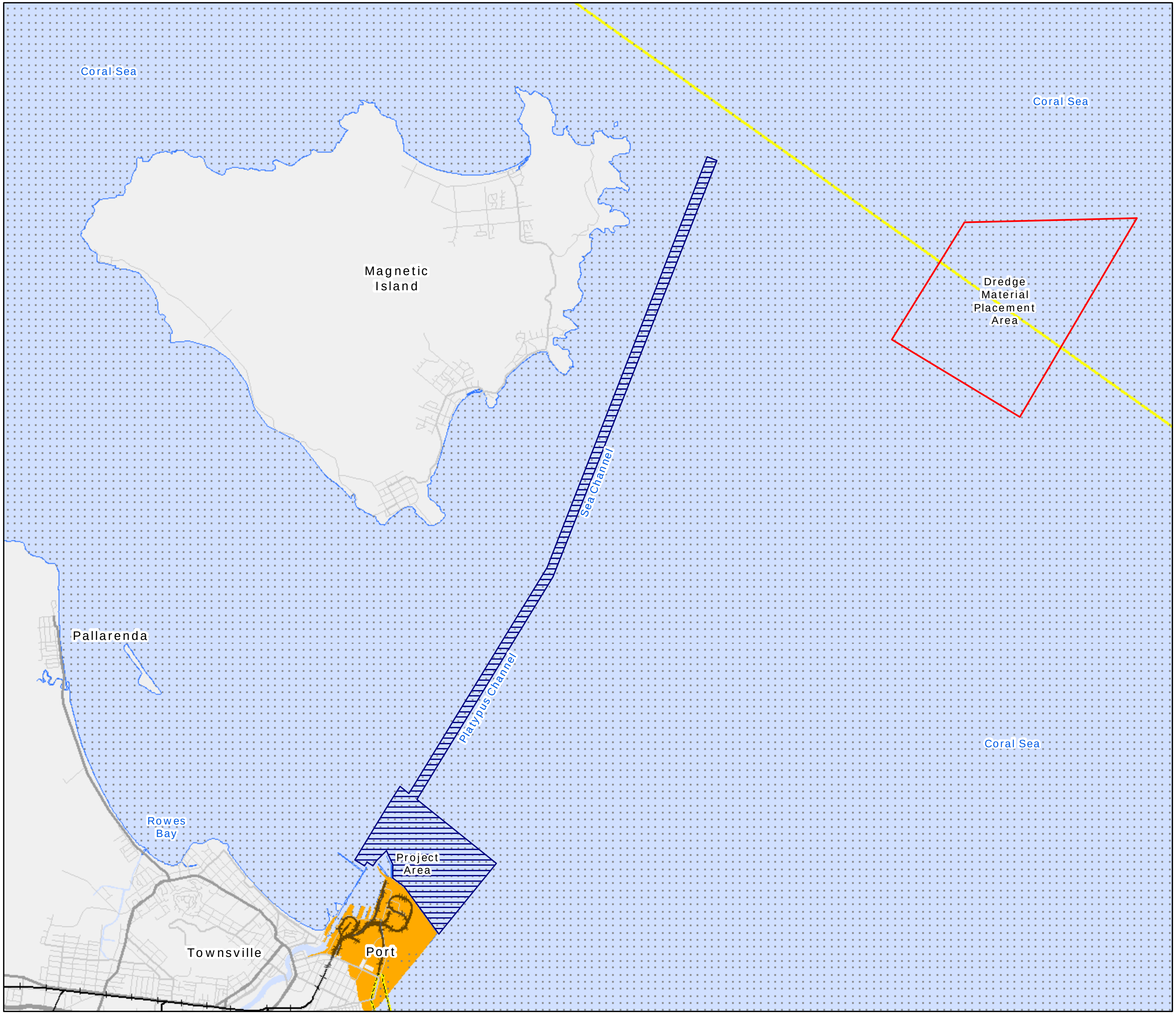
A.3.3.2.5 Dredged Material Placement Strategy

The existing POTL offshore DMPA is partly located in the port waters and is a reasonable sailing distance for the TSHD from the channel dredging operation. It has a depth varying from –11 m CD to –14 m CD, with a small pocket of up to –15 m CD at its most seaward boundary. Figure A.3.18 shows the location of the DMPA. Figure A.3.19 shows a recent hydrographic survey of the DMPA.

PORT EXPANSION PROJECT
EIS

Location of Existing Offshore
DMPA

Figure A.3.18



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- GBRWHA/National Heritage Place

N

Scale: 1:100,000 (when printed at A4)

0 0.5 1 2 3 4
Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_135

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
World Heritage Area - Queensland Goverment 2012
GBRMP Zones - Queensland Goverment 2012

Figure A.3.19 Hydrographic survey of existing DMPA and recommended zoning (POTL, 2010d)

A review of the capacity of the existing DMPA (Appendix E4) was undertaken to determine whether there is sufficient capacity available for the PEP dredging, but also collectively for the other known planned dredging projects in the port, being:

- dredging for the upgrade of Berths 8 and 10, and the new Berth 12
- minor channel improvements planned by POTL
- regular maintenance dredging campaigns undertaken in the port.

The review shows that the DMPA will have sufficient capacity to receive the material from the planned PEP dredging operations, including the soft material relocation from the outer harbour basin and reclamation area, and the channel deepening, provided the material is placed in designated Zones A, B and C (Figure A.3.19) appropriate for the equipment, and placement is evenly distributed in each zone.

A.3.3.3 Reclamation Strategy and Design

A.3.3.3.1 Reclamation Strategy

The extent of the reclamation footprint is based on the technical requirements for:

- the land area required for cargo operations and transport corridors, especially the area required for the rail loop to service the PEP
- basins of adequate size and volume for tailwater treatment from reclamation activities and staged land creation, and also providing for stormwater treatment
- maximising the beneficial re-use of dredged material.

In the overall reclamation footprint, discrete reclamation areas enclosed by construction bunds are proposed to support staged expansion of the port, in line with the staged dredging described in Section A.3.3.3.3 and to provide for flexibility during dredging operations. The proposed layout of the reclamation areas and bund wall configuration is shown in Drawing 6021922-SK1100 (Appendix E2). The layout aims to:

- provide reclamation areas sized to suit staged dredging of the outer harbour basin

- provide sufficient reclaimed land both in terms of area and appropriate dimensions for the operation of each berth
- allow land to be reclaimed sufficiently in advance of the berth being required to allow time for consolidation and ground treatment as appropriate
- provide sufficiently sized areas for treatment of reclamation tailwater for each stage of reclamation
- provide areas for the safe disposal of contaminated material should this be encountered
- provide intra-area bunds on the alignment to support key infrastructure including rail and road infrastructure.

The PEP includes reclamation of land adjacent to the new berths to support port operations associated with cargo handling and transportation. The reclamation will be formed from the firm to stiff material dredged from the harbour basin area.

A detailed description of the PEP layout, and the corresponding extent of land reclamation, is provided in Section A.3.2.5.

A.3.3.3.2 Reclamation Level

The nominal finished pavement level for the reclamation recommended in Section A.3.2.5 is +7.5 m CD. Allowing for a nominal pavement thickness of 0.7 m and the capping layer thickness of 1.0 m, the finished reclamation level will be approximately +5.8 m CD.

A.3.3.3.3 Reclamation Staging

A preliminary assessment of the dredge material, based on the available geotechnical data and historical dredging information, suggests that the dredged material placed in reclamation would need to be treated to consolidate the material and reduce post-placement settlement time prior to the use of the reclaimed land for port operations. The staging of reclamation (and any associated dredging works) must consider the lead time required for the construction and consolidation process. There is also an important relationship between the available time for consolidation of the reclamation and the cost of ground improvement. More rapid or accelerated consolidation typically requires more intensive ground treatment and would incur higher construction costs.

In principle, the reclamation construction involves:

- preparation of the seabed by the removal of soft sediments
- staged construction of bund walls to contain the dredged material, and breakwaters
- placement of dredged material in bunded reclamation areas and treatment of reclamation tailwater
- ground treatment works to improve consolidation and engineering properties of reclamation fill.

A construction staging sequence has been developed, based on commissioning one or two berths during each stage of the harbour development. In practice, future growth in trade through the Port of Townsville will dictate the preferred program for development of each stage, and a number of stages may be combined in a single phase of the PEP.

The dredging sequence is expected to be as follows.

Stage A – Dredging Works for Berths B14 and B15 and Stage 1 Channel Deepening

(Drawing 60161996-SK1015 in Appendix E2)

A1 Remove surface sediments along the alignments of the north-eastern breakwater, north-eastern revetment and eastern revetment using a mechanical dredge with hopper barges to relocate the material to the DMPA. The hopper barges will place the material in the DMPA by bottom discharge.

A2 Construct the eastern revetment, north-eastern revetment and north-eastern breakwater to form a protective coastal environment for further dredging work using a small TSHD.

A3 With the north-eastern breakwater and revetments in place, remove the remainder of the surface sediments in the reclamation and basin dredging area by a small (shallow draught) TSHD, and relocate the material the DMPA. A mechanical dredge will be used to dredge areas that cannot be accessed by the TSHD.

A4 Construct the internal bunds of the reclamation and tailwater treatment cells I to X.

A5 Construct the western breakwater (if required).

A6 Dredge the outer harbour basin for Berths 14 and 15 (and deepen the existing outer harbour basin area for Berths 11 and 12) using a CSD and place the dredged material in reclamation. Discharge tailwater to the bay from the eastern side of the reclamation site from Cell X.

A7 Deepen the Sea and Platypus Channels (chainage 1,000 to approximately chainage 15,000) using a medium-large TSHD of approximately 10,000 to 15,000 m³ hopper capacity and place the material in the DMPA (bottom discharge). Hard consolidated material will be crushed in situ by a CSD to be removed by the TSHD. Trimming of channel will be done by mechanical dredge.

A8 Widen the Platypus Channel between channel markers P11/P12 and P13/P14 (chainage 1,850 to chainage 2,750) to 130 m using a mechanical dredge with the material relocated to the DMPA using hopper barges (bottom discharge).

Stage B – Dredging Works for Berth 16

(Drawing 60161996-SK1016 in Appendix E2)

B1 Remove the soft marine sediments for the Berth 16 basin area using a large mechanical dredge and relocate to the DMPA using hopper barges (bottom discharge).

B2 Dredge the harbour basin for Berth 16 using a CSD and place the dredged material in reclamation. Tailwater is discharged to the bay from the eastern side of the reclamation site from Cell X.

Stage C – Dredging Works for Berths 17, 18, 19 and Stage 2 Channel Deepening

(Drawings 60161996-SK1016 and SK1017 in Appendix E2)

C1 Remove the soft marine sediments for the Berth 17 basin area (which will also be common to Berths 18 and 19 developed during Stage D) using a large mechanical dredge and relocate to the DMPA using hopper barges (bottom discharge).

C2 Dredge the harbour basin for Berth 17 (and deepen other dredged outer harbour basin areas for Berths 11 to 16) using a CSD and place the dredged material in reclamation. Tailwater is discharged to the bay from the eastern side of the reclamation site from Cell X.

C3 A medium-large TSHD of around 10,000 to 15,000 m³ hopper capacity deepens the Sea and Platypus Channels (chainage 1,000 to approximately chainage 16,500) and places the material in the DMPA (bottom discharge). Hard consolidated material will be crushed in situ by a CSD to be removed by the TSHD. Trimming of channel will be done by mechanical dredge.

Stage D

No dredging will be required during this stage as this will be undertaken when Berth 17 is developed.

A.3.3.3.4 Dredging and Reclamation Quantities

The estimated quantities of material to be dredged are shown in Table A.3.19. These are based on a bathymetric survey carried out during 2011.

Table A.3.19 PEP dredging requirements

Dredging Location	Material Description	In Situ Volume (m³)	Placement of Dredged Material	Comment
Outer harbour basin and reclamation	Soft marine sediments	1,500,000	Existing offshore DMPA	Top layer of material that is unsuitable for placement in reclamation
Outer harbour basin	Firm to very stiff and hard sandy clays and medium dense clayey sands	4,300,000	Outer harbour reclamation	In stages (>1,000,000 m³ each) according to berth development requirements

Dredging Location	Material Description	In Situ Volume (m³)	Placement of Dredged Material	Comment
Channel upgrade Stage 1 – deepening	Mostly firm to very stiff and hard sandy clays and medium dense clayey sands, but with some soft marine sediments	1,600,000	Existing offshore DMPA	Design depth of –12.8 m CD. The dredging process will make material unsuitable for reclamation purposes
Channel upgrade Stage 1 – widening from P11/P12 to P13/P14	Soft marine sediments, firm to very stiff and hard sandy clays and medium dense clayey sands	700,000	Existing offshore DMPA	Design depth of –12.8m CD
Channel upgrade stage 2 - deepening	Mostly firm to very stiff and hard sandy clays and medium dense clayey sands, but with some soft marine sediments	1,800,000	Existing offshore DMPA	Design depth of –13.7m CD. The dredging process will make material unsuitable for reclamation purposes

A.3.3.3.5 Reclamation Area Works

The soft seabed sediments overlying firm material will be removed by TSHD or mechanical dredge and placed in the existing offshore DMPA. Although the land area required for the PEP will be reclaimed using dredged material from the outer harbour basin, selected fill material will also be required from land sources to build bund structures to retain the dredged fill, to protect the reclamation from erosion and wave attack, and provide settlement areas for the management and treatment of the reclamation tailwater.

The proposed location of the internal bunds will be determined by the areas required to provide suitable land-based operational areas behind Berths 14 through 17, to provide a suitable foundation for heavily loaded areas (such as road and rail infrastructure) and to provide sufficient capacity and flexibility for treatment of reclamation tailwater during the harbour dredging and reclamation activities. In any given stage of the development, it is proposed that future reclamation cells will be developed in advance of the cell being reclaimed to provide sufficient capacity for settlement of tailwater.

The dredged material for reclamation will be placed in areas contained in bund walls. The purpose of the bund walls is to retain the often slurry-like output from the dredge in discrete areas, protect the reclamation from erosion and wave attack, and retain and manage the tailwater from the dredge material (for subsequent management) by forming settling ponds.

The bund walls will be constructed as conventional earth/rock fill structures. Those perimeter bund walls exposed to the sea will be designed to withstand extreme metocean conditions with limited overtopping.

The construction of the walls will be made impervious to retain the tailwater and avoid turbidity plumes generated by the water containing fine material from the dredged material escaping unmitigated to the sea.

The perimeter bund structure would typically incorporate a height adjustable weir box in the last settling pond to control the overflow tailwater discharge over a period of time.

Internal bund walls will control the movement of sediment and water so that areas can be dewatered and suspended sediments can settle to control the quality of tailwater (Section A.3.3.3). As for the perimeter walls, internal bund walls will be fully impermeable, but are only required to withstand wind-wave action that may be generated from in the bunded areas.

Height adjustable weir boxes are required between bunded areas to control the flow of water and suspended sediments. These are generally located to create a long path for the movement of water to maximise retention time.

The location of bund walls adopted for the PEP has been established considering:

- land requirements adjacent to berths.
- alignment of transportation corridors (road, rail and conveyor routes), in particular the location of the rail loop; where possible the bund wall forms a strong foundation for the transport corridor.

- appropriately sized bund to receive reclamation and tailwater treatment during the different stages of development.

These locations and bund sizes will be optimised during the detailed engineering design stage of each berth or channel development.

A.3.3.3.6 Dredged Fill Placement and Containment

The bunded areas will be arranged to provide dedicated ponds for reclamation and tailwater treatment, configured so that the treatment ponds become reclamation areas during subsequent dredge campaigns. This arrangement is generally preferred as it reduces the extent of bunded areas to be provided during the initial stages of the PEP.

Upon mobilisation of the CSD to the site, a floating and flexible pipe line will link the stern connection of the pump system of the dredger to the shore connection. From this point, land distribution lines will allow the material to be pumped to the start of the fill area and subsequently, with extensions to the pipe system, cover the area to be reclaimed.

An initial construction pad will be reclaimed to design levels from the starting point on a bund wall, using one or two outlets of the CSD discharge pipeline, as may be arranged using Y-pieces with valves. From this construction pad, the main discharge line will enter the reclamation area and branch off using Y-pieces and valves into the sub-discharge lines to advance the face of the reclamation in a planned manner to line and level. The design fill level will include an allowance for future settlement in order to avoid excessive earthworks in the future.

The levelling during the filling will be achieved by wide-track bulldozers (D6). Excessive discharges of clay may require the importation of sand from stockpile (created from dredged material with high sand content) to allow levelling and access by wide-track earthmoving equipment. Continuous access will be required to extend the discharge pipe lines.

A.3.3.3.7 Settling Pond and Tailwater Treatment

The dredging and reclamation process described in the previous sections involves fluidisation of seabed materials to slurry for hydraulic placement into the reclamation site. The bunded area receiving the discharged dredge material will contain mostly coarser materials that settle relatively quickly from the dredge inflow, such as any sandy material that may be present and material that may be in a cohesive form such as clay balls. Some fines will settle with the sand and clay balls, while a large portion of the finer suspended sediments will be entrained in overflow to subsequent bunded areas which act as settling ponds.

In order to mitigate the environmental impacts associated with discharge of the sediment laden tailwater, a system of tailwater treatment is proposed as part of dredging and reclamation strategy.

The methodology used for estimation of settling pond performance simplifies a number of operational practices in order to determine a conservative estimate of pond capacity requirements.

The calculation assumes uniform dredge production, material characteristics, settlement performance, wind and wave driven re-suspension and pond operational water levels. These factors will be variable throughout the dredging campaign and will influence the operation of the settling ponds and secondary treatment measures within the ponds if required.

During dredging and reclamation of the Eastern Reclamation Area (1996), the operational water levels of settling ponds were adjusted during dredging to reduce the hydraulic retention time where favourable material characteristics and settlement/re-suspension performance permitted. The hydraulic retention time was increased by raising the operational pond levels during periods where unfavourable materials were dredged and where wind/wave conditions resulted in increased sediment re-suspension.

Dredging of the in situ stiff clay materials of the outer harbour area using a CSD technique is likely to result in formation of clay balls in the reclamation area. Accordingly, a proportion of fine clay particles of the in situ material will be bound in clay ball conglomerates. Under this condition, the actual fraction of particles removed through settlement may be greater than estimated in this assessment, allowing a reduced hydraulic retention time. However, for the purpose of the EIS, the maximum probable treatment extent is identified to allow for potential variation in dredge plant, operational practices and dredged material characteristics.

Seabed Material Characteristics

The particle size distribution for material to be dredged from the outer harbour and placed in the reclamation area was based on the results of geotechnical investigations undertaken by Douglas Partners in 1997 (Douglas Partners, 1996). That investigation provides the most complete understanding of subsurface particle size distribution in the outer harbour that was available at the time of the assessment. It was assumed for this estimate that the particle size distribution from a borehole is representative of in situ material in the outer harbour area to be dredged as part of the PEP.

Secondary Tailwater Treatment Methods

Estimation of tailwater settling pond capacity was based on first principles methods and included a number of simplifying assumptions to describe the dredging and reclamation operations. In addition to the settling pond secondary tailwater treatment methods may be required to satisfy tailwater quality targets during dredging/reclamation operations that are outside of those assumed in the estimation and during periods where the settling performance is not consistent with that assumed in the estimation.

Secondary tailwater treatment methods that may be employed include:

- Increasing hydraulic retention time by raising operational pond levels or altering and lengthening pathway.
- Controlling releases using a weir box.
- Additional silt curtains prior to discharge from each settling pond.
- Selective dredging of more favourable materials.
- Coagulation/flocculation immediately prior to tailwater discharge.
- If required, as a last resort, suspension of dredging/reclamation until operational performance limits are achieved.

These measures are consistent with those adopted in the dredging and reclamation campaign of the Eastern Reclamation Area in 1996. Further details on tailwater management are given in Section A.3.3.3.

Reclamation Tailwater Management Objectives

The development of tailwater treatment methods and the treatment system capacity was based on the following objectives:

- Achieve tailwater quality objectives that mitigate potential environmental impacts and that are consistent with best practice.
- Establish a practical balance between the tailwater quality outcomes and the footprint required for treatment of tailwater, based on evaluation of potential environmental impact.
- Provide operational flexibility for probable dredge plant to be used for dredging and reclamation.
- Develop methods of tailwater treatment that support staged development.

Treatment Methods

The methods proposed for treatment of reclamation tailwater include:

- use of future reclamation areas as ponds for settlement of suspended sediments
- use of silt curtains within ponds as a secondary measure for filtration of suspended sediment from the water column.

A series of interconnected treatment ponds is proposed, to provide a number of performance and operational benefits, including:

- reduction of potential effects of particle re-suspension by wind and wave action
- flexibility in managing settlement performance variability by adjustment of operational pond water levels (and hydraulic retention time)
- increase in the mean hydraulic retention time in the pond series (reduction in hydraulic short-circuiting)

- provision for practical deployment of silt curtains at inter-pond bunds as secondary tailwater treatment.

Particle Settling Characteristics and Treatment

The discrete particle settling velocity for each material class was determined using Stoke's Law, which is relevant for laminar flow conditions with a Reynolds number less than approximately 0.2. Table A.3.20 shows the ideal settling velocity and Reynolds number for each particle size class.

In order to account for potential particle re-suspension by wind and wave action in the settling ponds, it was assumed in the calculation that the settling velocity would be 60% of the ideal settling velocity calculated using Stoke's Law. The assumed settling velocities for relevant particle size classes (with Reynolds number less than approximately 0.2) are shown in Table A.3.20.

Table A.3.20 Summary of particle size distribution of material to be placed in reclamation area (based on borehole OB9)

Particle Classification	Representative Particle Size (mm)	Fraction (%)	Ideal Settling Velocity (m/s)	Reynolds Number	Assumed Settling Velocity (m/s)
Coarse gravel	40	0	1.34E+03	5.17E+07	N/A
Medium gravel	12	0	1.20E+02	1.40E+06	N/A
Fine gravel	4	0	1.34E+01	5.17E+04	N/A
Coarse sand	1.2	1	1.20E+00	1.40E+03	N/A
Medium sand	0.4	1	1.34E-01	5.17E+01	N/A
Fine sand	0.12	11	1.20E-02	1.40E+00	7.22E-03
Coarse silt	0.04	29	1.34E-03	5.17E-02	8.02E-04
Medium silt	0.012	17	1.20E-04	1.40E-03	7.22E-05
Fine silt	0.004	7	1.34E-05	5.17E-05	8.02E-06
Clay	0.002	34	3.34E-06	6.46E-06	2.01E-06

The following assumptions underpinned the estimation of particle capture and treatment performance:

- suspended particulates at the inlet of a settling pond are uniformly distributed in the top 2.5 m of the water column
- particles that fall a distance of 2 m or greater during the pond hydraulic retention time will not be resuspended at the outlet weir and will be retained by the settling pond
- the hydraulic retention time for each settling pond is 75% of the theoretical hydraulic retention time, to account for potential hydraulic short-circuiting of flow through the ponds
- the dredge plant is 100% productive (although it is understood that actual dredge productivity is likely to vary between 60% and 80%, the assumption of 100% gives a conservative approach)
- silt curtains deployed in the settling ponds have 25% particle removal efficiency (it is expected that removal efficiency could be higher).

Based on these assumptions, it is anticipated that a total treatment pond capacity volume of approximately 1,500,000 m³ to 2,500,000 m³ is required to achieve a theoretical target suspended solids concentration of 30 mg/L. This target was established as a precedent during the Eastern Port Development dredging and reclamation campaign in 1996, but it is acknowledged that the target is approaching the theoretical performance limit for gravity settling systems of this type.

Hydrodynamic modelling was undertaken as part of the EIS to determine the dispersion and sedimentation characteristics of tailwater discharge associated with the proposed dredging and reclamation. The findings of the modelling are documented in full in the Hydrodynamic Modelling Report Appendix H1.

A.3.3.3.8 Reclamation Internal Bunds and Edge Structures

The main function of the internal bunds is to form the reclamation cells that retain the dredged material. Some cells will initially provide for settling of reclamation tailwater and will be systematically filled to form the reclamation during subsequent stages of the PEP. A rockfill bund option has a significant cost advantage over the other options and was selected as the preferred option.

The construction methodology and construction sequencing for the perimeter bund walls of the reclamation area is outlined below.

- The top layer of soft marine sediments under the footprint of the bund walls will be removed by mechanical dredge so that a firm foundation is achieved for the structures.
- The core of the bund wall is constructed using quarry run material, which will be placed on the prepared seabed. The placement of core will be land-based with material either by end tipping directly over the core or pushing the material over the core using a bulldozer after being end tipped on the core.
- Geotextile will be placed on the lee face of the bund wall. The purpose of the geotextile is to reduce migration of the fines in the dredged material through the bund. With the geotextile in place, the generation of turbid plumes due to the migration of the fines through the bund will be reduced.
- Placing of the geotextile will be done with care so that the entire face is covered and that minimum lap lengths are achieved. Placement of the geotextile will occur immediately behind bund construction work face to reduce the risk of complications resulting from tidal flows through the core material.
- Suitable granular material with an additional rip rap overlay where required will be placed over the geotextile (lee face) to keep it in place under tidal and wave induced loading and protect it during construction or until such time as the reclamation fill is placed. Nominal rock armour (rip rap) will be placed over the geotextile layer on the edges that may experience wave overtopping and edges inside ponds that may be affected by local wind-wave action.
- The seaward face of the bund wall core will be protected from waves using conventional armour design. This design will incorporate primary and secondary layers of rock armour, and may require a geotextile filter layer if the run of quarry in the core is at risk of migration through the armour.

During construction, some turbidity plumes will be caused by the suspension of fine material contained in the core as well as the primary and secondary rock armour. The turbidity releases (post construction) through the edge structures due to fine material migrating from the dredge fill material will not be significant because they will be controlled by the geotextile, which will act as a filter. Any turbidity releases will be small and will be negligible in comparison to the turbidity generated by material stirred up from the seabed in front of the toe of the revetment structures due to response from wave action and currents. Fines migration is anticipated to diminish with time as pores in the geotextile are clogged by the fines.

A.3.3.3.9 Capping Layer

In addition to the reclamation fill material sourced from dredging works, good quality fill material will be required for construction of capping and pavement layers on the surface of the reclamation. It is proposed that this material will be imported from land-based sources. The capping layer serves a number of functions including:

- providing a stable working surface to support plant and equipment until the reclamation fill has gained strength
- capping the reclamation to prevent erosion and degradation of the surface prior to the reclaimed land being developed
- providing a stable sub-base for pavement and facility foundation construction.

A nominal 1 m thickness for the capping layer has been adopted.

A.3.3.3.10 Ground Improvement

A preliminary estimate of primary and secondary settlements was undertaken as part of the Preliminary Engineering and Environment Study based on the methods of dredging and reclamation proposed for construction of the PEP and the observed historical settlement characteristics of the eastern reclamation, undertaken in 1993. The expected primary consolidation settlement of the reclaimed spoil, assuming placement of a 1 m capping layer of imported granular material (providing a 20 kPa load), but without further preload or surcharge material would be in the order of 500 mm. This settlement could take up to 50 or more years to occur. In addition to the primary consolidation settlement, long-term creep or secondary consolidation settlements of the order of 5 mm to 10 mm per year would be expected.

It is anticipated that the estimated period for primary settlement (without ground improvement) would be a major constraint to development of the PEP. A number of ground improvement options to accelerate the rate of primary consolidation settlement and increase the ground stiffness so that additional loading can be supported without excessive settlement were considered.

If the area is required within a specific time frame, e.g. two years, as will probably be required for the early stages of the PEP, then a combination of wick drains and surcharge would be the preferred method for modest load requirements.

For heavier load requirements, such as covered material stockpile areas in excess of 50 kPa, stone columns have been adopted as the most cost effective and preferred method.

A.3.3.4 Pre-Construction Activities

Prior to commencement of construction, it will be necessary for POTL and contractors to undertake pre-construction activities to prepare for, and support, the major work elements. The activities and requirements will be contingent on the project delivery strategy and contractor's work method and plant, the key activities at each PEP development stage being:

- Undertake detailed design of infrastructure.
- Develop and obtain approved Environmental Management Plans.
- Obtaining licences/permits for the construction works including temporary structures that require approval.
- Establish site office, workshop facilities, equipment and plant and maintenance and parking facilities (specific locations to be detailed during pre-construction stage).
- Implement site security and safety measures for land and water based activities.
- Establish moorings for dredging vessels and plant, construction floating plant and support craft. These may be using existing facilities, temporary structures or anchorages.
- Provide site access, power, telecommunications, water supply, refuelling facilities and other infrastructure (note there is no accommodation facilities proposed as a part of this project).
- Establish laydown areas for stockpiling of construction materials.

Existing port land will be required on the north-eastern side of the Eastern Reclamation Area to support construction activities during Stage A, while the later stages of development could use this area and/or new land created in the outer harbour.

The pre-construction activities will have the greatest requirement for Stage A, because this stage involves:

- Development of the reclamation bunds, revetments and breakwaters which will also involve establishment of the supply of a quarry for material.
- Use of a range dredgers and other dredging equipment for the development of the basin and channel works.
- Development of two wharf structures.

A.3.4 Construction Resources

The PEP will involve major construction works to develop the marine and landside infrastructure. Due to the scale of works heavy construction equipment will be deployed, in particular to:

- relocate seabed material by dredging to reclamation and DMPA

- haul and place material from land sources as part of the development of the land reclamation, edge structures and breakwaters
- construct wharf structures

These activities will largely determine the duration of construction and comprise the majority of the PEP construction cost. Other construction works comprising road and rail infrastructure and trunk services, although a small portion of the Project, are significant construction activities.

The terminal infrastructure (cargo storage, materials handling systems) will be developed as separate projects with their own approvals by port tenants.

This section outlines the expected key resources (equipment, materials and personnel) for the PEP.

A.3.4.1 Rock Source

POTL intends to use its own quarry (Granitevale) as well as other commercial quarries to supply the rock material required for the breakwaters, revetments and bund walls for the PEP. The Granitevale quarry is located in the Hervey Ranges, south-west of Townsville. It is located in the agricultural and rural residential area, well away from higher density residential areas. Approvals for the quarry are not part of the PEP EIS. The road haul distance from the quarry to the Port of Townsville is approximately 50 km.

POTL has assessed that the Granitevale quarry yields high quality armour rock with low fracturing properties. Large armour rock can be obtained using appropriate blast patterns making this a good source of rock for the armour layers. This is likely to be supplemented by other quarries near the Flinders Highway (Stuart/Roseneath), which would supply some of the filter and core material. These quarries generally have a shorter road haul to the port than the Granitevale quarry.

The estimated quantities of rock required are shown in Table A.3.21 for each stage of development. The vast majority of rock material required is during Stage A when the reclamation footprint, north-eastern breakwater, north-eastern revetment and eastern revetments are constructed.

Table A.3.21 Rock material quantity estimate

Rock Material Type	Rock Size W_{50} (kg)	Range (kg)	Estimate of In situ Rock Quantity (m³)				
			Stage A (B14 and 15)	Stage B (B16)	Stage C (B17)	Stage D (B18 and 19)	Total Stages A to D
Core	-	< 1,000	5,905,000	-	-	220,000	6,125,000
Filter Type1	600	300 to 700	240,000	-	-	-	240,000
Filter Type 2	300	100 to 500	95,000	-	-	-	95,000
Primary Armour Type 1	7,000	3,000 to 9,000	295,000	-	-	-	295,000
Primary Armour Type 2	3,000	1,000 to 5,000	45,000	15,000	15,000	-	75,000
Total Tonnage			**6,580,000**	**15,000**	**15,000**	**220,000**	**6,830,000**

A.3.4.2 Construction Equipment

The major items of equipment expected to be deployed for the Project are listed in Table A.3.22 for each stage of development. This equipment was used for impact assessment of construction activities.

Table A.3.22 PEP major construction equipment and indicative durations

Works and Activities	Equipment	Stage A		Stage B		Stage C		Stage D	
		Duration# (weeks)	Number	Duration# (weeks)	Number	Duration# (weeks)	Number	Duration# (weeks)	Number
North-eastern breakwater and revetments [24/7 activity]									
Delivery of breakwater and revetment core material and armour	Trucks (nominally 30 t)	90	50 (300 trips/ day)	-	-	-	-	40	2 (6 trips / day)
Handling and placing rockfill	Excavator	90	3	-	-	-	-	40	2
Trimming/level finish surface	Bulldozer	90	1	-	-	-	-	-	-
Rock armour placement	Crane	90	1	-	-	-	-	-	-
Construction management	Utility vehicles	90	3	-	-	-	-	-	-
Western breakwater (if required) [24/7 activity]									
Transporting and placing core and armour	Transport barge with tug	50	2	-	-	-	-	-	-
	Work boat	50	1	-	-	-	-	-	-
	Survey boat	50	1	-	-	-	-	-	-
Handling and placing rockfill	Excavator	50	1	-	-	-	-	-	-
Rock armour placement	Crane	50	1	-	-	-	-	-	-
Delivery of rockfill and rock armour	Trucks	50	12 (70 trips / day)	-	-	-	-	-	-
Moving rock on and off barge	Front-end loader / bulldozer	50	2	-	-	-	-	-	-
Dredging (outer harbour and channels) [24/7 activity]									
Dredging breakwater/revetment footing, widening Platypus Channel and trimming of batter slopes.	Mechanical dredge	45 (30 + 15)	1	5	1	15	1	-	-
	Small tug	45 (30 + 15)	1	5	1	15	1	-	-
	Work boat	45 (30 + 15)	1	5	1	15	1	-	-
	Survey boat	45 (30 + 15)	1	5	1	15	1	-	-
Transporting and placement of dredged material in the DMPA	Hopper barges (nominally 2,500 m^3 hopper)	45 (30 + 15)	3	5	2	15	2	-	-

Works and Activities	Equipment	Stage A		Stage B		Stage C		Stage D	
		Duration# (weeks)	Number	Duration# (weeks)	Number	Duration# (weeks)	Number	Duration# (weeks)	Number
Dredging of soft material in outer harbour, transporting and placement of dredged material in the DMPA	Small TSHD (nominally 4,000 - 6,000 m³ hopper)	25	1	5	1	5	1	-	-
	Survey boat	25	1	5	1	5	1	-	-
Dredges and pumps directly into reclamation area	Medium CSD	45	1	45	1	45	1	-	-
	Work boat	45	1	45	1	45	1	-	-
	Survey boat	45	1	45	1	45	1	-	-
Dredges channels and transport to DMPA	Medium TSHD	15	1	-	-	15	1	-	-
	Work boat	15	1	-	-	15	1	-	-
	Survey boat	15	1	-	-	15	1	-	-
Reclamation area [Dredge discharge activity 24/7] [Capping layer activity 12/5]									
Reclamation operations involving moving of pipelines, shifting surcharge material, placement of capping layer, construction of rail loop.	Bulldozers / front-end loaders / traxcavator	55	5	55	3	55	3	40	3
	Off-road dump trucks (nominally 30t)	55	4	55	3	55	2	40	1
	Mobile crane	55	1	55	1	55	1	40	1
Delivery of material for capping layer and pavements	On-road dump trucks (nominally 30t)	10	4 (9 trips / day)	10	4 (9 trips / day)	10	4 (9 trips / day)	10	4 (9 trips / day)
Ground treatment	Stone column or wick drain rig	25	1	25	1	25	1	-	-
Construction management	Utility vehicles	55	6	25	6	25	6	40	6
Road, rail, civil works and services [12/5 activity]									
Earthworks, pavement formation layers, delivery of materials, civil works for trunk services and utilities	Delivery trucks	30	4 (20 trips / day)	30	4 (20 trips / day)	20	4 (20 trips / day)	30	4 (20 trips / day)
	Mobile cranes	30	1	20	1	20	1	30	1
	Bobcats	30	2	20	2	20	2	30	2

Works and Activities	Equipment	Stage A		Stage B		Stage C		Stage D	
		Duration# (weeks)	Number	Duration# (weeks)	Number	Duration# (weeks)	Number	Duration# (weeks)	Number
	Excavators	30	2	20	2	20	2	30	2
	Grader	30	1	20	1	20	1	30	1
	Utility vehicles	30	3	20	3	20	3	30	3
Road pavement	Paving machine	4	1	3	1	3	1	3	1
Rail track work	Track machine	4	1	3	1	3	1	-	-
Wharf construction [24/7 activity]									
Pile driving	Barge-mounted pile driver	40	1	25	1	25	1	40	1
	Tug for barge	40	1	25	1	25	1	40	1
	Work boat to support	40	1	25	1	25	1	40	1
Deck construction	Large crane	35	1	25	1	25	1	35	1
Concrete delivery	Concrete trucks	35	2 (8 trips/ day)	25	2 (8 trips/ day)	25	2 (8 trips/ day)	35	2 (8 trips/ day)
Construction management	Utility vehicles	40	3	25	3	25	3	40	3

includes period of time while mobilising and de-mobilising

A.3.4.3 Workforce and Support Services

It is proposed to develop the PEP in a staged manner with the majority of construction expected to occur during Stage A, the details of which are included in Section A.3.3.1.2.

It is expected that at the peak of construction, which will occur in Stage A, the Project would demand approximately 100 full-time equivalent people during construction working directly on site related activities. It is most likely that this would be undertaken by contractors. In addition to the onsite work, further employment would be generated offsite from the Project relating to materials supply and construction support including transport operators, quarry workers, precast concrete factory workers, steel fabricators and the like.

The subsequent dredging, capping and ground treatment of the reclamation would be undertaken progressively to meet demand for land required for future development purposes. Similarly, the development of other berths and dredging work would also be undertaken progressively and the timing for the subsequent development for Stages B to D, as detailed in Sections A.3.3.1.3 and A.3.3.1.4 would be linked to the need for additional port capacity (that is, an increase in trade). Construction employment would follow suit.

The flow on construction employment opportunities arising from this Project will also include:

- construction of the cargo handling infrastructure development and equipment by port tenants, including shiploaders and unloaders, cargo storage sheds, administration facilities, conveyors, material receival facilities, pipelines and tank farms, which could peak at 150 workers
- operation of the cargo handling facilities by port tenants and users, from shipside to the port precinct gate (management and administration, equipment operators, maintenance and general labour) could number approximately 30 workers per facility

- marine operations in the new harbour (pilots, linesmen, tug crews, security staff) and harbour facilities maintenance (routine infrastructure maintenance, repairs to damaged infrastructure), which would involve a small workforce.

The greatest employment opportunities expected from the Project are those generated from the creation of industrial developments remote to the port, such as new or expanded mines, new or expanded refineries, and increase in product movement and transport. These developments rely on ready access to port infrastructure for import and export of product, and without PEP these developments would not have access to the required infrastructure to be viable in this region. The PEP offers benefits to the local, state and national economies and to increased employment opportunities.

Table A.3.23 shows an estimate of the construction workforce for the PEP stages of development. The cargo handling infrastructure development that will be undertaken by port tenants with approvals separate to the EIS will also have a requirement for a significant construction workforce. An estimate of this workforce is included in Table A.3.24.

Table A.3.23 Estimate of onsite workforce for construction of PEP

Construction Activity	Stage A			Stage B			Stage C			Stage D		
	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)
Onsite infrastructure construction												
Contractor's head office and site office	5	36	5.0	5	18	5.0	5	18	5.0	5	15	5.0
Dredge crew including surveyor, barges and work boats												
Backhoe or grab dredge	8	4.5	1.0	10	4.5	2.5	10	4.5	2.5	-	-	-
CSD	10	7.5	2.1							-	-	-
Small / medium TSHD	10	9	2.5	-	-	-	10	9	5.0	-	-	-
Bund and breakwater construction	10	18	5.0	-	-	-	-	-	-	10	4	2.7
Reclamation fill placement	5	7.5	1.0	5	6	1.7	5	6	1.7	-	-	-
Capping layer placement and ground treatment	5	9	1.3	5	6	1.7	5	6	1.7	5	6	2.0
Materials transport operators	45	36	45.0	10	18	10.0	10	18	10.0	10	15	10.0
Piling crew	5	12	1.7	5	7	1.9	5	7	1.9	5	12	4.0
Berth construction	10	12	3.3	10	8	4.4	10	8	4.4	10	12	8.0
Road and rail access	20	6	3.3	20	6	6.7	20	6	6.7	10	4.5	3.0
Services and utilities construction	20	6	3.3	10	6	3.3	10	6	3.3	15	6	6.0
Port and marine operations												
Head office and vessel control	3	36	3.0	2	18	2.0	3	18	3.0	1	15	1.0
Tug crew and pilots, pilot boat crew, linesmen	10	36	10.0	7	18	7.0	10	18	10.0	2	15	2.0
Security staff	3	36	3.0	3	18	3.0	3	18	3.0	3	15	3.0
Maintenance and repair crew	5	36	5.0	3	18	3.0	5	18	5.0	1	15	1.0
Total full-time equivalent workers		96			52			63			48	

Construction Activity	Stage A			Stage B			Stage C			Stage D		
	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)	Peak number of workers	Duration (months)	Full-time Equivalent (workers / month)
Duration (months)	36			18			18			15		

Table A.3.24 Estimate of onsite workforce for construction of cargo handling infrastructure and equipment by port tenants

PEP Stage	Number of Workers	Duration (months)
Stage A	150	18
Stage B	75	18
Stage C	75	18
Stage D	150	18

In addition to the onsite construction workforce, offsite construction support and indirect employment will be generated by the PEP and associated cargo handling infrastructure and equipment by port tenants as follows:

- offsite construction support: precast concrete fabrication, structural steel fabrication, equipment fabrication and supply, materials and equipment transport, quarry operations, materials supply, etc.
- indirect employment flowing on from onsite and offsite activities: residential accommodation, goods and services, etc.

A.3.4.4 Materials and Transportation

The major construction materials and their transport to site are as follows.

- Rock material comprises the largest quantity of material to be delivered for the Project with the vast majority being required during Stage A. The quantities of material for primary rock armour, filter layers and core material for bund construction is included in Section A.3.4.1. The material will be road hauled from the POTL Granitevale quarry and possibly other quarries along the Flinders Highway (Stuart/Roseneath) to the PEP site.
- The truck haulage route from the Granitevale quarry is expected to be Granitevale Road, Upper Ross River Road, Douglas Arterial, University Road, Bruce Highway, TPAR (under construction). The impact of traffic from the haulage of rock for the construction of PEP has been assessed as part of the EIS (B14 Transport and Infrastructure).
- The truck haulage route from the other quarry sources will be along the Flinders Highway and connecting to the port along the TPAR (under construction).
- The capping layer to complete the land reclamation will require approximately 250,000 m³ of material to be transported to the site. There are a number of potential locations that this is material could be sourced from, including using overburden material from the rock quarry. This material will be road hauled to the site accessing the port along the new TPAR.
- Concrete for wharf construction (ready-mixed and precast) will be transported to the site by road from various suppliers in the region via the new TPAR.
- Steel piles are proposed for wharf construction. It is expected that the piles will be delivered by ship directly to the port and transported from the wharf to the construction site by road on the port's internal road system.

- Other construction materials (steel reinforcement, pipes, culverts, etc.) will be transported to the site by road from various suppliers in the region mostly via the new TPAR.

A.3.5 Port Infrastructure - Associated Landside Requirements

In addition to the marine based port infrastructure works (dredging, reclamation and marine structures) there is a requirement for significant landside infrastructure and services to support the development of cargo handling terminals and facilities. This section discusses the major components of the landside development requirements, some of which will be undertaken as part of the PEP and others that will be undertaken as separate projects requiring separate approvals.

A.3.5.1 Land Transport

The transport of goods by land to and from the PEP will be via the existing Port of Townsville links to the hinterland. Access to the port, and especially the PEP, is presently being enhanced with the development of the EAC. At the time of preparing the EIS, the TPAR (located in the EAC) was under construction and planning was being progressed for rail to be developed in the EAC. The EAC also makes provision for future links between the port and the TSDA by conveyor and pipeline. In the long term, it is expected that the EAC will become the main corridor route for the port's transport, although existing road and rail will also continue to be used for traffic to the existing port areas.

Only the road and rail infrastructure to be built within the port boundary is included in the EIS. This does not include the EAC, which has been subject to a separate EIS process.

A.3.5.1.1 Rail

Effective and efficient rail transport will be a critical aspect of the PEP. Townsville is a critical component of the Mount Isa supply chain with the vast majority of commodities moved on the Mount Isa line either originating or arriving at the port. QR Network has prepared the Mount Isa System Rail Infrastructure Master Plan (QR, 2012), which identified the infrastructure and train length requirements for a number of forecast cargo tonnage trigger values for the upgrade of the line.

Approximately 80% of the port's cargo was transported by rail; 8.9 Mt of the 11 Mtpa of cargo during 2010/2011. This high proportion of cargo is due to the dominance of bulk cargo that is handled through the port. The proportion of rail transport was forecast to increase to over 90% by 2040 for the port due to the high growth of existing dry bulk cargoes (mainly nickel ore and mineral concentrates) and new dry bulk export trades (particularly coal, magnetite and fertiliser), which will be transported by rail.

Rail infrastructure will be required in the outer harbour with loading and unloading facilities for bulk cargo. Although some of the cargo in the outer harbour that will be transported by rail could be transferred from existing facilities in the existing inner harbour, a new rail loop will be required. The foundation for a rail loop will be constructed using rock material during Stage A.

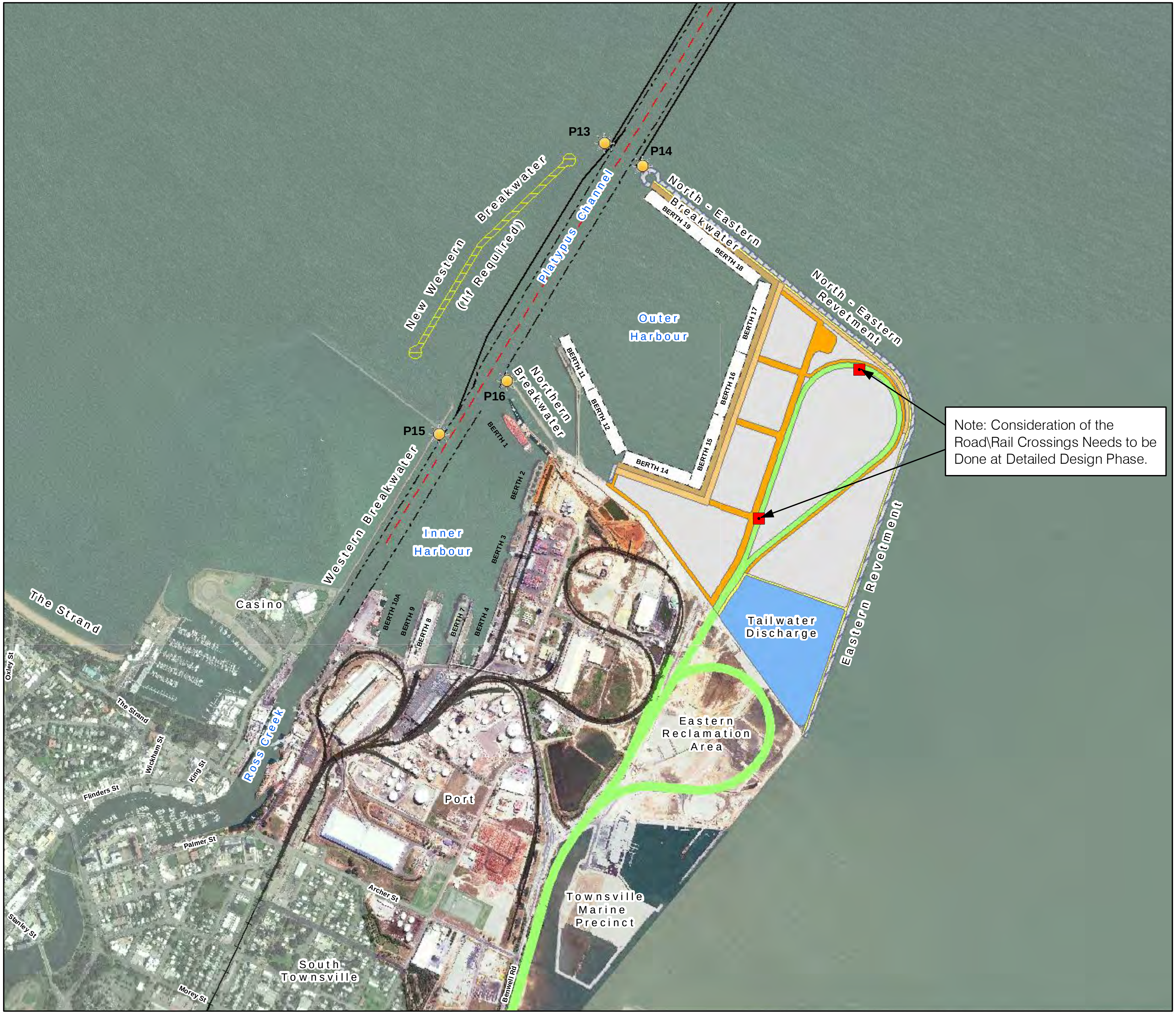
Based on the forecast trade through the Port of Townsville and the findings of the QR Network Master Plan (QR National), the rail layout includes provision for a three track balloon loop and connection to the future EAC rail system. The balloon loop was set-out to accommodate train lengths up to 1.5 km, which are anticipated over the planning horizon, and with a 200 m radius, which is acceptable to Queensland Rail. This set-out is a key factor in determining the overall reclamation footprint.

Only the rail infrastructure to be built within the port boundary is included in the EIS. Figure A.3.20 shows the alignment of the PEP rail and access via the existing port.

PORT EXPANSION PROJECT
EIS

Layout of Rail Loop

Figure A.3.20



Legend

- Road\RailCrossing
- Navigation Beacon
- Railway Line
- Access Road and Service Corridors
- Berths
- Cargo Transfer and Operations
- Dredging Reserve
- Perimeter Access Road "2 Way"
- Port Operations
- Future Railway Corridor
- Revetment
- Western Breakwater
- Wharf

N

Scale: 1:20,000 (when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_136

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
PEP Layout - AECOM 2012
Existing Rail - Schlencker Mapping Pty Ltd

A.3.5.1.2 Roads

Road access to and within the PEP area is essential to support effective and efficient port operations.

Currently road access to the port is primarily via Boundary Street and Benwell Road. Boundary Street is bounded by a mix of residential and non-residential uses including industrial, commercial and shop-type uses.

Both Boundary Street and Benwell Road form part of the Principal Road Freight Network as defined in the *Townsville City Plan 2005* (TCC, 2005a). Other connections to the port also exist via Archer Street and Ross Street that form part of the Secondary Road Freight Network and further on to Lennon Drive, which is part of the Principal Road Freight Network as defined in the plan.

The TPAR directly links the Flinders and Bruce highways to the port. Overall, the road is a 10 km corridor consisting of two key sections:

- Section 1: the Stuart Bypass (2.5 km in length with a posted speed of 80 km/h) linking the Flinders Highway to the Bruce Highway, which was opened to traffic in January 2010.
- Section 2: the Eastern Access Road (7.5 km in length with a posted speed of 80 km/h) is under construction and due to be completed in 2012.

The key benefits of the TPAR are to provide direct access to the port from the west and south, with the effect of reducing heavy vehicle traffic in the residential areas in South Townsville.

Road infrastructure within the PEP will be required to support a number of functions by providing access to:

- facilities to support operations
- key infrastructure for inspection and maintenance purposes
- terminals for the transport of cargo.

The PEP road network includes the requirement for access by vehicles ranging from cars to road trains. Only the road infrastructure to be built within the port boundary is included in the EIS. The concept road layout for the PEP (Figure A.1.3) includes the following key components:

- A main access road corridor alongside the rail corridor. In accordance with the recommendations of the *Port of Townsville Master Plan*, it is proposed that a 26 m corridor is retained for the main access road and below-ground services (water, wastewater, electricity and telecommunications).
- A turning area for long combination vehicles at the northern end of the main access road.
- Secondary access roads to provide access to the wharf and future lease areas of the PEP. It is proposed that a 26 m corridor is retained to the secondary access roads. It is anticipated that the corridor include provision for a single traffic lane in each direction, below-ground services infrastructure and stormwater drainage.
- An access corridor along the back of the wharves to provide access for service vehicles. It is not anticipated that this access corridor will be developed as a formal road; it would be trafficable.
- A 14 m road corridor to provide access from the PEP to the existing road network at Centenary Drive. It is proposed that this corridor accommodate a single traffic lane in each direction.
- A 14 m road corridor to provide access from the main access road to the bulk liquid storage area.
- Connections to the future cargo storage area located in the rail loop, including a direct connection from the main access road (at its southern end) and secondary connection at the northern end of the rail loop.

A.3.5.2 Energy

There will be a substantial demand for electrical power to support the cargo handling and berth operations of the PEP. It is anticipated that construction of a new zone substation in the PEP reclamation area will be required. The substation will consist of two 66 kV to 11 kV transformers and will be supplied via two 66 kV feeders from the existing Townsville Port Substation, located on Hubert Street.

A.3.5.3 Water Supply and Sewerage

Current planning for the development of the Port of Townsville's Eastern Reclamation Area includes provision of trunk water and wastewater infrastructure along the eastern perimeter of the existing developed area of the port. It is understood that the trunk water main will connect to the existing Townsville City Council water main located alongside Benwell Road.

Based on the forecast demand, it is proposed that the potable water reticulation system for the PEP include:

- a 200 mm diameter trunk main within the main access road corridor that connects to future water supply points in the eastern reclamation area
- a 150 mm diameter ring main system within the wharf/lease access road corridor(s) and the wharf interface area that connects to the existing 150 mm diameter ring main system in the Centenary Drive corridor.

While seawater systems could be used to accommodate fire water demand, it is considered that there is sufficient capacity at existing potable water supply points to accommodate a potable water system. Further investigation may be warranted during future stages of the design.

Wastewater from the PEP will be discharged to the existing Townsville City Council wastewater network, and will be treated at the existing Cleveland Bay Wastewater Purification Plant.

A.3.5.4 Stormwater Drainage

The stormwater drainage system will be designed to ensure that discharge of stormwater to the sea meets the water quality objectives and standards of the *Environmental Protection (Water) Policy 2009* and *Water Quality Guidelines for the Great Barrier Reef Marine Park* (GBRMPA, 2010a). This will be achieved by using separate piped systems to collect 'clean' stormwater (that is, stormwater collected from building roofs and other areas where it does not have the potential to be contaminated) and stormwater from areas that have the potential to be contaminated (that is, wharf aprons and material storage stockpiles).

Clean stormwater will be stored in tanks for beneficial use or discharged directly to the sea; stormwater that has the potential to be contaminated will be directed to the eastern side of the reclamation area by a system of open channel drains, culverts and pipes, where it will be stored and treated to acceptable standards prior to release to the sea. The water could be treated using the dredging tailwater treatment pond or by using packaged gross pollutant traps. The concept design of the stormwater drainage system is shown on Drawing 60161996-SK1050 (Appendix E2).

Chapter B2 (Water Resources) details the existing surface water environmental values that may be affected by the Project, the potential impacts on these values and proposed management and mitigation measures.

Tenants of terminal operation areas will be responsible for their own stormwater collection, treatment and connection to the trunk system. Depending on the nature of operations and materials handled, pre-treatment of the stormwater run-off will be required by the tenants prior to releasing it into the trunk system if permitted.

A.3.5.5 Telecommunications, Gas and Other Services

Specific assessment of demand for telecommunications, gas and other utilities that may be required at the Port of Townsville has not undertaken as part of the EIS. This will be undertaken at the preliminary design stage in consultation with the relevant authorities. Provision is made in the layout of the services corridor for telecommunications and gas services, and there is sufficient redundancy within the corridor for provision of other services that may be required by particular port tenants.

A.3.5.6 Solid Waste Facilities

It is proposed that the existing solid waste management regime in the port will be adopted for the PEP, whereby solid waste is collected by a licenced contractor and disposed of appropriately. The existing arrangements comprise:

- port operator/port tenant: the tenant or operator of each berth or land facility is responsible for the collection and disposal of waste at each site in accordance with the waste management requirements of the lease and applicable statutory regulations

- POTL activities/facilities and common user areas: on a similar basis to port operators or tenants, POTL is responsible for the collection and disposal of waste at each site in accordance with the relevant legislation and its own Environmental Management System
- shipping: it is the responsibility of shipping agents to ensure that any solid waste is handled and disposed in accordance with the requirements of Department of Agriculture, Fisheries and Forestry .

Chapter B12.0 (Waste) discusses landside waste management in detail and the proposed management and mitigation measures to address potential impacts.

A.3.6 Project Operation

The PEP will involve an expansion of existing port operations by developing a new outer harbour supported by deepening of the Sea and Platypus channels. The PEP operations will comprise shipping, landside cargo operations and land transportation similar to the existing operations. The trade and shipping forecasts (Sections A.1.4.2 and A.3.1.1.1) are likely to result in operations generally characterised by:

- high tonnages of predominantly bulk cargoes shipped in relatively large consignments many typically 40,000 to 75,000 t.
- specialised cargo facilities able to achieve high berth throughput of up to 5 to 10 Mtpa depending on the trade.
- landside transport by rail.

The PEP will delivery infrastructure to accommodate shipping as well as land reclamation, trunk services, rail and road to support the development cargo handling facilities by port tenants.

Further detail on the port operations is included in Part B, in particular the chapters on air quality (Chapter B9), noise and vibration (Chapter B10), and scenic amenity (Chapter B17).

A.3.6.1 Commissioning of Port Infrastructure

Commissioning activities for fixed port infrastructure will be minimal. They will involve the following:

- For the channel and harbour basin, a bathymetric survey will be undertaken to standards determined by Maritime Safety Queensland to ensure that there are no ‘high spots’ in the navigation areas. If any high spots are detected, they will be removed by dredging in a similar manner to the capital and maintenance dredging program, and no other environmental impacts will occur.
- Changes in the navigation environment (navigation footprint and depths, marine infrastructure layout and aids to navigation) will be supplied to Maritime Safety Queensland in order that appropriate revisions can be made to nautical charts, port procedures (Port Procedures and Information for Shipping – Port of Townsville (MSQ, 2012)) and Notice to Mariners.
- For the reclamation, it is possible that surcharge earthworks may remain in place until the site is taken up by a port tenant for development, and that subsequent testing and ground improvement, if required, will be undertaken by the developer as a separate activity to the PEP. No other commissioning activities are expected. Trunk services (stormwater, sewer, power, water supply, and telecommunications) will be commissioned by the relevant authority in accordance with standard procedures.
- For the breakwaters, no formal commissioning will be undertaken; but the structure will need to be certified by a Registered Professional Engineer of Queensland.
- For the wharf structures, no formal commissioning will be undertaken; but the structure will need to be certified by a Registered Professional Engineer of Queensland.

A.3.6.2 Maritime Operations

Chapter B18 (Port Operations) details the vessel operations and changes expected as a result of the PEP and growth in shipping. An overview follows.

A.3.6.2.1 Shipping Operations

As an existing commercial port, POTL and the Regional Harbour Master have the joint responsibility for managing the safe and efficient operation of the port. The Regional Harbour Master is appointed by Maritime Safety Queensland, a state government agency attached to DTMR. Shipping legislation in Queensland is controlled by Maritime Safety Queensland. The Regional Harbour Master is the key authority on navigation matters in the port. Shipping operations in the channel and port are under the control of Maritime Safety Queensland and its Regional Harbour Master, and are not part of POTL's operations.

The *Port Procedures and Information for Shipping – Port of Townsville* (MSQ, 2012) provides important navigation information of the port and the ship operations. It also describes the mandatory requirements for vessels operating in the port.

Shipping associated with the PEP will use the existing channels managed by existing Maritime Safety Queensland ship management systems and arrangements (Vessel Traffic Services, pilotage). These will be progressively expanded and revised with expected increases in ship traffic over the PEP timeframe.

The Maritime Operations Management Plan (Section C2.4) details a range of management measures to maintain safe, efficient and effective vessel operations in the Port of Townsville. The proposed measures include:

- review of minimum ship UKC rules for increased vessel sizes
- development of navigation areas (channel and basin depth, channel width)
- additional aids to navigation
- review of marine management systems to address changes and growth in shipping
- ongoing review of tug fleet, pilotage resources and pilot launches
- consideration of long-term measures to address channel capacity
- review of ship anchorage procedures
- review of emergency management plans and procedures
- measures to maintain safety for recreational and other craft using Cleveland Bay

The Vessel Management Plan (Construction) included as Section C2.3, outlines additional vessel management measures during the construction periods.

A.3.6.2.2 Ship Anchorage

Vessels waiting to enter the port generally do so well offshore, although there are some limited areas that they can anchor inside the port waters with depth constraints. There are presently no specific designated anchorage areas; however vessels are provided a general anchorage area determined by Townsville Vessel Traffic Service (managed by Maritime Safety Queensland). Vessels are prohibited from anchoring in the channel and harbour basin areas, as well as a designated area east of Magnetic Island. Figure A.3.21 shows the typically used anchorage area and areas where anchoring is prohibited.

In order to improve efficiency and safety for current ship operations, POTL and the Regional Harbour Master were, at the time of preparing the EIS, considering the introduction of designated anchorages. The designated anchorage concept is shown in the Maritime Operations Management Plan (Section C2.4). Although not assessed in detail, it was expected that there may also be environmental benefits associated with this strategy.

POTL does not have any jurisdiction over offshore anchoring of vessels, but is able to influence the strategy if it is supported by the maritime industry, Maritime Safety Queensland and GBRMPA.

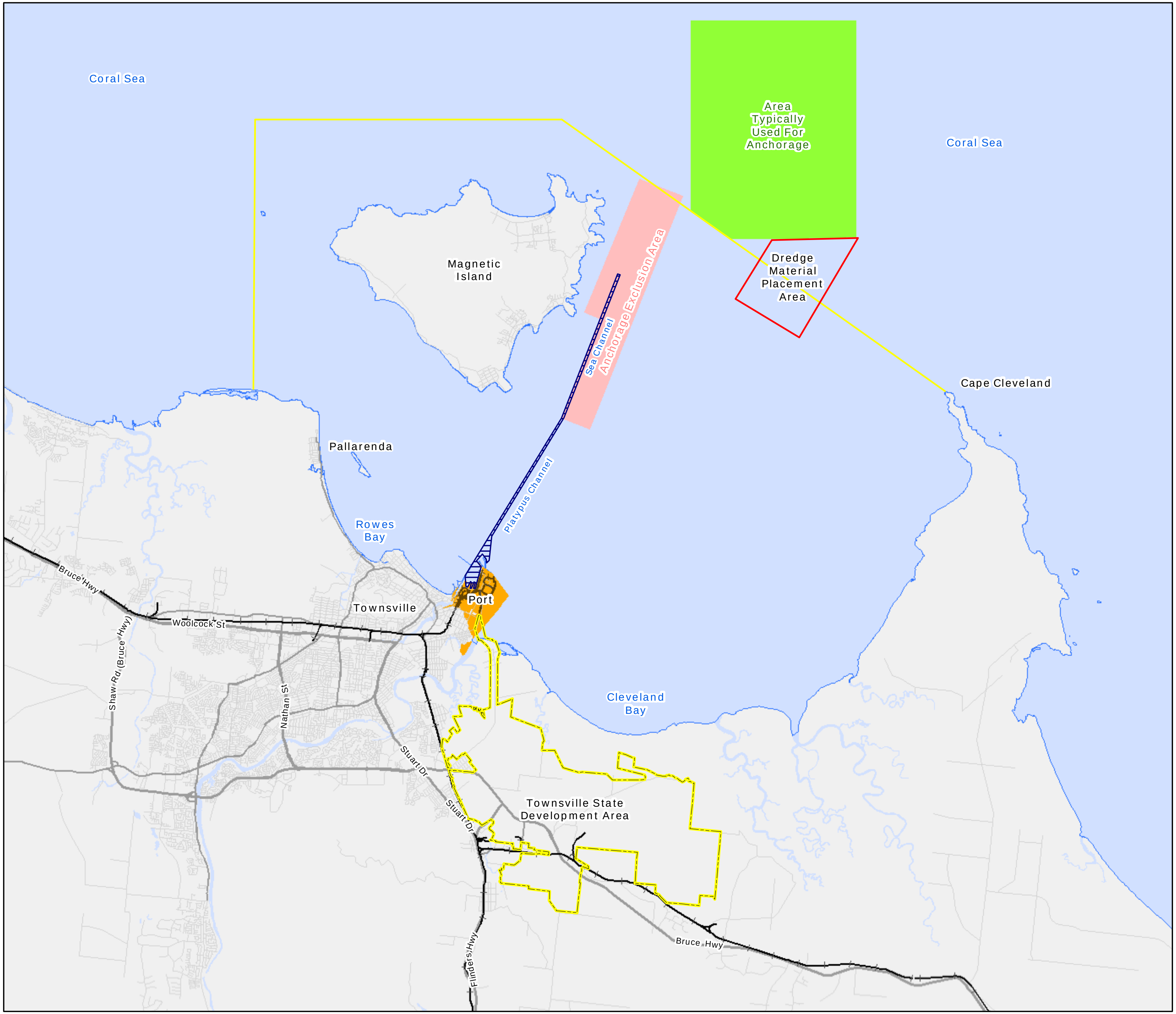
It is important to note that the port will operate differently from the large bulk ports around Australia, such as Newcastle, where the logistics chain and port capacity is unable to match the export volume, and where product is sold on the open market as well as on contract, leading to long queues of ships waiting for a berth, and unscheduled ships waiting speculatively for spot cargoes.

At Townsville, the volume of bulk trades passing through the port will be much less than in the large bulk ports, and the introduction of the PEP to handle the increased trade and shipping means that the logistics chain and materials handling infrastructure in the port and the hinterland will be matched to the shipping task, and vessels will not have to queue. Also, the bulk trades through Townsville will generally be shipped through contract arrangements only. Exporters will have a contract to deliver to a particular end user(s) and shipping will be scheduled to meet the requirements of the contract. Similarly, importers will have scheduled arrivals as they do at present. Scheduled shipping reduces the number of ships requiring anchorage, and there will be no queue of uncontracted ships waiting for spot cargoes and anchoring. For these reasons, anchoring and queuing will be kept to a minimum, and the number of ships waiting at anchor is not expected to significantly increase in future.

PORT EXPANSION PROJECT EIS

Typically Used and Prohibited Anchorage Areas

Figure A.3.21



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Channel
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Anchorage Exclusion Area
- Area Typically Used For Anchorage

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_137

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd

A.3.6.2.3 Vessel Manoeuvring

Ships will enter the new outer harbour under pilotage along the deepened Sea and Platypus channels. The forecast doubling of shipping under the high-case scenario indicates that in order to avoid any channel capacity issues, improved vessel traffic management procedures may be required in the latter half of the forecast period. These procedures could include managing the arrival and departure of deep draught ships in convoy to make optimum use of the tidal windows, or providing layby berths in the outer harbour.

Ships will generally turn inside the harbour before being berthed. These operations will be carried out with tug assistance as required by the Regional Harbour Master. Navigation of the vessels will be guided by a series of channel markers along the channel, and a series of lead lights and markers inside the harbour, all as shown on the Drawings 60161996-SK1006 to SK1009 (Appendix E2).

These operations have been simulated in a 2D simulation exercise carried out as part of the Preliminary Engineering and Environment Study. The channel and harbour layout were found to be satisfactory to the pilots and Regional Harbour Master, subject to confirmation at the detailed design stage which may involve additional 3D navigation simulation.

A.3.6.2.4 Other Vessels and Recreational Boating

Considering the nature of shipping and landside operations planned for the PEP, as well as safety and port security requirements, there are no facilities planned for other non-cargo handling marine operations or public activities. The navigation arrangements in the harbour basin and channels will be under the control of the Regional Harbour Master, which will be detailed in the *Port Procedures and Shipping Information* publication.

Vessels with a requirement to navigate in the outer harbour basin on a day-to-day basis include ships being loaded or unloaded, together with the associated support craft (tugs and pilot boats) for vessel operations.

Use of the outer harbour basin on an exceptional basis will be under the control of the Regional Harbour Master and most likely to be restricted to:

- layby vessels awaiting a berth in either the inner or outer harbour
- construction, maintenance and dredging vessels undertaking work in the basin (including the work as part of the various PEP stages of development)
- vessels directed to the outer harbour for safety reasons.

A.3.6.3 Ship Services

A.3.6.3.1 Bunkering

Refuelling of cargo ships (bunkering) from another vessel such as a bunker barge is not undertaken in the Port of Townsville at present, and POTL's policy is that bunkering will not take place in the new outer harbour. Some minor refuelling of navy vessels, tugs and pilot vessels takes place from time to time by road tanker or from diesel fuel supply lines at a number of berths in the inner harbour.

At this point in time POTL has no intentions of having refuelling facilities in the outer harbour. Should refuelling be considered in the outer harbour in future, it will need to be accessed through applicable processes at that time.

A.3.6.3.2 Waste Management

Waste management is discussed in detail in Chapter B12 of the EIS. In summary, liquid waste from ships is not often discharged in the port and solid waste from ships is collected by licenced contractors organised by the shipping agent, all under the supervision of Department of Agriculture, Fisheries and Forestry. This practice will continue in the new outer harbour.

A.3.6.4 Security

The new outer harbour facilities will be fenced and access controlled in a similar manner to the existing port. This can be summarised as follows.

- POTL and the port community are responsible for port security including:

- the development and implementation of a Port Security Plan
- nomination of Port Security and Port Facility Security Officers
- establishment of a Port Security Committee
- introduction of a port identification card system
- compliance with the Port Security Plan and legislation.

The Port of Townsville has an approved Maritime Security Plan as required under the *Maritime Transport and Offshore Facilities Act 2003* (Cth). The plan was officially approved by the Department of Transport and Regional Services (now Department of Infrastructure and Transport) on 10 June 2004. The maritime transport security legislation gives effect to Australian implementation and interpretation of the International Ship Port Security Code. It establishes a regulatory framework to safeguard maritime transport and protect ships, ports, and port facilities. The International Ship Port Security Code was developed by the International Maritime Organisation, as part of the Safety of Life at Sea Convention, 1974, (SOLAS Convention). It aims to promote an industry-wide focus on preventative security measures to detect and deter acts that threaten security in the maritime industry.

A.3.6.4.1 Ship Security Requirements

From 1 July 2004 the ship's Master, prior to entering the Port of Townsville, must report directly to Port Control or via their respective Ship Agency the following details:

- International Ship and Port Facility Security Code compliance number
- current ship security level or any change to the ship security level while in port
- ship Security Officer contact details
- list of expected visitors/contractors
- nominated provedore
- crew list and identification
- any security incident (as defined under the International Ship and Port Facility Security code or maritime transport security Legislation) while in port.

A.3.6.4.2 Security Levels

In addition to normal security measures undertaken, additional security measures on the land and water may be implemented:

- if directed by the Commonwealth Department of Infrastructure and Transport
- the current ship security level is higher than security level 1 or the port/port facility security level.

Additional security measures will include:

- increased number of maritime security guards
- controlled access to the waterside security zone and/or additional security waterside patrols
- controlled access to the ship security zone and landside restricted zone
- random or compulsory inspection of all baggage/stores and vehicles.

Responsibility for the implementation of the additional security measures will be agreed via a declaration of security between the ship and POTL or the port facility operator. If between the ship and the port facility operator, the port security officer must be consulted and agree with the security measures proposed to be implemented.

A.3.6.4.3 Port Entry

The port land areas are fenced, and access is only available through controlled gates. Access to the new outer harbour will be via the existing port entry points. Port security officers occupy the gatehouse at the Benwell Road entrance at peak times and by CCTV during other times. All persons wishing to access the port must be able, when requested, to demonstrate they have official business in the port and the appropriate authorisation. For example:

- port-issued identification card
- prior notification via port entry application
- current drivers' licence
- Maritime Security Identification Card
- passport
- crew visa.

Additional security requirements such as random and compulsory baggage checks may also be carried out. Unauthorised port access by members of the public is prohibited.

A number of cameras are stationed around the port to assist security officers monitoring the operations. The vision from these cameras can, if required, be passed onto third parties for their use in investigating incidents. Third parties include but are not restricted to Australian Customs and Border Protection Service, Queensland Police Service, Department of Infrastructure and Transport, and Maritime Safety Queensland.

A.3.6.5 Cargo Handling

The conveyance, storage, loading and unloading of cargo has been considered in general for the EIS. The EIS covers infrastructure provided by POTL up to an elevation to the top of reclamation and wharf. Cargo handling will be undertaken by the port tenants who will be responsible for complying with all statutory requirements, mandated as part of the lease agreement. The following discussion outlines how cargo handling will generally be undertaken.

The PEP is primarily to provide for the dry bulk export trade; it may also handle other cargo types. Dry bulk export cargo will ultimately arrive by rail via the EAC. Large volumes will be unloaded through a purpose built rail wagon unloading station on the rail loop to be built on the reclamation, which can be either:

- Bottom dump facility, whereby hatches in the bottom of the rail wagon are opened and material falls through a grid in the facility floor into an underground hopper as the train moves slowly through the facility; or
- Rail wagon tippler, whereby the rail wagons (up to four at a time) are tipped into the underground hopper while the train is stationary during each tipping operation. Unloaders of this type tend to be of a high cost and typically used in facilities with either very high throughput, high density cargo that is too heavy for bottom discharge wagon doors or 'sticky' cargo that will not flow sufficiently for bottom discharge. The wagon types available could also determine whether a tippler is used.

The rail wagon facility would be fully enclosed, and where appropriate equipped with other controls, to contain any dust emissions from the unloading process.

Smaller quantities of material arriving at the port could also be unloaded from bulk rail wagons by a mechanical grab to a covered stockpile or hopper, or could arrive at the port in containers that would either be loaded directly onto the ship or emptied into an underground hopper in a similar fashion to a rail wagon tippler.

From the underground hoppers the material will be transported by covered conveyor to a covered stockpile area on the reclamation behind the wharf. Stockpiles are generally expected to be covered to control dust emissions, that is, they will be stored in large storage buildings similar to the bulk sugar building already at the port, or in silos. The material will be reclaimed from stockpiles and out-loaded into the ship via a covered conveyor feeding to a shiploader on the wharf. Shiploaders are typically rail mounted and move along the ship from hatch to hatch, placing the material directly into the ship's hold through a delivery chute.

Imported dry bulk material will typically be unloaded from the ship's hold by either a grab unloader into a hopper, or a screw unloader directly to a covered conveyor. The grab unloader hopper typically discharges material directly to road trucks or rail wagons passing under it, or onto a covered conveyor that takes the material to the covered storage facility. Smaller quantities of material can be loaded by wheeled loaders onto trucks inside the storage facility. Larger quantities are usually fed through holes in the storage facility floor onto underground conveyors that discharge into rail wagons.

Two berths (Berths 18 and 19) have been tentatively designated for bulk liquid. At these locations, liquids will be unloaded by pumping through flexible hoses supported by unloading arms on the wharf platform, and conveyed by pressure pipeline to storage tanks, which are planned to be located on the land inside, or west of, the rail loop. From there the bulk liquids will be pumped into road tankers or rail tank wagons for distribution outside the port. Liquid transfer and storage facilities will be bunded to contain any spills, and operators will be required to meet safety and environmental protection requirements by the terms of their lease and by their statutory obligations.

A.3.6.6 Landside Cargo Transport

Cargo is presently transported to and from the port by road and rail, as well as by a pipeline that supplies oil to the Yabulu Refinery. The future development of the TSDA could present an opportunity to stockpile bulk materials in the TSDA and conveyor cargo to/from the port.

Bulk cargoes comprise the main growth component of the PEP trade forecast and are expected to be transported by rail either directly to/from the port or via the TSDA.

The development of any infrastructure in the TSDA to support landside cargo transport outside of the PEP development footprint is not part of the EIS but would have any potential impacts assessed through its own EIS process.

A.3.6.6.1 Rail

Queensland Rail owns and manages the rail network from the hinterland to the port via the Mount Isa Line System and the North Coast Line System. Train operations occur in a competitive environment, which allows various train operators to transport port cargo.

The PEP growth will be a driver for concurrent upgrade and expansion of rail infrastructure on the network serving the port. In particular new rail access to the port will be required in the EAC for any significant increase in rail traffic. This new rail line was anticipated in the EIS for the EAC. Specific project approvals would be required for construction of a rail line in the approved corridor.

The PEP includes development of three rail loops in the reclamation area capable of accepting trains of 1.5 km in length (Figure A.1.3). The rail infrastructure in the PEP reclamation could be developed and owned by various organisations or Queensland Rail.

A.3.6.6.2 Road

DTMR is the owner of the network of major roads serving the transport of cargo by road. Other local roads owned by Townsville City Council are used by light traffic generated by port activity.

The construction of TPAR by DTMR was well advanced at the time of preparing the EIS. The road will directly link the Flinders and Bruce highways to the port and will be the primary road for heavy vehicle access. POTL operates the internal roads in the port.

The PEP makes provision for roads in the outer harbour to provide access to terminals and perimeter services roads (Figure A.1.3). The development of roads in terminal areas will be the responsibility of port tenants.

A.3.6.6.3 Conveyors and Pipelines

The PEP layout can accommodate conveyors and pipelines between the wharves and various locations in the outer harbour in the services corridors and lease areas, as well as to link up to facilities in the existing port areas. This infrastructure could also connect to facilities beyond the port's boundaries, in particular the TSDA when it is developed. The EIS for the EAC anticipated the inclusion of a pipeline and/or conveyor system in the corridor.

The conveyors and pipelines are considered cargo handling infrastructure, which will be provided by the port's as yet unidentified tenants, who will lease POTL land and berth facilities and construct their own operating infrastructure as and when they take up their lease. The necessary planning, environmental assessments and approvals for the development of this infrastructure will be independently undertaken by those proponents at the appropriate time in the future.

A.3.6.7 Maintenance of Marine Infrastructure and Navigation Areas

Marine Infrastructure

The permanent marine infrastructure components will be designed in accordance with latest version of applicable Australian Standards such as the *Guidelines for the Design of Maritime Structures* (Standards Australia, 2005b). The current guideline recommends that port infrastructure be designed for a 50-year life. The main marine infrastructure components for the PEP are:

- NE breakwater (and western breakwater if required)
- Revetment structures around the perimeter of the port which protect the reclamation area and the tailwater treatment pond
- Wharf structures
- Aids to Navigation

POTL as the port authority will manage this marine infrastructure and will oversee the construction and maintenance of the infrastructure to serve the intended function and to support a safe working environment.

The marine infrastructure will be designed to have minimal maintenance requirements for the structural components, the top structures of the aids to navigation and buoys with electronic components being the exception. The aids to navigation associated with the PEP will form part of the existing aids to navigation system and will be maintained and managed on the same basis in conjunction with Maritime Safety Queensland and Australian Maritime Safety Authority.

The detailed design of the marine structures will determine specific maintenance and inspection requirements for the marine infrastructure. When constructed, the structures will be incorporated in POTL's asset management plans which will outline regular inspection and maintenance programs. In addition to these regular programs, POTL inspects infrastructure following extreme metocean events or unplanned events or usage that may affect the structural integrity of the infrastructure.

Maintenance Dredging

POTL undertakes regular maintenance dredging of channels, basins and berth pockets to remove the natural accumulation of marine sediments. This is typically undertaken annually and as necessary after cyclone or flooding events. In the order of 400,000 to 500,000 m³ per annum (in situ volume) is typically dredged using mechanical dredgers, small CSD and TSHD. Most of the material is removed by TSHD and relocated to the DMPA (Figure A.1.2). Any material encountered that is unsuitable for offshore placement is taken onshore before being relocated to a suitable land site.

The coastal processes in Cleveland Bay result in most of the dredging requirements taking place in the Berth 11 basin and the adjacent areas of the Platypus Channel. The development of the breakwater protected outer harbour is expected to substantially reduce the accumulation of sediments in these locations because of the protection from waves and currents. However, there will be an increase further seaward in the Platypus Channel near the end of the new north-eastern breakwater.

Hydrodynamic modelling of coastal processes has been undertaken for the PEP EIS (Chapter B4). It estimates that the total maintenance dredging volumes will be less volume than for the existing situation.

A.3.6.8 Workforce

The operational workforce will depend on the exact nature of operations conducted and type equipment deployed. The estimated port workforce associated with the operation of the new outer harbour is shown in Table A.3.25.

Table A.3.25 Estimate of workforce for PEP operations

Description	Stage A	Stage B	Stage C	Stage D
Management and administration, maintenance, equipment operators, general labour, rail shunters, stevedores pilots, tug crews etc.	60	30	30	60
Cumulative total	60	90	120	180

In addition to workforce that will be directly engaged in PEP operations, there will be associated employment:

- employment at mines and other import/export industries that could not be established without the PEP being in place
- indirect employment flowing on from the above, residential accommodation, goods and services, etc.

A.3.6.9 Decommissioning of Infrastructure

The intent of examining decommissioning and rehabilitation methods is to ensure that there are no unmanageable risks in the future associated with closing down or removing the infrastructure and that it will be feasible to decommission or remove the infrastructure safely and without adverse environmental effects.

Marine infrastructure has a long effective life. While the design life of marine infrastructure is typically 40 to 50 years, it can be expected to have a service life of 100 years or more, especially wharves, breakwaters, reclamation areas, and channels. Much of the existing base infrastructure in the port is already around the 100-year old mark, and it is unlikely that the base infrastructure of reclamation, breakwaters and channels would ever be removed. Remodelling of port infrastructure to suit changing technologies or operation conditions is more common than removal.

Decommissioning would only arise from the removal of aids to navigation, removal of breakwaters, or removal or reconstruction of wharves (noting that operational infrastructure such as ship loading equipment, storage sheds and the like does not form part of the EIS and would be assessed separately).

It is not envisaged that the reclamation would ever be removed or decommissioned. It is possible that the channels could be abandoned or decommissioned in the future, but it is not envisaged that they would ever be removed by filling them.

The works envisaged for this Project can be constructed using conventional materials and standard construction methods, and no unusual or high risk methods or materials will be required. Consequently, no special decommissioning methods will be required. There is considerable precedent in the decommissioning of such infrastructure.

Aids to navigation are typically pile mounted structures and are routinely removed on decommissioning by taking off the navigation aid structure using floating plant, and then extracting the piles or cutting them off at seabed level.

Decommissioning of breakwaters would occur as the reverse of construction: removal of the armouring using either land-based plant or floating plant/cranes and barges; and removal of the internal fill by excavator or dragline working from the breakwater and discharging into trucks.

Removal or decommissioning of wharves is a routine construction procedure and typically involves the removal of the concrete deck and beams using conventional techniques such as sawing the deck into sections and removing by crane, or using excavator-mounted demolition hammers and recovering concrete spalls from the seabed using a dragline or long reach excavator. Removal of the piles is by vibratory equipment mounted on floating plant or more likely cutting off the piles at seabed level.

In order to bridge the gap between design life and the long service life, it can be expected that rehabilitation or remediation will need to be undertaken at various intervals to preserve and extend the life of the infrastructure. In particular, the channel will need periodic maintenance dredging to remove any sediment accumulation and maintain the declared channel depth; the breakwaters may need minor repositioning of any armour moved by severe weather events; and wharf structures may require remediation as they will be subject to corrosion and concrete degradation over time. These are conventional activities carried out routinely in ports and no adverse environmental effects have been identified.

Port Expansion Project EIS

Part B

Section B0 – Overview

AECOM BMT WBM

B.0 Existing Environment – an Overview

The following information is a prelude to more detailed descriptions and assessments on a series of specific environmental factors in the subsequent Environmental Impact Statement chapters.

B.0.1 Economic and Social Values of Townsville and the Region

The Port Expansion Project (PEP) is located at the Port of Townsville in Cleveland Bay, North Queensland. Despite being immediately adjacent to Townsville, the PEP is located wholly in the Great Barrier Reef World Heritage Area, which is also a national heritage place. A Sea Channel extension is proposed, towards its seaward limit, to be located partially in the Great Barrier Reef Marine Park. The nearest island of significance to the development is Magnetic Island, which is a continental island located approximately 8 km offshore from Townsville. Existing shipping lanes accessing the Port of Townsville commence within 2 to 2.5 km off the southern tip of Magnetic Island.

B.0.1.1 Townsville Community and Queensland's Economy

Townsville is the major administration centre for North Queensland. The Townsville region has a population of approximately 190,000 (TCC, 2011b) and has shown a sustained population growth rate of approximately 1.5 to 2.0% per annum over the last 10 years (ABS, 2011). The region supports a diverse economy. Major occupations in the region are in the fields of public administration and safety, retail trade, health care and social assistance, construction, education and training, manufacturing and accommodation and food services (ABS, 2011).

The Port of Townsville has been significant to the history, development and success of Townsville and the wider North Queensland region. Established in 1864, the town that developed around the harbour was to become the largest urban centre in North Queensland and a de facto northern capital city. The place of the port in the prosperity of the region is evident. As the most important entry point in the North Queensland region in the years after its founding in the 1860s, the Port of Townsville has continued to service the evolving economic, industrial and communal development of North Queensland.

Major infrastructure, such as the port, also plays a significant role in the creation of direct and indirect jobs for the state. Apart from the services that are provided, additional employment and the people (including families) that employment brings to the state increases the size of consumer markets and thresholds for a range of services that might otherwise be difficult to sustain. Today, the port is estimated to generate 8,000 full time jobs and provides in excess of $300 million in direct and indirect wages and salaries to the community. Since the port's foundation, Townsville has grown and the port has become more than a source of economic prosperity; it has become a landmark and key identifier for Townsville and the region. Given its prominence as the gateway to the city from sea, the daily operations of the port have entwined into the daily activities of communities, employees, business and local residents of Townsville and North Queensland.

The port's ability to accommodate increased trade is directly linked to the capacity of the mining sector, such as in the North West Region, to deliver minerals and derivative products to overseas markets. Increased mineral production leads to increased royalties, which have direct effects on the state's budget capacity to fund social service and infrastructure initiatives.

B.0.1.2 Landforms and Visual Amenity

Townsville is situated on a low-lying coastal landform bounded by Cleveland Bay and the Paluma and Hervey mountain ranges (DCILGPS, 2000). Castle Hill and Mount Stuart are key landform elements in the wider landscape rising above the urban areas of Townsville.

The Port of Townsville is a visually dominant feature of near-field and distant viewpoints, including open space and recreation areas of significance to the community, such as The Strand and Castle Hill. The most important designated landscape in the region is the coastal vista bounding the waters of the Great Barrier Reef World Heritage Area. The bowl-shaped landscape of Cleveland Bay, combined with the two key headlands of Cape Pallarenda and Cape Cleveland, and Magnetic Island constrains the scenic amenity effects of existing infrastructure on the wider world heritage area and parts of the marine park.

The natural character of this part of the Great Barrier Reef World Heritage Area is already influenced by the existing industrial development in a context of productive human endeavours, and urban and industrial establishments along the shores of Cleveland Bay and Magnetic Island.

B.0.1.3 Cultural Heritage

B.0.1.3.1 European and Natural Heritage

The Port of Townsville has played a significant role in the development of Townsville and, more broadly, of northern Queensland. Established in 1864, the port was created to service the newly settled hinterland to provide a harbour for trade vessels and service the demands of settlers north of the Burdekin River for a low risk flood locality. A jetty was originally constructed on Ross Island, between Ross Creek and Ross River, for goods and people to be loaded and unloaded after being discharged from vessels in the lee of Magnetic Island and transferred in lighters to Ross Island.

An historic cultural heritage study commissioned by Port of Townsville Limited (POTL) as part of the PEP EIS indicated that there were no listed places of historic heritage significance in the port (AECOM, 2009). A search of the Townsville City Council's Local Heritage Database identified 143 properties of local significance in the adjoining suburbs of Townsville and South Townsville.

A search of the National Heritage List, the Commonwealth Heritage List, the Register of the National Estate, and the Queensland Heritage Register identified 55 places within approximately 3 km of the westward point of the PEP boundary. The Great Barrier Reef Marine Park is the only place listed on the national heritage register, protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

B.0.1.3.2 Indigenous Cultural Heritage

Land areas bounding Cleveland Bay contain tangible archaeological evidence for Aboriginal use and occupation. Cleveland Bay, Magnetic Island and the Townsville coastal plain are situated in a broad cultural landscape that retains significant Aboriginal cultural heritage values. Listed heritage values consist of both tangible and non-physical elements of Aboriginal cultural significance and traditional owners have expressed a view that both land and sea country remains as a component of the region's Aboriginal cultural landscape.

Areas of Ross River and Ross Creek are identified as integral components of the local Aboriginal creation story that explains the creation of the Halifax Bay and Cleveland Bay coastlines. The area of Benwell Road Beach was noted as an important place that many local Aboriginal people still use for fishing, yabbying and collecting shellfish.

Recognition of Aboriginal cultural heritage values of the broader area has been discussed through consultation with representatives of the Aboriginal parties and specific measures have been agreed to mitigate potential indirect impacts of port operations, including the main navigation channel, as embodied in the Cultural Heritage Management Plan registered with DATSIMA.

B.0.1.4 Land Use and Management

There is a series of local and state-based frameworks and policies affecting land use in the vicinity of the city and the port:

- *Port Land Use Plan 2010* (POTL, 2010b) is the statutory land use plan that governs all development on strategic port land in the port area
- *Port of Townsville Port Development Plan 2010|2040* (POTL, 2010a) will more accurately reflect the final outcome of the preferred reclamation, surface infrastructure and berthing arrangements once planning and assessment for the PEP has been finalised
- *Townsville City–Port Strategic Plan* (DI, 2007a) includes consideration of transport management issues and formed much of the basis for the construction of the Townsville Port Access Road, through the Townsville State Development Area and across Ross River, to service the port's growth needs

- *Development Scheme for the Townsville State Development Area* (DEEDI, 2010) identifies a number of land use precincts specifically intended for various land uses
- *Townsville Community Plan 2011-2021* (TCC, 2011a) provides the council's vision for the community based on key values identified in the plan
- *Townsville City Plan 2005* (TCC, 2005) is the local planning scheme that currently applies to development on land around the port that is not strategic port land.

B.0.1.5 Port Operations

B.0.1.5.1 Shipping Activity

POTL and the Regional Harbour Master have joint responsibility for managing safe and efficient operations at the port. Ships currently using the port are typically up to Handymax (55,000 dead weight tonne) in size. The port can accept vessels of Panamax size (beam 32.3 m) subject to the vessel maintaining a minimum 1.3 m underkeel clearance.

The Regional Harbour Master, appointed by Maritime Safety Queensland, a state government agency attached to Department of Transport and Main Roads, is responsible for:

- improving maritime safety for shipping and small craft through regulation and education
- reducing vessel sourced waste and providing response to marine pollution
- providing essential maritime services such as pilots and aids to navigation
- encouraging and supporting innovation in the maritime industry.

As such, the Regional Harbour Master is the key authority on navigation matters in Queensland waters and in the port. POTL supports the Regional Harbour Master in its function. In addition, the *Port Procedures and Information for Shipping – Port of Townsville* (DTMR, 2012) provides important navigation information relating to port and ship operations. It also describes the mandatory requirements for vessels operating in the port.

Vessels berth in an enclosed, breakwater-protected harbour (other than Berth 11) and arrive via the Platypus and Sea channel system, which currently has an overall length of 13.9 km. There are currently no capacity issues with the operation of the existing channel system. Forecast growth in shipping traffic, due to expansions in regional industries such as mining, will drive the need to increase port and shipping channel capacity in the future.

B.0.1.5.2 Traded Products

The annual trade through the port during 2010/11 amounted to approximately 11 Mt of product. Current trade forecasts predict a fourfold increase in this trade tonnage throughput by 2040. This increase is expected to result from increases in existing trades (particularly those linked with the mining and industrial sectors) and new bulk trades. Current trade tonnage is dominated by nickel ore imports (37%), mineral concentrate exports (12%), oil imports (9%), sugar exports (8%) and fertiliser exports (7%). By 2025, 46% is expected to come from new mineral product exports (such as coal), 19% from additional magnetite exports and 12% from additional nickel imports, 8% from additional mineral concentrate exports and 7% from additional fertiliser exports.

B.0.1.6 Land Based Traffic and Transport Systems

Currently, road access to the port is primarily via Boundary Street and Benwell Road. Boundary Street is bounded by a mix of residential and non-residential uses, including industrial, commercial and shop-type uses. Both Boundary Street and Benwell Road form part of the Principal Road Freight Network as defined in *Townsville City Plan 2005* (TCC, 2005). A connection to the port also exists via McIlwraith Street, Perkins Street and Archer Street to Ross Street, which forms part of the Secondary Road Freight Network, This route connects to Lennon Drive, which is part of the Principal Road Freight Network.

Rail access is provided via the rail corridor located along Perkins Street in South Townsville. The track continues to the south yard and enters the port alongside Jetty Road in South Townsville. The *Townsville City Plan 2005* identifies that this transport route is part of the Rail Freight Network.

Construction of the Stuart Bypass and Townsville Port Access Road, part of the Eastern Access Corridor commenced in August 2008. It is envisaged that the current rail route will continue as a rail transport corridor to and from the port; however, development of the Eastern Access Corridor is expected to eventually provide an alternative rail transport corridor to and from the port. The new road/rail link over the mouth of the Ross River will improve port accessibility between the port and the State Development Area at Stuart, and reduce the heavy traffic burden in South Townsville.

B.0.1.7 Acoustic Conditions

Noise is generated by land vehicles moving to and from the port. The Eastern Access Corridor will divert heavy vehicles from the suburbs. This development will also ultimately provide an alternative rail corridor to the port.

The majority of port land is used for industrial-based operations and the areas immediately adjoining wharves are used as short-term lay-down areas for the loading and unloading of ships. The PEP will extend port operations seaward; that is, to the north of the existing port infrastructure and away from existing surrounding land uses.

The areas surrounding the existing port are heavily developed for urban purposes. The port is in close proximity to South Townsville, which is dominated by a mix of residential community and light industry. Port operations are separated by physical barriers including open space (Port Environmental Park), road corridors and lower impact development (such as warehousing). The areas to the south-west of the Project Area (not in port land) include the residential, commercial and industry centre of Townville, while land south-eastwards across the Ross River includes an environmental reserve.

B.0.1.8 Air Quality

The Department of Environment and Heritage Protection monitors a network of air quality monitoring stations throughout Queensland with a monitoring station located at the port. It collects PM_{10} (particulate matter finer than 10 µm) data. At Pimlico, approximately 6 km to the south-west, meteorological data and PM_{10} are measured. Continuous monitoring of total suspended particulates is also conducted at Coast Guard, a site adjacent to the western boundary of the port.

Previous studies of air emissions, specifically particulate emissions, have been undertaken by POTL to support the environmental management of the Port of Townsville. The studies indicate that PM_{10} concentrations at off-port locations are compliant with guideline values and sources of elevated particulate emissions during operation of the port were not identified.

PM_{10} particles present a higher respiratory risk than dust (often measured as total suspended particles or dustfall rates); therefore, long-term data have been generated for the Townsville area with contributions from Port of Townsville-operated monitoring (a site near Berth 10) covering a period between 1994 and 2011.

A number of potentially sensitive receptors are located in close proximity to the Port of Townsville, including residential and recreational areas and the Townsville CBD. Air quality in the port area and at most adjacent locations is influenced by traffic, commercial and industrial emissions. Atmospheric dust comprising fine dust particles, which may be carried substantial distances, is the main component of emissions together with minor quantities of nitrogen, carbon oxides and residual hydrocarbons. At times, the ambient 24-hour PM_{10} criterion have been exceeded, even as recently as October 2011, when warm, dry, windy conditions elevate background particulate levels.

B.0.2 Natural Values of Cleveland Bay and the Great Barrier Reef

B.0.2.1 Cleveland Bay

B.0.2.1.1 Topography, Geology and Sediments

The port is constructed predominantly on reclaimed land and the new land for the PEP will be similarly constructed using dredged material from the seafloor of the outer harbour basin.

The site is underlain by Quaternary-age alluvium and colluvium sediments of late Palaeozoic-age granites. Previous characterisation of marine sediments (Golder Associates, 2008a) in the outer harbour basin and reclamation areas and in Platypus and Sea channels identified the following broad material types:

- A surface layer of recent seabed sediments consisting of a mixture of very soft to soft silty clay to clayey silt with very loose and loose sand to silty sand to clayey sand. Shell fragments and organic materials commonly occur in this layer. The seabed sediments are easily identified by their dark hue and very soft and very loose nature. Preliminary investigations indicate that some of the surface materials are potential acid sulphate soils and, due to their soft and compressible nature, are unsuitable for use as reclamation fill or as the foundation material for structures.
- A subsurface layer of geologically older stiff to hard clays and sandy clays and medium dense to very dense clayey sands and sands. These materials are much lighter in colour than the seabed sediments. The subsurface material was not identified as potential acid sulphate soil and is considered suitable, although not ideal, as reclamation fill.

The surface layer has a thickness of approximately 1 to 1.5 m in the new harbour basin and reclamation areas. A lesser thickness of the surface layer, typically in the order of 0.5 to 1 m occurs in the Platypus and Sea channels. This lesser thickness in the access channels is likely to be the result of regular maintenance dredging undertaken at the Port of Townsville.

B.0.2.1.2 Marine Coastal Processes

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

The Strand Beach is a significant coastal feature located immediately west of the Port of Townsville. The beach was redeveloped in 2000 to provide five beach units separated by artificial rocky headlands, which control the natural longshore transport of sand.

The port and surrounding coastal areas have been extensively modified and the port has been artificially created by previous land reclamation events since it was first established as a port in 1864.

B.0.2.1.3 Water Quality

Located between the mouths of Ross River and Ross Creek, the port is situated on the south-western boundary of Cleveland Bay. Ross Creek estuary has been extensively modified as a result of development in the near coastal river basin, particularly in the lower estuarine margins. Although extensively modified from its natural state, the Ross River estuary provides a contiguous aquatic habitat in its lower reaches. Catchment discharges from the Ross Creek and Ross River, typically after seasonal rainfall events, influence the ambient quality of inshore marine waters.

Ambient water quality in the bay is strongly influenced by coastal process events with fine terrigenous sediments, characteristic of the seabed in the bay and delivered by river discharges, readily suspended by wind-driven waves and currents. In the shallow bay environment at times this results in high ambient turbidity levels. Flood and stormwater flows are also known to contribute sediment and contaminant loads into Cleveland Bay waters.

Water quality monitoring data, for example *Townsville Marine Precinct Project Environmental Impact Statement* (GHD, 2009a) and data collected as a part of the current study, shows that the near-shore waters of Cleveland Bay are frequently turbid. In addition, elevated levels (compared to the relevant guidelines) of nutrients and certain contaminants have been recorded in the vicinity of the Ross River estuary.

The water clarity of outer bay waters in the vicinity of the existing offshore disposal ground when not in use, and further offshore as bathymetry deepens, is comparatively less turbid than near-shore waters. Energy driven re-suspension of fine sediments does not occur as frequently in these areas as in inshore situations.

Coastal sediments are of generally of good quality, but can exhibit low levels of contamination in a few locations (albeit below published guideline limits under the National Assessment Guidelines for Dredging) and potential for acid sulphate soils if oxidised.

B.0.2.1.4 Marine Conservation Areas

Cleveland Bay provides a range of marine habitat types that form the basis of marine conservation areas. These areas are recognised as providing communities such as hard corals, seagrasses and mangroves, which also form part of the habitat requirement for a number of threatened species. These areas are declared in statutory notices and occupy areas in Cleveland Bay or adjacent to it. Some of the key conservation areas include:

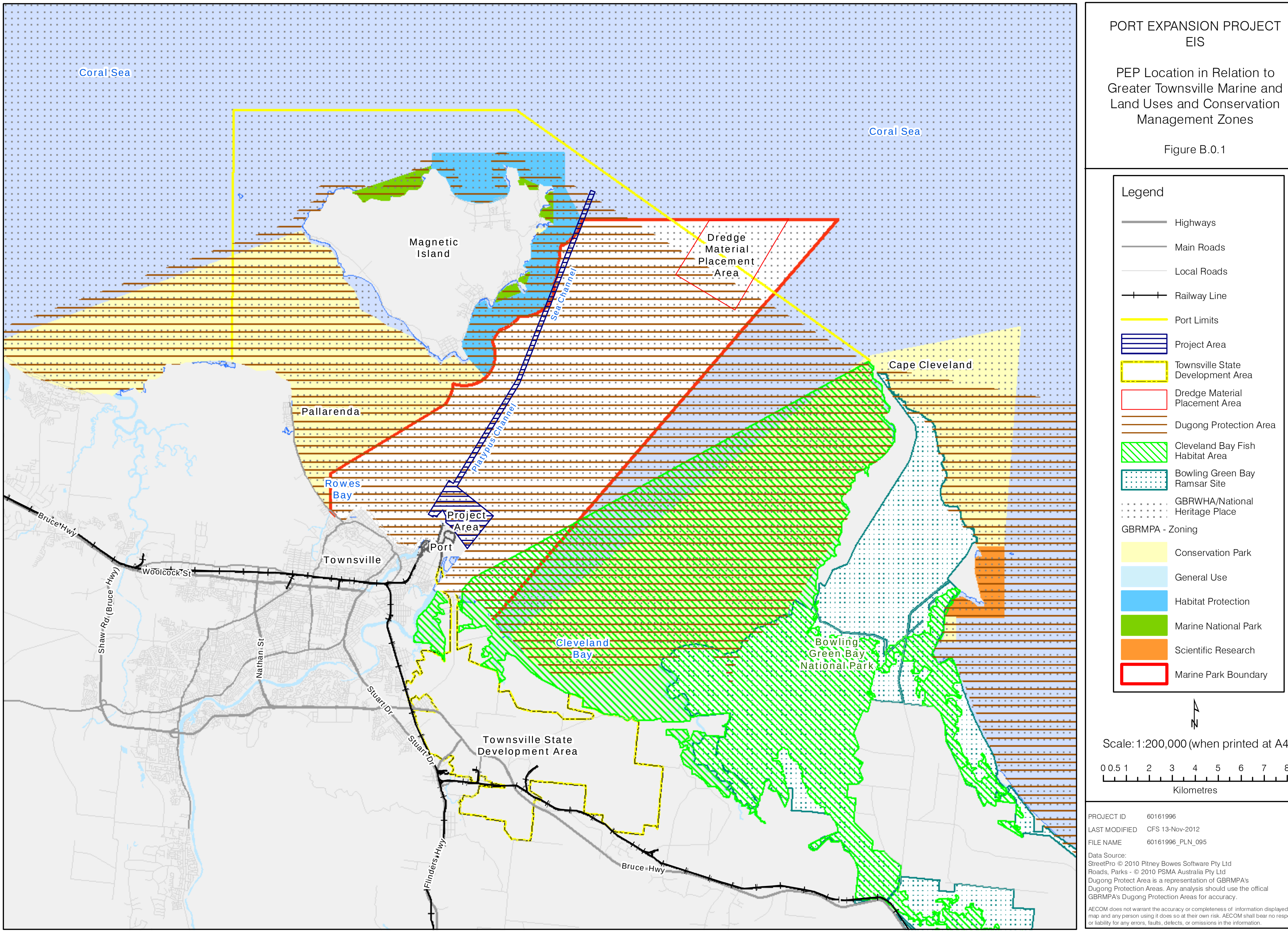
- Great Barrier Reef Marine Park and state marine park (including a number of different zones of protection)
- Great Barrier Reef World Heritage Area (and national heritage place)
- Dugong Protection Area
- Fish Habitat Area
- Bowling Green Bay Ramsar-listed wetland
- Magnetic Island National Park.

These areas as well as other features of the region are shown in Figure B.0.1.

PORT EXPANSION PROJECT
EIS

PEP Location in Relation to Greater Townsville Marine and Land Uses and Conservation Management Zones

Figure B.0.1



PROJECT ID 60161996
LAST MODIFIED CFS 13-Nov-2012
FILE NAME 60161996_PLN_095

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Dugong Protect Area is a representation of GBRMPA's Dugong Protection Areas. Any analysis should use the offical GBRMPA's Dugong Protection Areas for accuracy.

B.0.2.1.5 Marine Ecosystem Values

There has been substantial previous study of marine ecology in Cleveland Bay and the surrounding Great Barrier Reef. The following sections provide a brief description of major aspects of the marine ecosystem values known in Cleveland Bay.

Megafauna

Cleveland Bay is recognised as a key foraging area for the flatback turtle (*Natator depressus)* and a key feeding and nesting area for the green turtle (*Chelonia mydas*) (GHD, 2011a). The port and PEP development footprint is not a known transit route or area of high utilisation for turtles.

The following species, listed under the *Nature Conservation (Wildlife) Regulation 2006*, have been observed within 2 km of the port:

Endangered:

- loggerhead turtle (*Caretta caretta*)
- leatherback turtle (*Dermochelys coriacea*)
- olive ridley (*Lepidochelys olivacea*).

Vulnerable:

- dugong (*Dugong dugon*)
- green turtle (*Chelonia mydas*)
- hawksbill turtle (*Eretmochelys imbricate*)
- flatback turtle (*Natator depressus*).

Near Threatened:

- Australian snubfin dolphin (*Orcaella heinsohni*)
- Indo-Pacific humpback dolphin (*Sousa chinensis*).

The following conservation plans, in accordance with the *Nature Conservation Act 1992*, are in place:

- *Nature Conservation (Whales and Dolphins) Conservation Plan 1997*
- *Nature Conservation (Dugong) Conservation Plan 1999*
- *Recovery Plan for Marine Turtles in Australia 2003* (Environment Australia, 2003).

The waters of Cleveland Bay are entirely in a Dugong Protection Area and dugongs are known to be relatively abundant in the bay. The *Townsville Marine Precinct Project Environmental Impact Statement* (GHD, 2009a) documented that dugongs were found most often in areas with greater concentration of seagrass in Cleveland Bay, such as over the meadows near the southern and eastern shores of the bay.

Boat-based and aerial marine megafauna surveys have been conducted in Cleveland Bay since 2008. Turtles, dugongs, rays, sea snakes and dolphins were observed as part of these surveys. Both the Australian snubfin dolphin and the Indo-Pacific humpback dolphin were also observed as part of these surveys and were reported to be highly mobile and move in and out of Cleveland Bay.

Benthos

There are a few dominant benthic habitat types around Cleveland Bay as follows.

Benthic Communities

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

A number of additional baseline studies have been undertaken as part of the PEP Environmental Impact Statement to characterise the benthic environments in and around the outer harbour, in the entrance channels and at the offshore dredge material placement area. These studies characterise sediment type as well as epifauna and infauna communities in these areas including the presence of any associated reef or seagrass communities not previously mapped.

The breakwaters and revetments of the port provide hard substrates that support a range of algal and sponge dominated communities, as well as corals in more quiescent areas. Video survey of rockwall habitats around the current port have assessed the condition and health of these systems and provide a good indication of the future environment created as a result of any PEP revetment structures.

Seagrass

Seagrass meadows occur in parts of Cleveland Bay and provide important habitat for a range of species of conservation significance, and provision of food resources for vertebrates including dugong and turtles.

Baseline surveys of seagrass in Cleveland Bay were commissioned by POTL and undertaken by the Department of Primary Industries and Fisheries (now Department of Agriculture, Fisheries and Forestry) commencing annually in 2007 (Taylor & Rasheed, 2009). The baseline surveys identified large and continuous seagrass meadows in Cleveland Bay, most commonly in lower inter-tidal and shallow sub-tidal areas. The best quality shallow seagrass meadows occur as shallow beds near Cape Cleveland, The Strand, Cape Pallarenda and around Magnetic Island. The dominant species in shallow waters include *Halophila ovalis*, *Halodule uninervis*, *Zostera capricorni*, and *Cymodocea serrulata*. The reef flats surrounding Magnetic Island support areas of *Thalassia hemprichii.*

The distribution, extent and density of seagrass assemblages in near-shore areas can show great variation over a range of temporal scales (particularly seasonally and inter-annually) in response to variations in a range of environmental factors. In particular, changes in the light availability that result from wave-driven bed sediment remobilisation and turbidity associated with catchment discharges, are key drivers of temporal change in seagrass meadows (Taylor & Rasheed, 2009). Surveys found that the near-shore seagrasses have also significantly diminished in biomass over the years since monitoring started. This is a trend along the Queensland coast.

Cleveland Bay also contains deep-water seagrass beds. These deep-water meadows are typically patchy (non-contiguous, fragmented beds) with a sparse cover and low species richness. The deep-water meadows also show seasonal and inter-annual variability, with the surveys from 2007 to 2009 showing a decline in biomass of these communities that has been attributed, because of a diminution of light availability, to effects derived to seasonal flooding (Taylor & Rasheed, 2009).

Seagrass is not known to occur in the existing inner or new outer harbour areas of the port, although shallow water and inter-tidal seagrass beds can occur nearby (e.g. near the Ross River mouth and along The Strand).

Reef Communities

Reef communities comprised of hard corals exist around Magnetic Island, at Middle Reef and Virago Shoal (located between Magnetic Island and Cape Pallarenda). A large number of hard corals have been recorded in these communities, including extensive areas of *Montipora digitata*. Chapter B6 includes the details of coral surveys undertaken as part of the PEP EIS.

The distribution and abundance of coral species varies in the fringing reefs and is related to the physical characteristics of the substrate and energy environments. The Cockle Bay reefs, located on the south-western side of Magnetic Island, are characterised by species that are better adapted to high siltation and turbidity, with a general trend toward decreasing coral density in comparison to reef habitat in Geoffrey Bay, located on the south-eastern side of Magnetic Island (Bell & Kettle, 1989)A previous study of the fringing reefs on the south-eastern side of Magnetic Island between Florence Bay (north) and Geoffrey Bay (south) indicates that these areas are qualitatively similar (Mapstone, Choat, Cumming, & Oxley, 1989).

Coral cover, species diversity and aesthetic quality is generally considered higher in the fringing reefs on the northern side of Magnetic Island (Horseshoe Bay) than in other fringing reefs.

Mangroves

Mangrove communities are most extensive in the southern portion of Cleveland Bay between Sandfly and Cocoa creeks and in the Ross River, south of the port. Smaller, structurally simpler mangrove stands occur in Rowes Bay and at Three Mile Creek. Mangrove communities are ecologically important as they provide habitat for a range of fauna. In areas such as the southern shores of Cleveland Bay, where seagrass meadows are close inshore, they combine with the mangrove forests and wetlands to form a highly productive nursery habitat for commercial and recreational fish and crustacean species, including crabs and prawns. They also provide roosting habitat for aerial animals such as birds and bats. Predominant threats to mangrove ecosystems arise from land use conflicts and local effects on water quality. Mangroves do not inhabit lands adjoining the PEP harbour and reclamation.

Fish

The mangroves, seagrasses, reef and soft bottom benthic communities present in Cleveland Bay provide habitat for a variety of fish species. Fishing for target species is a common practice in Cleveland Bay, undertaken by traditional owner, commercial and recreational fishers.

Fish habitat areas have been established in Cleveland Bay and in the nearby Bohle River and Bowling Green Bay. These areas provide protection and are breeding grounds for target species such as barramundi, grunter, mud crabs and prawns. While these species are highly mobile, it is recognised that the loss of important habitat such as for feeding or breeding associated with habitats, including seagrasses, reef and benthic habitat, may affect long-term stock levels and abundance.

Great Barrier Reef region

The Great Barrier Reef supports significant commercial industries and activities, and supports employment and the livelihoods of many in coastal cities and towns along the Queensland coast. As a result, an assessment of the commercial and non-commercial uses of the Great Barrier Reef (GBR) region was made by GBRMPA in its Outlook Report in 2009.

In terms of identifying impacting processes on marine ecosystem values, GBRMPA (2009) listed key uses and activities of GBR waters as shown in Figure B.0.2 where the level of impact of those uses on marine biota and ecosystem were graded. Activities and uses such as marine tourism, Defence and scientific research were graded as very low impact, with fishing and traditional use being of higher impact grading, albeit with less certainty. Ports and shipping were graded as “low impact” in this summary by GBRMPA (2009).

4.9.2 Impacts of use

Assessment component	Summary	Assessment Grade: Very low impact	Low impact	High impact	Very high impact
Commercial marine tourism	Marine tourism extends throughout the Great Barrier Reef but its impacts are concentrated in a few intensively managed areas.	●			
Defence	The majority of routine defence training activities have negligible impacts.	●			
Fishing	There is limited information about many targeted species and of the survival success of discarded species resulting in a poor understanding of the ecosystem effects of fishing.			?	
Ports and shipping	Most routine shipping activities have negligible consequences. Dredging and construction of port facilities can have significant but localised impacts.		●		
Recreation (not including fishing)	The impacts of recreation (not including fishing) are mainly localised in inshore areas.		●		
Scientific research	Impacts of scientific research are concentrated primarily around research stations.	●			
Traditional use of marine resources	Traditional use, mainly hunting, fishing and collecting, involves a range of marine species (some of conservation concern) but levels of take are unknown. Poaching by non-Traditional Owners is a concern for Traditional Owners and management agencies.			?	
Impacts of use	The impacts of different uses of the Great Barrier Reef overlap and are concentrated inshore and next to developed areas. There are some concerns about localised impacts and effects on some species. In particular, species of conservation concern such as dugongs, some bony fish, sharks, seabirds and marine turtles are at risk, especially as a result of fishing, disturbance from increasing use of coastal habitats, illegal fishing, poaching and traditional use of marine resources. There is evidence that fishing is also significantly affecting the populations of some targeted species. The survival success of non-retained species is not well understood, nor are the ecosystem effects of fishing.		◉		

GRADING STATEMENTS

Very low impact - Any impacts attributable to use of the Region are minor and localised, with no observable effects on overall ecosystem function.

Low impact - The impacts of use are observable in some locations or to some species, but only to the extent that limited additional intervention would be required for the ecosystem to be used sustainably. Enjoyment of some aspects or some areas is reduced.

High impact - The impacts of use are obvious in many locations or for many species to the extent that significant additional intervention would be required for the ecosystem to be used sustainably. Enjoyment is substantially reduced.

Very high impact - The impacts of use are widespread, to the extent that ecosystem function is severely compromised. Opportunities to enjoy the Region are limited.

Figure B.0.2 Assessment summary of impacts from current marine uses (after GBRMPA (2009); section 4.9.2)

B.0.2.2 Terrestrial Values of Cleveland Bay Shores

B.0.2.2.1 Terrestrial Ecology

The PEP is located in a sub-tidal area and it is not anticipated that there would be direct impacts to terrestrial ecology values. The landside port area adjoining the PEP is strategic port land and does not support terrestrial flora and fauna values.

Avifauna (i.e. birds) may visit the coastal zone and use nearby shoreline and littoral habitats. Marine birds would be expected to frequently occur at the development footprint, while feeding, resting or overflying from one area to another. Nearby inter-tidal shores (for example, near the southbank of the Ross River mouth) are known for shorebird occurrence, providing a key roosting and feeding habitat. Many of those bird species that occur are listed as threatened or migratory species. The predominant areas of bird habitation are located on the sandspit on the eastern bank of Ross River.

On a broader scale, the Townsville region supports a number of wetland areas, including lacustrine (lake), palustrine (marsh), riverine, estuarine and marine wetland types. Such habitats support extensive and valuable bird populations, including the migratory birds that fly through the coastal plain on their annual journey along the East Australian Flyway.

Bowling Green Bay is listed under the Ramsar Convention and protected under the *Environment Protection and Biodiversity Conservation Act 1999*. This Ramsar site is largely situated to the east of Cape Cleveland, but also extends along the south-east coastline of Cleveland Bay. The site has outstanding values with respect to provision of habitat to migratory and resident waterbirds, marine megafauna (turtles, dugong) and a range of other natural resource values. The Ramsar site boundary is approximately 9 km from the port.

There are also two wetlands of national importance (listed in the Directory of Important Wetlands) located in the Townsville region, including the Burdekin-Townsville coastal aggregation and the Ross River Reservoir.

Wetland protection areas, under the draft *State Planning Policy 4/11: Protecting wetlands of high ecological significance in Great Barrier Reef catchments* (DERM, 2011a), are located more than 6 km west of the port.

B.0.2.2.2 Climate Events and Natural Disaster Risk

Townsville is located in a dry tropical region and is characterised by a tropical wet and dry climate. High humidity and frequent storms with occasional cyclones typically occur during the wet season (November to April). The dry season produces mild and moderate temperatures. The temperature ranges from a mean maximum of 31.5°C in December to a mean minimum of 13.6°C in July. Wind speed is highest in the afternoon and the monthly wind speed averages vary between 18.1 km/h in June and 23.6 km/h in September. The dry season months are dominated by south-east trade winds, while the wet season months bring winds typically from the north-east.

Tropical cyclones occur in Townsville leading to major flooding events and beach erosion. Storm surges often occur during the passing of a tropical cyclone causing flooding to low-lying coastal areas and the potential for severe wave action acting on coastal structures.

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

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

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

Port Expansion Project EIS

Part B

Chapter 1.0 - Land

AECOM BMT WBM

B.1 Land

B.1.1 Relevance of the Project to the Land and its Values

The Port Expansion Project (PEP) proposes a significant expansion of the port's area and its capacity to handle products in and out of Townsville and the region. The PEP will need to reclaim seabed adjacent to the port, which currently has potential recreational and commercial uses. The increase in port activity that the PEP is expected to bring also has the potential to affect surrounding land uses through indirect impacts, notably those involving transport of goods to and from the port via road or rail. The purpose of this chapter is to detail and assess the existing land environment for areas associated with the PEP and to identify potential impacts on land-based characteristics resulting from the construction and operation of the Project. Regional, district and local land characteristics are assessed, including potential impacts on the existing uses in Cleveland Bay. Land characteristics that have been assessed include:

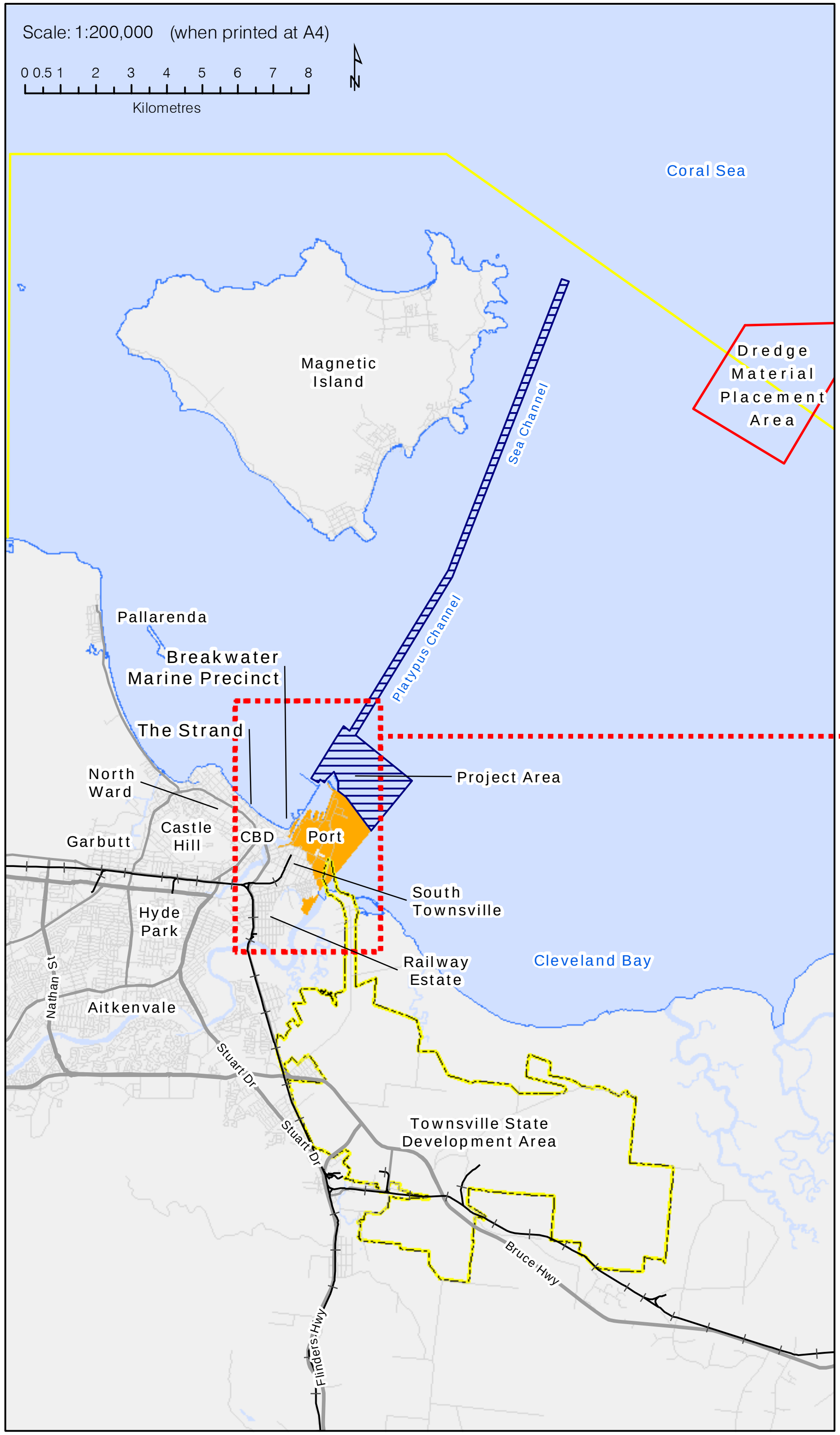
- topography, geology and soils
- land contamination
- land use and tenure.

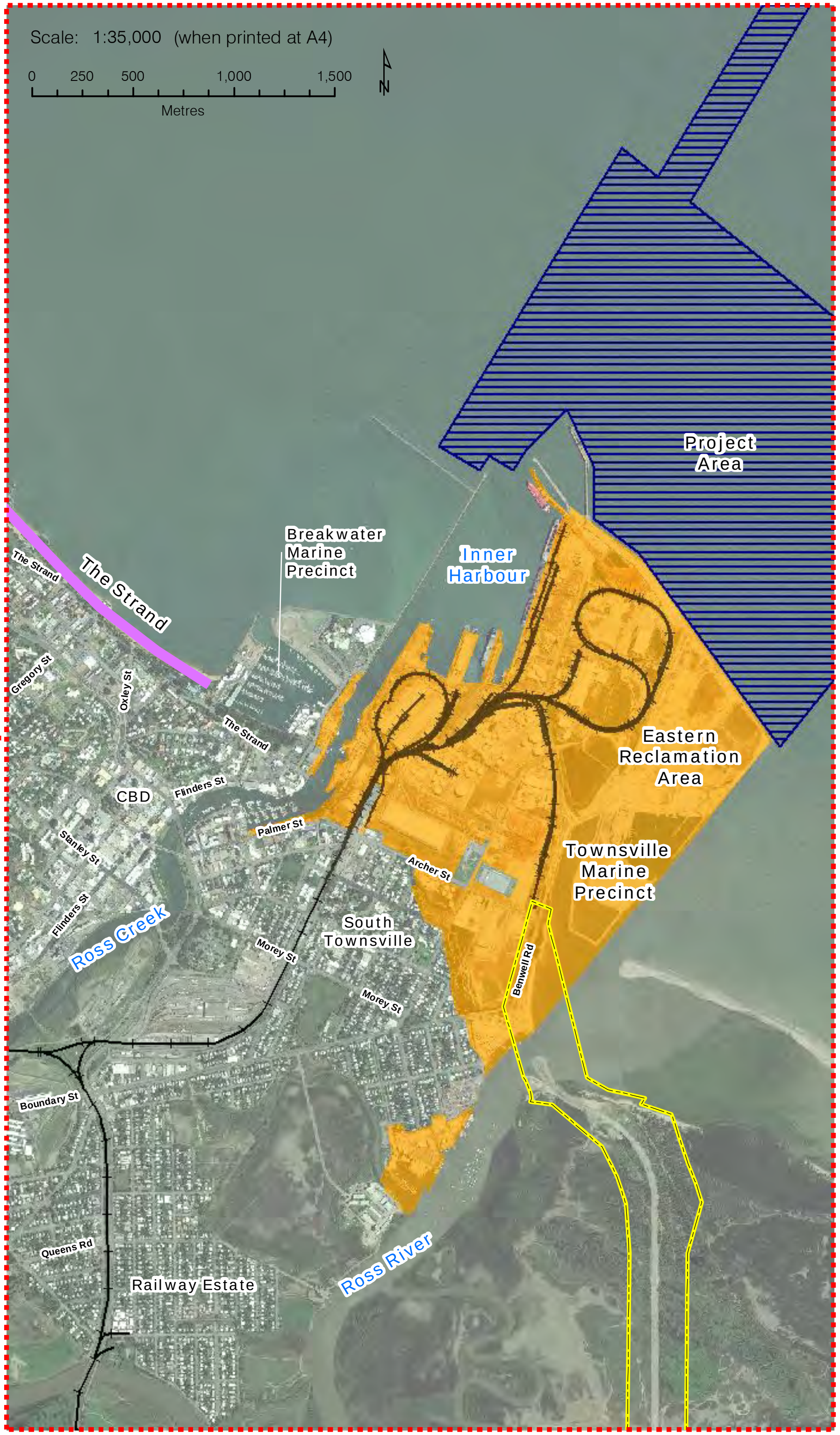
The key land attributes are assessed in terms of the regional, district and local policy frameworks that identify preferred outcomes for the attributes. The information is used to contextualise the role of the PEP and its potential impacts, direct or indirect on land characteristics using available information that describes those characteristics. The key land characteristics are described in terms of the urban areas and Cleveland Bay that surround and include the existing port and the Project Area. Key urban areas and locations that are assessed are:

- South Townsville
- Railway Estate
- Magnetic Island
- North Ward (including The Strand)
- Townsville CBD (including the Breakwater Marine Precinct)
- Townsville State Development Area (TSDA).

The locations are shown in Figure B.1.1. The location of the project is shown in State, regional and local context in Figure B.1.2.

Potential land related impacts of the PEP are primarily assessed in terms of the relationship of the port and the PEP with the surrounding area, including the greater Townsville area, and the future interaction of the Project with the current existing land and marine area uses. Consideration is also given to the likely effects on the displacement of existing land activity and the need for any specific mitigation measures for the management of particular land characteristics (for example, acid sulfate soils or contaminated land) or interaction between PEP related and other land uses. Impacts are identified and described using the general methodology that has been adopted for the Environmental Impact Statement (EIS) in Sections A2.1 to 2.4.





PORT EXPANSION PROJECT
EIS

Land Use Assessment
Study Area

Figure B.1.1

Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- The Strand
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

PROJECT ID	60161996
LAST MODIFIED	CFS 13-Nov-2012
FILE NAME	60161996_PLN_014

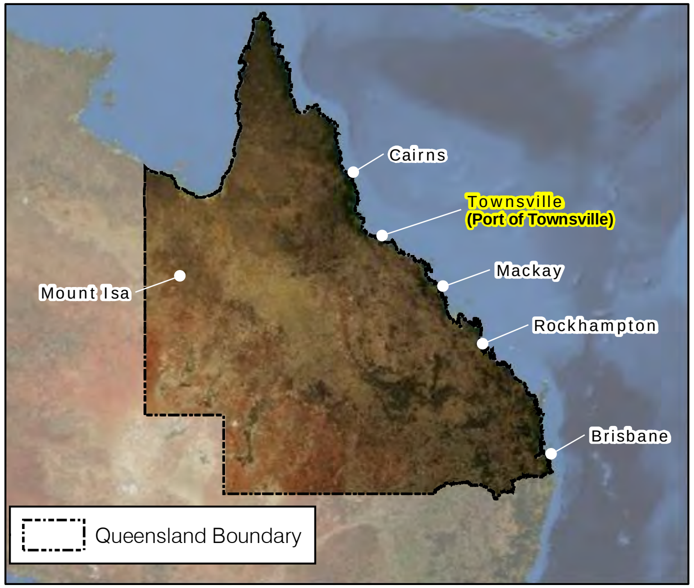
Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery (insert) - Port of Townsville 2011.

Location of the Port of Townsville at State Level

Scale: 1:32,000,000 (when printed at A4)

0 250 500 1,000

Kilometres

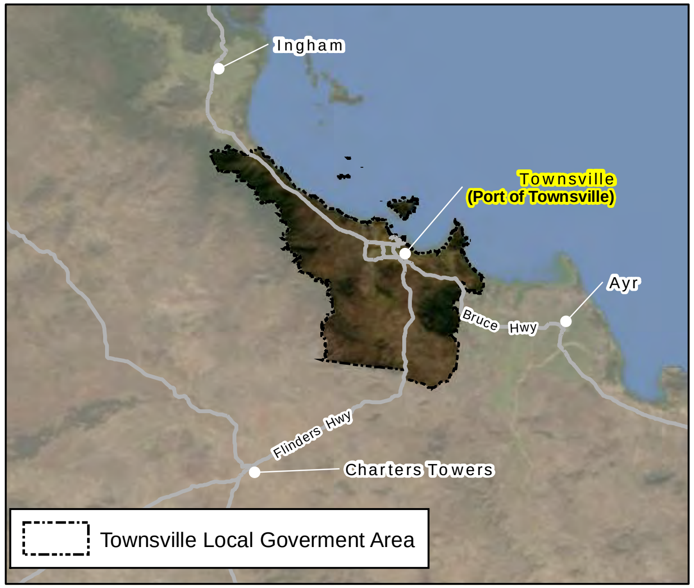


Location of the Port of Townsville within Townsville's Local Government Area

Scale: 1:3,000,000 (when printed at A4)

0 50 100

Kilometres



Location of the Port of Townsville within Townsville

Scale: 1:250,000 (when printed at A4)

0 5 10 20

Kilometres

PORT EXPANSION PROJECT EIS

Location of Port of Townsville

Figure B.1.2

Legend

- Highways
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

PROJECT ID 60161996

LAST MODIFIED CFS 08-Mar-2013

FILE NAME 60161996_PLN_146

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Imagery - ESRI 2013

B.1.2 Assessment Frameworks and Statutory Policies

Assessment frameworks and statutory policies are considered for:

- topography, geology and soils (including land contamination)
- land use and tenure.

These frameworks and policies provide an overview of the physical environmental and planning management outcomes for the area and to assist in forming a basis for the assessment of likely impacts, relevant controls and directions for mitigation.

B.1.2.1 Topography, Geology and Soils

The topography and landforms in the Study Area were reviewed using relevant maps, including topographic maps, aerial photography from 1961 to 2010 inclusive, and relevant previous studies.

The geology and soils in the Study Area were assessed based on desktop review of previous investigation reports, aerial photography, geological maps and soil bore logs in the Project footprint and its immediate surroundings.

A range of land investigations have been undertaken at the Port of Townsville including geotechnical and contamination assessments of the seabed sediments at the inner and outer harbours, acid sulfate soils (ASS) and soil investigation studies and groundwater monitoring programs at the existing port. Due to the PEP's location adjacent to marine near-shore and estuarine coastal sediments an ASS study was completed by Golder Associates (2012a) as part of the EIS. This study comprised a desktop review of information provided by Port of Townsville Limited (POTL) and site surveys undertaken in 2008, and is in accordance with the following legislation/guidelines:

- *State Planning Policy 2/02: Planning and Managing Development Involving Acid Sulfate Soils* (SPP 2/02)
- *Queensland Acid Sulfate Soil Technical Manual* (DNRM, 2004)
- *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998*, developed by the Queensland Acid Sulfate Soils Investigation Team (Ahern, Ahern, & Powell, 1998)

The following assessment framework and policy references are applicable for the assessment of contaminated land:

- *National Environmental Protection (Assessment of Site Contamination) Measure* (NEPC, 1999)
- *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (DE, 1998)
- *AS 4482.1:2005 Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil* (Standards Australia, 2005a).

Dredging and disposal of material for reclamation may be considered as disposal on land, which is covered by the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998*. This matter is considered in detail in Coastal Processes (Chapter B3) and Marine Sediment Quality (Chapter B5).

A land contamination desktop review was undertaken of land affected by the PEP and immediately adjacent areas to identify properties that may have been impacted by contamination or that may impact on the PEP footprint. The desktop study comprised:

- review of the Department of Defence (DoD) unexploded ordnance (UXO) mapping
- review of historical aerial photography to determine likely land use classification (e.g. industrial, residential, etc.) and to identify properties for which searches on the Department of Environment and Heritage Protection (DEHP) Environmental Management Register and Contaminated Land Register were required.

Reports that were reviewed as part of this assessment include:

- *Townsville Marine Precinct Project – Environmental Impact Statement*

    - Appendix P - Baseline Groundwater Monitoring (GHD, 2008b)
    - Appendix H - Acid Sulfate Soils Investigation (GHD, 2009b)
- *Summary of Geotechnical Testing Undertaken Within the Port of Townsville Redevelopment Area* (Golder Associates, 2008a).

B.1.2.2 Land Use and Tenure

Assessment frameworks and statutory policies relating to land uses exist at Commonwealth, state and local government levels. These frameworks and policies establish the operational regimes within which land use decisions are made and differ from the legislative frameworks discussed in Section A2.6, which largely establishes the heads of power and procedures in law used to implement land use decision-making.

B.1.2.2.1 Commonwealth Land Use Planning Frameworks and Statutory Policies

Great Barrier Reef World Heritage Area

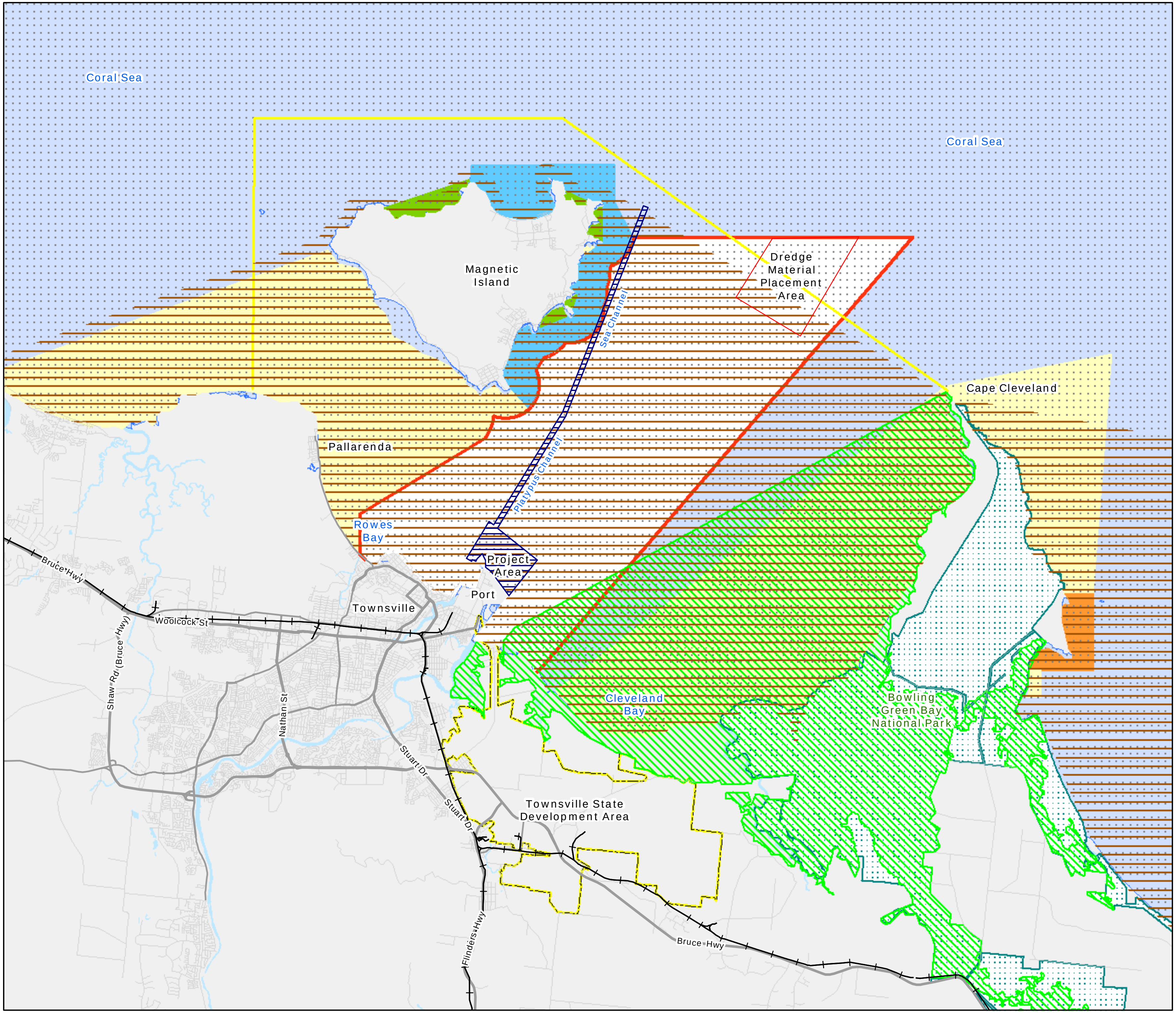
Waters in the vicinity of and including the Project Area are part of the Great Barrier Reef World Heritage Area (GBRWHA). Cleveland Bay, including Magnetic Island, is in the GBRWHA. There are no specific plans or codes that apply to the entire GBRWHA. Assessment of impacts and the determination of specific mitigation methods are primarily determined through environmental assessment processes, including EIS, under the *Environment Protection and Biodiversity Conservation Act 1999*.

Great Barrier Reef Marine Park Zoning Plan 2003

The Great Barrier Reef Marine Park (GBRMP) is under the jurisdiction of the Great Barrier Reef Marine Park Authority (GBRMPA). The principal assessment framework that applies to GBRMP is the *Great Barrier Reef Marine Park Zoning Plan 2003* (GBRMP zoning plan), which is administered by the GBRMPA. The GBRMP zoning plan does not apply to waters affected by the PEP, other than for a small section of shipping channel deepening at the northern end of the Sea Channel.

The GBRMP zoning plan establishes zones over parts of Cleveland Bay, which are intended to protect marine habitat and species as well as permitting other compatible uses to take place relative to the level of habitat protection considered necessary. The three main zones in Cleveland Bay are detailed below and shown in Figure B.1.3.

- General Use Zone
    - The objectives of the General Use Zone are to provide for the conservation of areas of GBRMP, while providing opportunities for reasonable use. The General Use Zone provides for the widest range of uses of any GBRMP zone. The deepening and lengthening of the Sea Channel is an extension of the existing seaway in this zone and is consistent with the intent of the zone.
- Habitat Protection Zone
    - The objectives of the Habitat Protection Zone are to provide for the conservation of areas of GBRMP through the protection and management of sensitive habitats, generally free from potentially damaging activities while also providing opportunities for reasonable use.
- Conservation Park Zone
    - The objectives of the Conservation Park Zone are to provide for the conservation of areas of GBRMP while also providing opportunities for reasonable use and enjoyment, including limited extractive use.



PORT EXPANSION PROJECT EIS

Great Barrier Reef Marine Park Zonings and Environmentally Sensitive Areas in Cleveland Bay

Figure B.1.3

Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Dredge Material Placement Area
- Dugong Protection Area
- Cleveland Bay Fish Habitat Area
- Bowling Green Bay Ramsar Site
- GBRWHA/National Heritage Place

GBRMPA - Zoning

- Conservation Park
- General Use
- Habitat Protection
- Marine National Park
- Scientific Research
- Marine Park Boundary

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 13-Nov-2012
FILE NAME	60161996_PLN_015

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Dugong Protect Area is a representation of GBRMPA's Dugong Protection Areas. Any analysis should use the offical GBRMPA's Dugong Protection Areas for accuracy.

National Strategy for Ecologically Sustainable Development 1992

The *National Strategy for Ecologically Sustainable Development1992* (National ESD Strategy) defines ecologically sustainable development (ESD) as *"using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased"* (ESD Steering Committee, 1992). The strategy sets out a strategic policy framework under which governments cooperatively make decisions and take actions to pursue ESD. The national ESD Strategy was endorsed by the Council of Australian Governments on 7 December 1992 as a factor in future environmental decision making.

Great Barrier Reef Outlook Report 2009

The *Great Barrier Reef Outlook Report 2009* (Outlook Report) defines the current conditions of the Great Barrier Reef, its management and its future outlook. The Outlook Report underpins decision making for the long term protection of the Great Barrier Reef (GBRMPA, 2009). The GBRMPA states the aim is to provide information about:

- *The condition of the ecosystem of the Great Barrier Reef Region (including the ecosystem outside the Region where it affects the Region).*
- *Social and economic factors influencing the Great Barrier Reef ecosystem.*
- *Management effectiveness of the Great Barrier Reef.*
- *Risk-based assessment of the long-term outlook for the Region.*

(GBRMPA, 2009)

The Outlook Report identifies that there is generally "good planning" at individual port levels with most planning for ports and shipping activities appearing to be responsive rather than strategic and proactive. Ports have not been recognised as a specific form of development which is perceived to directly impact on social values of the GBR. Ports and shipping are recognised by the Outlook Report as providing strong social benefits to regional communities and contributes to the economic value of the Great Barrier Reef. Ports and shipping have not been have not been included in the listed in the community perceptions about the direct threats to the Great Barrier Reef ecosystem.

The Outlook Report identifies the use of the GBR region for ports and shipping as making a significant contribution to the environmental, economic and social values of the region, in ways that sustain the fundamental value of the natural resource. Most routine shipping activities are identified as having negligible consequences. Dredging and construction of port facilities can have significant but localised impacts. Overall the impact of Ports and shipping in the GBR region is identified as being of 'low impact'.

B.1.2.2.2 State Land Use Planning Frameworks and Statutory Policies

State assessment frameworks and statutory policies affecting land use planning in the area surrounding and including the PEP, include:

- State planning regulatory provisions (SPRP)
- State planning policies (SPP)
- Regional planning policies
- Local state-based strategies and policies.

State Planning Regulatory Provisions

A SPRP is a planning instrument that is made under the provisions of the *Sustainable Planning Act 2009* (SP Act) for an area to advance any purpose of the Act. A draft SPRP has the same effect as an SPRP once the draft is made. SPRP can include the identification of levels of assessment for defined areas or specific uses, prohibit development, and identify assessment criteria that are required for assessable development. Where other planning instruments may be inconsistent with the provisions of an SPRP (including a draft SPRP), the provisions of the SPRP prevail. Other planning instruments include regional plans, state planning policies, statutory planning guidelines, local planning schemes and temporary planning instruments.

The draft *Coastal Protection State Planning Regulatory Provision* (draft Coastal Protection SPRP) came into effect on 8 October 2012 (DSDIP, 2012). The draft Coastal Protection SPRP replaces *SPP 3/11: Coastal Protection* while the SPP is being reviewed. The provisions of the draft Coastal Protection SPRP apply to the preparation of local planning schemes and scheme amendments, the preparation of regional plans, assessment of proposed community infrastructure, and the assessment of development applications under the Integrated Development Assessment System of SP Act. The draft Coastal Protection SPRP is the only SPRP that applies to land that is to be affected by the PEP.

The draft Coastal Protection SPRP includes assessment provisions that relate to:

- coastal hazards
- development in erosion prone areas
- nature conservation
- areas of high ecological significance
- public access
- coastal-dependent land use
- canals and dry land marinas.

The draft Coastal Protection SPRP specifically notes that:

> *Maritime infrastructure has an important role in the state's economy and is appropriate where there is no net loss of public access to the coast and adverse impacts on coastal resources and their values are avoided where practicable or minimised.*

The provisions of the draft Coastal Protection SPRP do not apply to this stage of the PEP's assessment, but would apply to any future development applications in the coastal zone, should the SPRP still be in place at the time a development application is lodged. At this stage, the Queensland Government has identified that the planning instrument is to apply for an initial period of 12 months.

State Planning Policies

SPP are statutory policies that have been prepared under the provisions of SP Act, which can also have a basis in other related legislation (e.g. environmental legislation). SPP can affect both the preparation of local planning schemes and have provisions that must be considered in the assessment of assessable development regardless of whether those provisions exist in a relevant local planning instrument.

Unlike local government planning schemes, consideration of SPP is not statutorily mandatory for the preparation of a port land use plan, prepared under the provisions of the *Transport Infrastructure Act 1994.* SPP must be considered for any assessable development that is affected by such a plan (i.e. for Strategic Port Land). In this regard, although SPP do not play a statutory role in any amendment of the *Port of Townsville Land Use Plan*, any future assessable development prior to the PEP's inclusion in to Strategic Port Land or development that is made assessable under the plan must have regard for applicable SPP.

Queensland SPP and their relevance to the PEP are listed in Table B.1.1.

Table B.1.1 State Planning Policies that may be Relevant to PEP Assessable Development

SPP Name	Key Characteristics	Application to PEP
SPP 4/11: Protecting wetlands of high ecological significance in Great Barrier Reef catchments	Protects referable wetlands in river catchments, including coastal locations, that drain towards the Great Barrier Reef.	Although there are wetlands of high ecological significance in the Cleveland Bay area, such wetlands do not occupy the development footprint of the PEP and are not in close proximity to impacts from the PEP. The PEP is not expected to have any significant impact on any wetlands affected by SPP 4/11.
SPP 3/11 Coastal Protection and *State Policy for Coastal*	This SPP is presently being reviewed by the Queensland Government. Its provisions have	Draft Coastal Protection SPRP (in lieu of SPP 3/11) is relevant to the PEP where assessable development is

SPP Name	Key Characteristics	Application to PEP
Management (DERM, 2012)	been temporarily replaced by the provisions of the draft Coastal Protection SPRP. SPP3/11 is part of a broader state planning document, the *Queensland Coastal Plan*. This plan consists of two parts: the *State Policy for Coastal Management* and SPP3/11. The *State Policy for Coastal Management* is to be considered for development that does not constitute assessable development under the provisions of SP Act, while SPP 3/11 provides the assessment criteria for assessable development in state coastal land (replaced by draft Coastal Protection SPRP). The *State Policy for Coastal Management* is not an SPP under the provisions of SP Act.	to be considered under the provisions of SP Act. The *State Policy for Coastal Management* applies to the consideration of the PEP at the EIS stage and deals primarily with policy objectives and outcomes for the protection of natural coastal areas such as dune systems and beaches. The policy establishes objectives to ensure that development is not adversely affected by and will not affect coastal processes that can lead to sediment movement, deposition and erosion, as well as ensuring that reasonable public access is maintained to the coastal area. Key aspects of the *State Policy for Coastal Protection* that apply directly to the PEP include requirements for: ▪ management of areas of ecological significance (including sea grass beds) ▪ public access and use of the coast. The policy provides that where impacts from activities, structures and infrastructure cannot feasibly be avoided, management actions are to be taken to reduce impacts and, where possible, rehabilitative actions are to undertaken to ensure there is no overall loss of the impacted values. The mitigations proposed by the technical chapters in Part B and the environmental management actions proposed in Part C provide a detailed basis for the minimisation of adverse impacts. The *State Policy for Coastal Protection* seeks to ensure that tenure decisions for state coastal land (including reclaimed land such as the PEP) do not result in the loss of public access to or use of coastal land or the foreshore. Exceptions may be made where there is an over-riding need in the public interest or to establish or support a public benefit asset. Factors for determining over-riding need in the public interest include: ▪ the overall social, economic and environmental benefits of granting the tenure outweigh the conflict with the policy outcome ▪ the activity for which the tenure is to be granted cannot be located elsewhere so as to avoid conflicting with the policy outcome. The application of this part of the *State Policy for Coastal Management* will apply at the time POTL formally applies for tenure of the Project Area. The EIS addresses the range of social, economic and environmental impacts that the *State Policy for Coastal Management* seeks to avoid or mitigate. The PEP is an integral part of the port's overall expansion and its future in servicing North Queensland and is unable to be effectively located elsewhere. The PEP is not significantly affected by the *State Policy for Coastal Management* in terms of foreshore access effects. The PEP is an extension of the existing port facilities, which already restrict foreshore access. The PEP will not lead to any further restriction of foreshore access.

SPP Name	Key Characteristics	Application to PEP
Temporary SPP 2/11: Planning for stronger, more resilient floodplains	This SPP ensures that development in floodplains is compatible for the flood regimes that are experienced. The SPP provides basic code assessment provisions for assessable development and envisages that provisions that are more detailed will be incorporated into new planning schemes as they are developed or where major amendments are to occur.	The PEP is not expected to significantly contribute to or be affected by existing fluvial flood levels due to its location in the marine environment, beyond the mouths of the Ross River and Ross Creek. This aspect is addressed in detail in Chapter B2 (Water Resources).
SPP 3/10: Acceleration of compliance assessment	Compliance assessment is an expedited level of assessment that is to apply to certain forms of reconfiguring a lot from one lot into two lots in industrial and residential areas.	This SPP does not apply to uses associated with the PEP. This includes future subdivision of land where such creation of title is undertaken through the provisions of the *Land Act 1994.* Any such subdivision of land is generally not defined as assessable development under the provisions of SP Act.
SPP 2/07: Protection of extractive resources	This SPP is for the protection of key resources areas (KRA) identified for their extractive materials including rock quarries. The SPP provides assessment criteria for development in and adjacent to KRA buffer areas.	SPP 2/07 does not directly affect the development of the PEP. The PEP will use significant amounts of quarry material during its construction. POTL has its own approved quarry facilities at Graniteville Road, Pinnacles (on the western outskirts of Townsville) for amour rock used for seawall and revetment construction. The quarry is not a listed KRA. Extraction of material from the quarry will not adversely affect the operation of other quarries in the area in terms of the provisions of the SPP.
SPP 1/03: Mitigating the adverse impacts of flood, bushfire and landslide	This SPP considers physical constraints to development due to bushfire, flooding or land instability.	Based on the PEP's location in Cleveland Bay, it will not be significantly affected by or affect flooding in Ross Creek or Ross River. The PEP is not in a bushfire or land slip prone area. Flood impacts are assessed in Chapter B2 (Water Resources).
SPP 2/02: Planning and managing development involving acid sulfate soils	SPP 2/02 identifies ASS as significant impact constraints to development and environmental protection. Assessment criteria are provided for assessable development in locations that are likely to be affected.	SPP 2/02 applies to the assessable development as part of the PEP and is discussed in Section B.1.3.1.
SPP 1/02: Development in the vicinity of certain airports and aviation facilities	This SPP affects development in proximity of listed airports to ensure that aviation safety is not compromised.	Townsville Airport and surrounding areas are subject to the SPP. The form of development represented by the PEP (i.e. primarily reclamation and ground-based operational works) is not considered by the SPP. Land development for the PEP will consider certain safety requirements, which may include use of safety clearance lighting for tall structures. The SPP is not expected to affect significantly the nature of the PEP.

B.1.2.2.3 Regional Planning Policies

Non-statutory regional policies that are relevant to the PEP and the Port and Townsville include:

- *Queensland Regionalisation Strategy 2011* (DLPG, 2011b)
- *Queensland Infrastructure Plan 2011* (DLPG, 2011a)

- *A Second Capital for Queensland – Townsville Futures Plan 2012* (TFPT, 2011)
- *Northern Economic Triangle Infrastructure Plan 2007-2012* (DI, 2007b)

There are no statutory regional plans that affect the PEP or the surrounding area. The *North West Regional Plan* (DLPG, 2010)is a statutory regional plan that affects the North West Region of Queensland (i.e. the local government areas of Mount Isa, Cloncurry, McKinlay, Richmond and Flinders). Although it has no direct statutory relevance to Townsville or the port area it may indirectly influence outcomes for the Project.

These plans are described in more detail below.

Queensland Regionalisation Strategy

The *Queensland Regionalisation Strategy* recognises the importance of minerals and agricultural exports to the state and the key role that Townsville plays as a focal point for the state's minerals corridor, energy corridor, tropical expertise, Tourism and agriculture. The Port of Townsville was identified as one of Queensland's key ports with (export) tonnages in excess of 5 Mtpa. POTL has estimated that tonnages during the 2010/2011 financial year reached 11 Mtpa, which is expected to more than double to 25 Mtpa by 2015/2016. Apart from facilitating trade, the Port is also about to provide a significant contribution to the region's tourism trade with the redevelopment of Berth 10 for passenger cruise ships.

Queensland Infrastructure Plan

The *Queensland Infrastructure Plan* identifies key infrastructure provision priorities for Queensland. The Port of Townsville is recognised by the plan as 'a high priority, with its proposed expansion opening up Townsville to a higher level of national and international shipping services' (DLPG, 2011a). The plan identifies opportunities for port expansion with an indicative investment amount of $500 million expected between 2011 and 2015.

A Second Capital for Queensland – Townsville Futures Plan

The *Townsville Futures Plan* is a broad-based, non-statutory, strategic planning document for Townsville that describes a vision for the city. It seeks to build on Townsville's comparative advantages and accommodates economic and population growth in its regional, social and economic spheres of influence to realise its vision for Townsville as the 'Second Capital for Queensland'. The plan identifies a range of strategies that are intended to deliver economic prosperity, liveability and sustainability outcomes to accommodate economic and population growth by focusing on:

- infrastructure and services
- business and innovation
- people
- lifestyle
- image and marketing
- leadership and decision-making.

The importance of the port is recognised in maintaining economic prosperity for the region as well as ensuring that Townsville continues to develop into a vibrant and liveable city through good urban design, well-integrated land uses, and maximising functionality and amenity of urban areas.

The plan identifies the need for rejuvenation of the CBD through good urban design and maintaining its integration with The Strand. Key requirements to add to the overall amenity of the area include preserving cultural and recreational benefits, and historic buildings, and promoting the creation of improved access to interesting public places. The plan provides state endorsed planning and community development principles that are reflective of the state's growth management objectives for Townsville and the region. Many of these principles are also encapsulated in the TCC *Land Use Proposal* for its new planning scheme.

Northern Economic Triangle Infrastructure Plan 2007-2012

The *Northern Economic Triangle Infrastructure Plan 2007-2012* establishes directions for economic growth and development of the region bounded by Mount Isa, Townsville and Bowen. This growth was focused on the extensive mining activity in this region and its need for support services in the key identified towns. The vision is:

> *To foster sustainable economic, social and community development and growth through the emergence of Mount Isa, Townsville and Bowen as a triangle of mineral processing and industrial development over the course of the next half century.*

Key strategic objectives are:

- provide access to competitively priced and reliable energy in North West and North Queensland
- exploit the rich mineral resources of North West Queensland
- plan for long-term integrated efficient development with transport and port infrastructure providers
- plan large-scale land and industrial precincts that are 'investor-ready'
- integrate the activities of the triangle's economic centres
- develop sustainable regional communities.

Specific strategies and actions that affect the port include:

Strategy 11: Protect the integrity of the Port of Townsville as the major gateway to North, North West and Far North Queensland by adoption of the *City-Port Strategic Plan*

Action 11.1: Adoption and implementation of the *City-Port Strategic Plan* to guide development to achieve an effective and sustainable interface between Townsville's port area and the adjacent city area

Strategy 12: Ensure future development and efficient operation of the Port of Townsville by adoption and progressive implementation of the *Port of Townsville Master Plan*

Action 12.1: Adoption and progressive implementation of the *Port of Townsville Master Plan* to drive appropriate redevelopment, rationalisation and expansion

Action 12.2: Continue to support transport routes including the Townsville Port Access Road (TPAR) between the Bruce and Flinders highways and the Port of Townsville

The expansion of the port is identified as a key factor for the realisation of the trade potential that exists for minerals predominantly from the North West and the North East Minerals Provinces. Although the PEP has undergone some design modification since its conception, the original PEP concept plan has been recognised in the Northern Economic Triangle Infrastructure Plan.

North West Regional Plan

The North West Regional Plan is the regional planning document that must be considered when making land use planning decisions in the Flinders, Richmond, and McKinlay, Cloncurry or Mount Isa council areas. The plan recognises that '… mining for base metals in the region has the potential to produce state-wide social and economic benefits for decades to come'. Strong communities are regarded as a key objective of the plan. Key values include:

- maintaining stable populations
- access to education and learning opportunities
- social planning and social infrastructure
- provision of social services
- maintaining regional lifestyle, cultural heritage and arts
- promoting health and wellbeing
- leadership, networks and coordination.

Increased trade potential in base metals and other minerals from the region through PEP infrastructure is expected to provide greater revenue and investment into the North West, which is expected to be a catalyst for the realisation of many of the objectives and values of the plan.

B.1.2.2.4 Local State-Based Frameworks and Statutory Policies

Local, state-based frameworks and policies affecting land use near the port include:

- *Townsville City – Port Strategic Plan*
- *Development Scheme for the Townsville State Development Area*

Townsville City – Port Strategic Plan

The *Townsville City – Port Strategic Plan* is a non-statutory plan prepared by the Coordinator-General in 2006, which provides planning outcomes for the integration of the port and its expansion with the surrounding urban area. It includes consideration of transport management issues and forms much of the basis for the construction of the TPAR through the TSDA and across Ross River to service the port's growth needs.

Development Scheme for the Townsville State Development Area

The *Development Scheme for the Townsville State Development Area* (TSDA Development Scheme) provides the statutory controls for material change of use development applications in the TSDA. The Development Scheme is administered by the Coordinator-General and includes code provisions that are considered in the assessment of such applications. The TSDA has been established by the state government to provide land that is suitable for heavy industrial development, well serviced by heavy transport routes and associated infrastructure, and separated from residential areas.

The TSDA Development Scheme identifies a number of land use precincts specifically intended for heavy and other industries that are able to integrate with and compliment port activity. These precincts include:

- heavy industry: recognising existing large-scale industrial development in the region and protecting it from incompatible encroachment from other development
- transport industries and medium industry: recognising existing or proposed Department of Transport and Main Roads infrastructure and associated planning for the area and to enable industry to maximise industry advantage from heavy transport services and proximity
- low impact and light industry: to encourage further light industry and warehousing expansion in Townsville in a manner that takes advantage of the port and other transport proximity while ensuring that adverse encroachment from other industries does not occur
- materials transportation and services corridor: provision of a dedicated route for heavy road transport and key trunk infrastructure (i.e. water, gas, electricity and sewer) and for incorporation of rail when required
- buffer/restricted development: to provide additional protection to heavy industry against other incompatible development through physical separation and to provide areas where flora and fauna may continue to exist in their natural state
- investigation area: to recognise areas suited for continued use for waste water disposal, polishing, recycling and irrigation, and their potential for long-term use for low-key industry and related activity
- open space: to recognise areas that are subject to ongoing environmental rehabilitation works.

B.1.2.2.5 Local Land Use Planning Frameworks and Statutory Policies

Port of Townsville Port Development Plan 2010-2040

This plan provides the overall strategic direction for the port's growth and includes the expansion of its northern area, which generally includes the Project Area. The plan will be amended to more accurately reflect the final outcome of the preferred reclamation, surface infrastructure and berthing arrangements once planning and assessment for the PEP has been finalised.

Port of Townsville Land Use Plan 2010

The Port of Townsville Land Use Plan 2010 (Port Land Use Plan) was prepared pursuant to the provisions of the *Transport Infrastructure Act 1994* and approved by the Minister for Transport and Main Roads. It is the statutory land use plan that affects development on strategic port land.

The Port Land Use Plan identifies strategic port land, proposed strategic land (i.e. land to be designated as strategic port land through the consultation process undertaken for the preparation of the Port Land Use Pplan) and future strategic port land (i.e. land identified as being required to accommodate planned future expansion). The Port Land Use Plan also references the applicable planning codes and guidelines for assessable development and criteria that determine self-assessment for proposed development on strategic port land.

The Port Land Use Plan currently identifies the PEP as future strategic port land. A strategic port land designation makes any development on such land exempt from the provisions of any local planning instrument and makes the port authority (i.e. POTL) the assessment manager under the provisions of SP Act. Strategic and proposed strategic port land is shown in Figure B.1.5.

The Port Land Use Plan contains planning objectives and strategic outcomes that form the basis for detailed controls. The strategic outcomes are categorised according to six key themes, which are summarised in Table B.1.2.

Table B.1.2 Port Land Use Plan 2010 – Strategic Outcomes

Theme	Strategic Outcomes
Land use pattern	▪ Grouping of core port activities into zones and precincts ▪ Protecting the viability of current and future uses from incompatible uses ▪ Ensure that new development supports and does not conflict with land use patterns identified through zones and precincts
Nature conservation	▪ Continue interaction with Commonwealth, state and local authorities to protect environmental values adjacent to the port ▪ Compliance with Commonwealth and state legislation and relevant SPP ▪ Implementation of environmental management plans through the development process to ensure environmental quality is protected ▪ Continual improvement of POTL's environmental policies and practices to reduce environmental impacts of growth ▪ Review of developments, including expansions and major maintenance projects, to ensure they meet appropriate environmental criteria and reduce impacts on lands and waters under POTL's jurisdiction ▪ Promotion and incorporation of sustainable environmental management into POTL's planning, development and operation
Economic development	▪ Grouping of compatible land uses to achieve synergies and economies to maximise existing and planned infrastructure ▪ Maintain the port's role as a key economic generator for the community and the region ▪ Development to increase economic opportunities at the port and promote the port as a 'gateway' for trade throughout the world ▪ Development to optimise the use of, and return on, strategic port land ▪ Promotion and incorporation of sustainable environmental management into POTL's planning, development and operations
Community identity and diversity	▪ Continued cooperation with TCC, relevant state authorities and adjacent residential and commercial communities to reduce adverse impacts ▪ Reduce amenity impacts from development (including, but not limited to noise, light, odour, dust and stormwater) ▪ Provision and maintenance of buffers between port facilities and adjacent urban development ▪ High standard of design that incorporates good site layout, building design, landscaping and sustainability principles

Theme	Strategic Outcomes
	▪ Management, protection and conservation of Indigenous cultural heritage management areas by traditional owners and other Indigenous groups through cultural heritage management plans ▪ Cooperation with port users (port community) to assist them to comply with security and safety requirements for the operation of the port
Infrastructure and services	▪ Ongoing strategic planning based on available data to provide for infrastructure needs for future development ▪ Development is sited in locations that can economically provide and maintain essential infrastructure ▪ Maximisation of port facilities use ▪ Consolidating development in well serviced precincts and the provision of ongoing maintenance of infrastructure ▪ Preparation of plans to obtain fair/equitable contributions during the development process towards the provision of infrastructure
Access and mobility	▪ Ongoing cooperation with the Department of Transport and Main Roads, Queensland Rail, QR National, TCC and other relevant authorities to proactively plan and cater for a coordinated transport system that protects and enhances the operation of the port ▪ Reduce the social and environmental impacts associated with transport systems development and operation ▪ Expansion and maintenance of the port's internal road network ▪ Integration of development with the road and rail Eastern Access Corridor route from the port, through the TSDA to the Bruce and Flinders highways

The strategic outcomes are facilitated through land use zones identified by the Port Land Use Plan. There are five land use zones:

- port operations
- port industry
- marine industry
- special use
- port buffer.

The land use zones for the port are shown in Figure B.1.4. The PEP is to be located adjacent to port industry zoned land. The purpose of the port industry zone is to cater for a wide range of industrial uses that directly support the import and export of cargo, and handling, storage and transportation of cargo. It is anticipated that once tenure of PEP land has been obtained and the land has been incorporated into strategic port land, it will adopt a zoning that is commensurate with existing zones for similar port activity as is anticipated for the PEP.

PORT EXPANSION PROJECT EIS

Port Land Use Zones

Figure B.1.4

Legend

- The Strand
- Railway Line
- Stage 2 Alignment Proposed Rail Corridor
- Townsville Port Access Road
- Project Area
- Townsville State Development Area

Port Zoning 2011-2012

- Marine Industry
- Port Buffer
- Port Industry
- Port Operations
- Special Use

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_017

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery - Port of Townsville 2011.
Strategic/Proposed Port Land - Port of Townsville Land Use Plan
Stage 2 Allignment Proposed Rail Corridor - AECOM 2012
Townsville Port Access Road - AECOM 2012

PORT EXPANSION PROJECT
EIS

Strategic Port Land

Figure B.1.5

Legend

- The Strand
- Railway Line
- Townsville State Development Area
- Proposed Strategic Port Land
- Strategic Port Land
- Future Strategic Port Land

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000
Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_016

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery - Port of Townsville 2011.
Strategic/Proposed Port Land - Port of Townsville Land Use Plan

Townsville Community Plan 2011-2021

The *Townsville Community Plan 2011-2021* provides the TCC vision for the community based on key values identified in the plan and summarised under four themes:

- strong, connected community
- environmentally sustainable future
- sustained economic growth
- shaping Townsville.

The plan is an overarching, community-led framework for the council's strategic and statutory decision-making with respect to development. It is intended that the council's new planning scheme, once it is completed, will reflect the broader community values of the Townsville Community Plan. The plan recognises sustainable economic activity as being of strategic importance to Townsville's future and, in so doing, provides the port with a complementary strategic framework for its expansion and facilitation of trade (TCC, 2011a).

Townsville City Plan 2005

The *Townsville City Plan 2005* is the local planning scheme that currently applies to development on land around the port that is not on strategic port land. The planning scheme applies to the area that was previously the TCC area prior to its amalgamation with the City of Thuringowa in 2008. Although the port is recognised in the *Townsville City Plan 2005* for spatial recognition purposes and to identify relationships between development that the council has jurisdiction over and strategic port land, the planning scheme provisions have no direct effect on development on strategic port land under s. 287 of the *Transport Infrastructure Act 1994*.

Desired Environmental Outcomes

The planning scheme has a number of desired environmental outcomes addressing economic vitality, infrastructure and services, transport and mobility, health and safety, sense of place and community, equality and equity, environmental management, heritage and character, and settlement patterns. The desired environmental outcomes are used as the basis for other more detailed planning controls that are reflective of defined planning districts with different planning precincts.

Planning Districts

Planning districts form logical larger planning units within the planning scheme boundary (i.e. the previous TCC area). Four planning districts may be influenced directly or indirectly by the PEP (Figure B.1.6). The port is depicted directly a part of (or abutting) District 1 (Townsville City Centre). The depiction is used to identify the port's relation to adjoining land uses; however, the provisions of the planning scheme do not apply to strategic port land. The districts that are likely to be influenced by the PEP are assessed in greater detail below.

- District 1: Townsville Central City

  The Townsville Central City District represents the main CBD area to the west of Ross Creek and that part of South Townsville that is north of Boundary Street on the eastern side of Ross Creek. Key locations in the district that are likely to be influenced by or have an influence on the PEP include:

  - the Palmer Street tourist and entertainment area that is located adjacent to the port on the eastern side of Ross Creek
  - the Breakwater (Peninsula) Marine Precinct located on the western side of Ross Creek
  - South Townsville
  - port land (including the Townsville Marine Precinct located along the western foreshore of Ross River).

  Overall planning outcomes for the district are identified by the planning scheme to include:

  - maintaining the primary focus of centralised employment, economic, cultural, community, tourism, recreational, commercial and entertainment activities of Townsville
  - mixed-use development

    - maintenance of balance between North Queensland character while transforming other parts of the city into pleasant and distinctive environments
    - protecting green space values
    - promoting passive recreation and effective pedestrian, cycle and public transport access through the CBD.
- District 2: Townsville Inner Suburbs

  Key locations in District 2 that are likely to be influenced by the PEP include North Ward, (including The Strand) and Railway Estate, which is located immediately to the south of South Townsville.

  Overall planning outcomes for the district include:

    - the maintenance of the predominantly residential character of the district for residents' and visitor accommodation
    - residential housing diversity
    - maintenance of existing housing architectural character
    - provision of commercial facilities and services in designated centres that reflect their commercial hierarchy status
    - safe and attractive living environments
    - protection of open spaces areas
    - accommodation of high quality intensive residential development along parts of The Strand
    - maintaining the historic significance of the Jezzine Barracks and Kissing Point areas.
- District 6: Stuart

  District 6 includes the TSDA, which is subject to its own development scheme and is not subject to the provisions of the planning scheme for any material change of use decision. Other forms of development are subject to the planning scheme provisions. The district also includes sensitive environmental areas along the Cleveland Bay foreshore and along Ross Creek, which are important for nature conservation and recreation purposes.

  Overall planning outcomes for the district include:

    - development as a core industrial area while maintaining protection of core environmental conservation areas
    - limiting residential development to Cluden
    - retail development only as an ancillary component of industrial development
    - protection of existing waste water treatment facilities from incompatible development
    - protection against inappropriate development in areas affected by potentially adverse coastal processes.
- District 8: Magnetic Island

  Magnetic Island represents its own district and has a number of settlements, including Horseshoe Bay, Arcadia, Nelly Bay and Picnic Bay. Nelly Bay represents the main tourist area on the island and is the location for the main ferry terminal, the tourist core and significant marina-side apartment based development. With the exception of the settlements, most of the island is in a natural state, with steep forested terrain consisting of dry tropical forest and some rainforest-like pockets of vegetation.

  Overall planning outcomes for the district identified by the planning scheme include

    - continuation of residential development only in established village areas
    - protection of the natural landscape and habitat values
    - recognition and protection of the island's heritage and historic buildings and facilities

- protection of the world heritage values of Magnetic Island and the Great Barrier Reef
- provision of a variety of accommodation experiences and choices.

Planning Precincts

Each planning district is affected by a range of planning precincts that act as land use zones. The planning precincts identify different levels of assessment for development, an overall precinct outcome, and specific outcomes for different aspects of development, acceptable solutions and assessment code provisions. Districts share the range of precincts that are identified by the planning scheme. The planning precincts provide a guide as to the type of land uses that are considered acceptable, as well as precinct code provisions to control the form of development and provision of services. The precincts are summarised in terms of their planning intent for the location in Table B.1.3 and shown in Figure B.1.6.

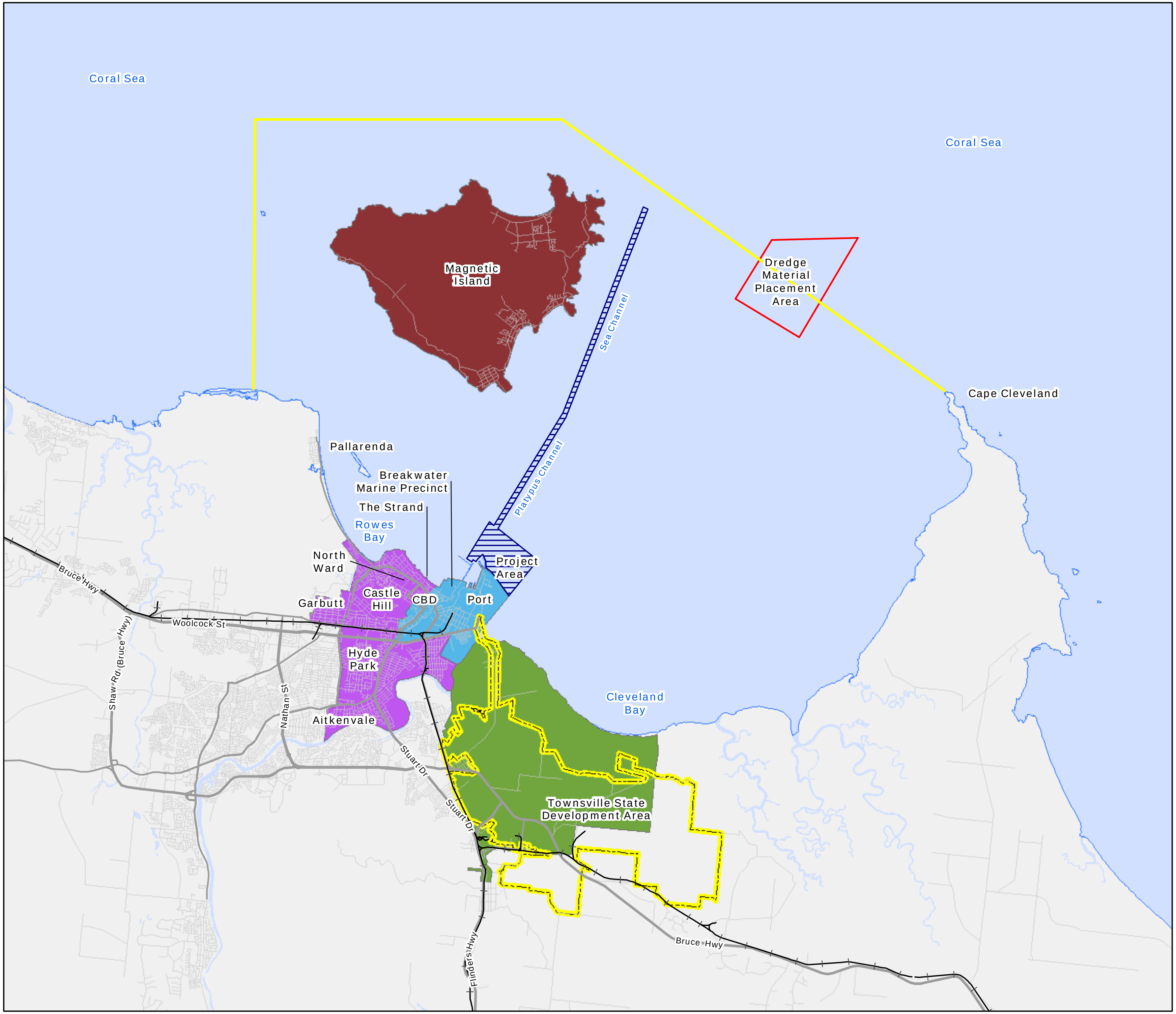
Table B.1.3 Townsville City Plan 2005 Planning Precincts Affecting Land in the Vicinity of the PEP

Precinct	Planning Intent Based on Precinct Specific Outcomes
CBD business core	Primarily accommodates offices for business, administration and business support services, together with mixed-use residential and tourist accommodation.
CBD retail core	Primarily for retail outlets (including major department stores, comparison and convenience shopping), restaurants and arts and craft centres, together with entertainment uses (such as wine bars), and mixed-use residential and tourist accommodation.
CBD entertainment core	Indoor recreation (other than cinemas), museums, art galleries, hotels, bars, pinball parlours, restaurants, markets, tourist facilities, mixed-use residential and tourist accommodation, including backpackers hostels, (particularly on upper levels), boat charter and ferry terminal facilities.
CBD tourist core	Quality restaurants, art and craft centres, museums/cultural heritage, entertainment uses and mixed-use tourist accommodation, motels, multiple dwellings and hotels.
Breakwater	Marina facilities and medium to high density residential development, mixed tourist activities, entertainment and dining facilities supporting the marina.
Cultural centre	A variety of community and cultural services such as theatres, cultural facilities, galleries and studios, Townsville Cultural Centre.
Education, heritage and business park	University or other educational establishments and complementary commercial functions including knowledge based business activities and supporting retail activities.
Neighbourhood centre	Primarily relates to North Ward Shopping Centre with smaller centres in Railway Estate and on Magnetic Island. Intended for small-scale shopping centres servicing their immediate area with some mixed residential and commercial uses.
Centre frame	Intended for offices, service industries, shops, child care centres, places of worship, and the like including uses that complement the CBD and other nearby centres requiring larger sites, generate higher traffic volumes but do not need a centre location.
Business and industry	Small-scale, light industry to service the needs of the surrounding community (such as sales or hire yards, service industries, storage or contractors' yards and the like), business support services servicing the surrounding area and dining and eating facilities to service workers in the locality.
Traditional residential	Primarily for detached houses on individual lots. Non-residential uses serve their local neighbourhood.
Neighbourhood residential	Primarily for low to medium density residential development and uses directly servicing residents.
Mixed residential	Residential development of a wide variety of urban housing forms ranging from detached houses and dual occupancies to multiple dwellings and accommodation buildings.
City view slopes residential	Stanton Hill and Melton Hill for residential development, which is consistent with the topography and visual prominence of this location.
Medium density residential	Capitalises on the precinct's proximity to Ross Creek and the wide range of amenities available in the city centre.
Rural	Agricultural related uses and existing low intensive uses of land. The precinct only relates to the Stuart location, which forms part of the TSDA.
Community and government	A variety of community and social services such as educational establishments, hospitals or major utilities.
Not subject to planning scheme	Denotes locations that are not subject to the provisions of the planning scheme.
Green space	Primarily accommodate parkland and recreational activities and ancillary structures.

PORT EXPANSION PROJECT EIS

Townsville City Council Planning Scheme 2005 - Planning Districts Influenced by the PEP

Figure B.1.6



Legend

- Highways
- Main Roads
- Minor Roads
- Local Roads
- Railway Line
- Port Limits
- Townsville State Development Area
- Dredge Material Placement Area
- District 1 - Townsville Central City
- District 2 - Inner Suburbs
- District 6 - Stuart
- District 8 - Magnetic Island

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_119

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Townsville City Council Planning Scheme 2005 - Planning Districts, derived from Townsville City Plan Maps - TCC 2012

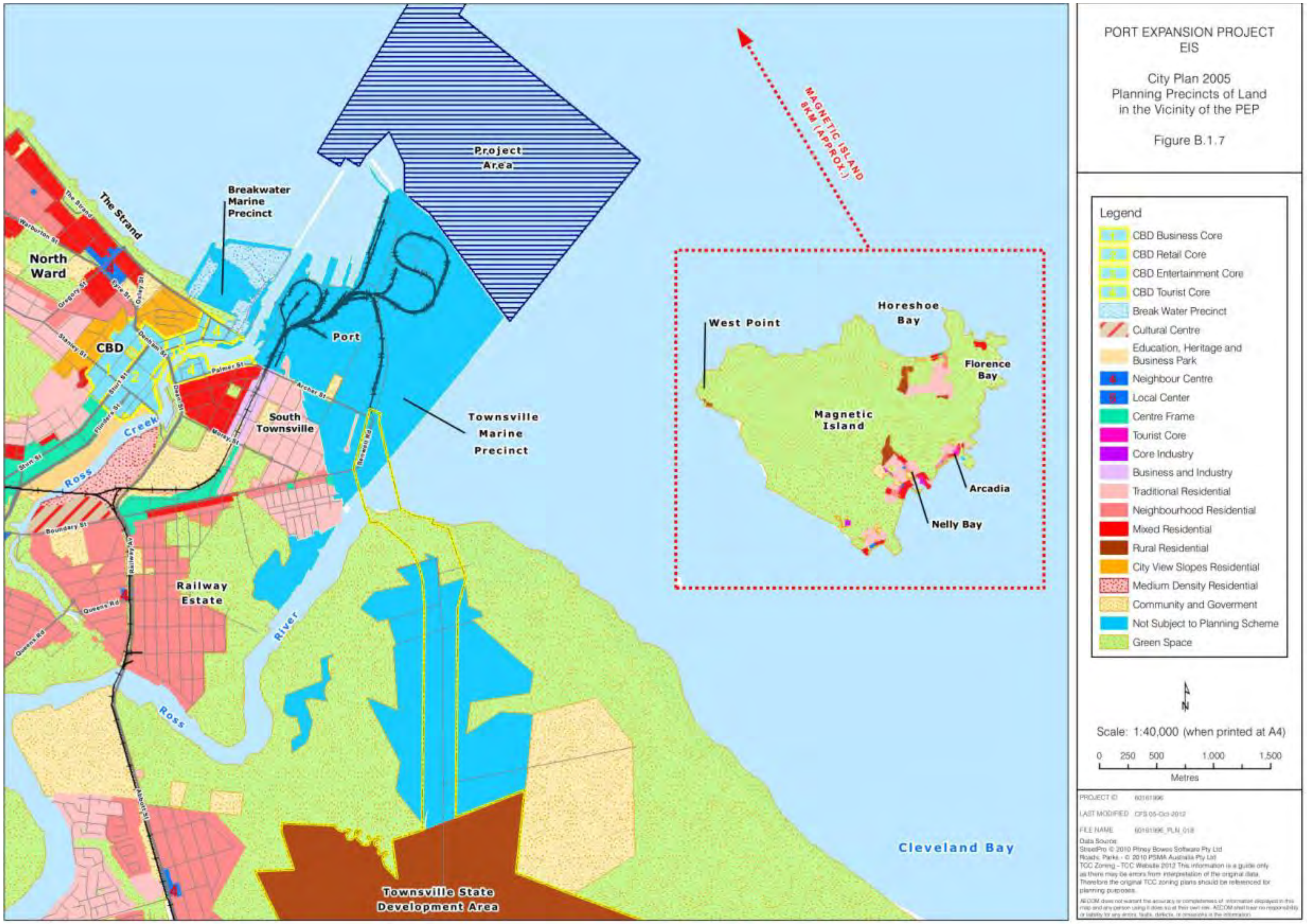


Figure B.1.7 City Plan 2005 Planning Precincts of Land in the Vicinity of the PEP

Draft Townsville Land Use Proposal 2011-2032

The *Townsville Land Use Proposal 2011-2036* (TCC, 2011b) has been prepared by TCC to provide the strategic intent for its new planning scheme and help inform consultation. The Townsville Land Use Proposal identifies key land use themes, strategic outcomes and policies to be accounted for in the preparation of the new planning scheme. The key themes and strategic outcomes are shown in Table B.1.4.

Table B.1.4 Townsville Land Use Proposal Themes and Proposed Policies

Theme	Strategic Outcomes Overview
Shaping Townsville	▪ The promotion and development adherence to a hierarchy of planned centres ▪ Accessible and affordable lifestyle and housing opportunities ▪ Containment of residential development in designated areas ▪ Recognition and protection of the cultural heritage of Townsville ▪ Provision of efficient reliable and safe passenger and freight transport networks to support the city's population and economic growth ▪ Efficient provision of infrastructure
Strong, connected community	▪ Protection and enhancement of community character in urban and rural areas of Townsville ▪ Protection of architectural, cultural, scenic, natural, social or spiritual qualities of places ▪ Accessibility to community services and facilities ▪ High quality open space provision ▪ Urban design that reinforces community spirit and identity
Environmentally sustainable future	▪ Conservation of natural values for future generations ▪ Retention and restoration of habitat areas and corridors for biodiversity protection ▪ Waterways and wetlands are protected from development to maintain water quality and water health' ▪ Protection of coastal land ▪ Minimisation of risk to people and property from natural hazards and climate change ▪ Reduce impacts of development on the natural environment
Sustaining economic growth	▪ Economic and employment growth through identified centres and precincts of core economic activity, including the CBD, the major industrial areas, the Port of Townsville, the Townsville Airport and knowledge precincts around the university and hospital ▪ Industrial activity in identified industrial areas and with timely release of land and efficient provision of services and infrastructure ▪ Facilitation of more efficient transport networks through clustering of activities and employment in defined centres ▪ Development adjacent to extractive and other resource areas does not prejudice their continued use ▪ Establishment of tourist accommodation and attractions in approved locations to reduce conflict with surrounding uses

The port, the Stuart industrial precinct (District 6) and TSDA are recognised as being the city's key productive precincts for industry. These areas are seen as instrumental in enabling the city to maintain its quality of life and achieve economic growth. A specific outcome for industrial land in the plan is:

> *The existing and future safety and operational efficiency of Townsville Airport, Port of Townsville and Defence Land holdings are not fettered as a result of encroachment of potentially sensitive development.*

Strategies to protect the port and other major productive precincts include:

- the planning scheme will recognise these important institutions for their particular strategic and economic value to the community

- council will ensure that new development near these areas and the transport/freight routes that serve them is compatible with the physical and operational characteristics of the use
- new development will be required to be located and designed to reduce potential impacts
- the planning scheme will identify key component facilities and relevant operational areas or buffers (as appropriate) for the airport, DoD land and the port, and will avoid the introduction of more intensive development in these areas.

B.1.3 Existing Values, Uses and Characteristics

Existing values and characteristics of the area surrounding the PEP are described in the following sections:

- topography, geology and soils
- land contamination
- land use and tenure

B.1.3.1 Topography, Geology and Soils

B.1.3.1.1 Topography

The coastal topography near the port has a natural ground level typically between 0 and 3 m Australian height datum (AHD). The reclamation area, which presently forms part of the bed of Cleveland Bay, is immediately adjacent to Lot 601 on EP1802 and Lot 791 on EP2348. The port land that the PEP is to adjoin was previously reclaimed. To the south lies the mouth of Ross River, low sand dunes and tidal mud flats with mangroves close to shore.

The local topography is dominated by a coastal escarpment located 5 to 10 km inland from the coast, the narrow coastal plain and the estuaries of Ross River (south-east) and Ross Creek (west) (Golder Associates, 2012a).

B.1.3.1.2 Geology

The geomorphological history of the Townsville coastal plain is described in detail by Hopley (1970). He described the area, being situated below the escarpment in the hinterland, as consisting of younger coastal plain deposits formed through a combination of the redistribution of marine sediments and from the deposition of eroded hinterland escarpment deposits. These deposits are at their widest near the mouths of streams (e.g. Ross River and Ross Creek) and in the southern parts of Cleveland Bay.

Holocene outwash fans composed of leached white sands overly coarse water worn gravels. These largely uncemented deposits overlie much older Pleistocene fan deposits which at their landward end are presently being actively eroded by numerous short coastal streams and which contribute to contemporary coastal depositional within Cleveland Bay.

The Recent geology of landward deposits is complex consisting of a mix of Pleistocene and Holocene deposits including older reworked fluvial deposits resulting in a variety geomorphological features including incised deposits, old river terraces and elevated (stranded) river levees. Stream diversions are relatively common in the Recent geomorphological record. Deposits in watercourses consist primarily of sands and gravel.

Mangroves and salt marsh are not extensive along the coast. Mangroves are limited to the small creeks draining the beach ridge areas. Of the major streams, only the Bohle River [not the Ross] has extensive mangroves at its mouth. Salt marsh and salt pan are found behind the beach ridges in areas of formerly impounded tidal drainage. Some areas may have originated as small lagoons. These are most extensive in the south eastern part of Cleveland Bay. Beach ridges have built up along the entire coast, many of them showing distinct signs of developing as spits under the influence of a strong south to north littoral drift. The ridges are generally closely spaced and overlie a variety of deposits including little modified Pleistocene clay plain, mangrove muds, beach rock and unconsolidated gravels.

Parts of the Cleveland Bay tidal flats are also characterised by extensive coastal Chenier deposits. These consist of a range of materials including gravels, pumice, coral rubble and some vegetation matter and lie on top of the tidal deposits. They are thought to be primarily the result of much higher wave energy and elevated sea levels most likely during severe weather events including cyclones. Beach recession appears to be taking place along much, of this coast and the present shoreline truncates the trend of the older ridges. This is especially so just north of Rollingstone Creek where excellent sections in the ridges are exposed in a low cliff. The outer ridges have a core of shingle and coral fragments with a dune capping of about three feet.

Geological mapping information for Townsville (Tile 8259) (Trezise, Holmes, & Cooper, 1986) at a scale of 1:100,000 indicates that the near surface lithology in the vicinity of the Project Area comprises Quaternary-aged (Holocene) sediments including silt, mud and sand, described as coastal tidal flats, mangrove flats, supra-tidal flats saltpans and grassland. The underlying bedrock comprises Permian-age biotite leucogranite and microgranite (Golder Associates, 2012a).

In the dredge and reclamation areas, the geology/lithology encountered during seabed drilling comprised Holocene 'surface' seabed sediments (silt and clay with sand zones, ranging in thickness from 0.8 to 3 m), underlain by Pleistocene sediments (sandy clays, clayey sands and clays ranging in thickness from 2 to 4 m). Seismic analysis of the Project Area undertaken in 2008 and more recently in 2011 confirmed the presence of relatively shallow density (soft) sediments (implied as Holocene) generally matching the stratigraphy identified by the drilling programs conducted by Golder Associates (2008a) and GHD (2008b). According to the Golder Associates' investigation offshore of the north-east boundary of the existing port land, bedrock is probably at least 16.5 m below the seabed.

B.1.3.1.3 Soils

General

Soils beneath the Project Area are sub-tidal marine sediments. The soil profile in the Platypus and Sea channels is broadly similar to that of the harbour and reclamation area. Along the Platypus Channel, prior to the 1993 dredging event, the reported surface sediment thickness generally ranged from 1 to 3 m. The soft surface sediments vary in thickness, but are relatively thin and are thought to arise from tidal and seasonal movement of the marine sediments. The underlying in situ material is generally comprised of very stiff to hard grey and brown sandy clay and medium to coarse grained clayey sand.

Geological information of the reclamation area and dredge footprint is presented in Golders Geotechnical Review Report (2012a) as Appendix F1, including specific depths of sediments (sections 5.2 and 5.3) and the suitability of dredged material for use as fill (section 6.2.3).

The terms of reference (TOR) specify that "*soils should be described and mapped at a suitable scale and described according to the* Guidelines for Surveying Soil and Land Resources *(McKenzie et al. 2008) and* Australian soil classification *(Isbell & CSIRO, 2002)*". However both publications relate to describing the characteristics of *in-situ* soils which, although important considerations for terrestrial projects, are not relevant here given the project area is currently a marine environment.

Consideration of the engineering properties of the fill that will be imported to the project area is essential, to ensure the materials are suitable for conditions at the site (including tidal influence as well as capacity to support planned and likely future infrastructure). Such consideration will be/is typically undertaken during the preconstruction phase of the project, as the responsibility of the contractor.

Acid Sulfate Soils

The TCC ASS map (Amendment No. 2005, 15) (Golder Associates , 2012) indicates that the existing port land is located in a low-lying area (< 5 m AHD); therefore, mapped as potential acid sulfate soil (PASS).

An ASS investigation undertaken by Golder Associates in 2008, using the pH/pH_{FOX} screening method, demonstrated the absence of actual acidity and absence of PASS or excess buffering capacity, except in 4 of 31 samples. Overall, Golder Associates concluded that there is a low risk of PASS at some locations in the outer harbour and reclamation areas. Generally, the PASS layer corresponds with the Holocene deposits 1 to 3 m below natural surface, situated below lowest astronomical tide (LAT) and overlying benign Pleistocene sediments. The remainder of the PASS layer has excess acid neutralising capacity and this is the case for the Holocene layer as a whole.

Golder Associates (2008a) referred to selected boreholes (those nearest to the PEP) of a GHD (2008b) study to extend the 2008 data set for characterisation of the PEP reclamation area. The data set applicable for the Project Area includes samples from nine representative locations.

Results of the borehole programme and screening tests confirm the presence of moderate potential acidity, in excess of action criteria, in Holocene sediments from the dredge and reclamation areas. These sediments display characteristics typical of PASS (i.e. generally dark grey, saturated clays and silts). They do not display any actual acidity as the sediments were from below LAT. Stratigraphy obtained from boreholes and seismic analysis confirm that the Holocene layer is generally 1 to 3 m thick in the area to be disturbed and forms a consistent layer containing relatively uniform amounts of acid neutralising capacity from calcareous materials. A similar depth of Holocene sediments was identified by previous seismic analysis along the Platypus Channel. The depth of recent sediment has been reduced by dredging carried out in 1993 and recent cyclonic activity (confirmed by the recent seismic investigations), and now appears to be absent altogether (Golder Associates , 2012).

B.1.3.2 Land Contamination

B.1.3.2.1 Chemical Contamination

Activities identified as being likely to cause land contamination are listed as 'notifiable activities' in Schedule 3 of the *Environmental Protection Act 1994* (Qld). Common land uses that can cause contamination include chemical storage, fuel storage, and loading/unloading goods in bulk.

The following searches and reviews were undertaken to identify potentially contaminating activities near the Project Area that may adversely impact on the PEP.

- Environmental Management Register (EMR): a land use planning and management register. Land that has been or is being used for a notifiable activity, and about which DEHP has been notified, is recorded on the EMR. Twenty-nine lots near in the Project Area were searched for entry on the EMR; twenty of these were listed. Details of the properties listed on the EMR are presented in Table B.1.5. The register search indicated that other than Lot 791 which is the eastern reclaimed land and which is directly adjacent to the PEP, none of the land directly adjacent to or to be affected by the PEP is listed on the EMR. As such, there is no recognised risk to the Project from the notifiable activities on these properties.
- Contaminated Land Register: a register of 'risk' sites; that are proven contaminated land that are causing or may cause serious environmental harm. Land is recorded on the Contaminated Land Register when scientific investigation shows it is contaminated and action needs to be taken to remediate or manage the land. The register search found that none of the identified EMR listings are on the Contaminated Land Register.

Table B.1.5 Lots in the Study Area Listed on the EMR

Lot	Plan	EMR ID	Address	Notifiable Activity
430	EP1068	14025	Benwell Rd, South Townsville	Coal gas works
594	EP1758	14027	Benwell Rd, South Townsville	Coal gas works
11	T118191	14028	17 Archer St, South Townsville	Chemical storage
601	EP1802	14184	4001 Wharf Area, South Townsville	Petroleum product or oil storage
318	EP2024	14186	4001 Wharf Area, South Townsville	Petroleum product or oil storage
4	T118185	14218	78 Perkins St, Townsville	Petroleum product or oil storage
8	T118185	14219	78 Perkins St, Townsville	Petroleum product or oil storage
791	EP2348	28030	Benwell Rd, South Townsville	Chemical storage
578	CP896279	28524	Lennon Drive, Townsville	Chemical storage
10	SP130956	30445	94 Hubert St, Townsville	Coal fired power station
758	SP130956	30447	94 Hubert St, Townsville	Coal fired power station
5	SP143321	38478	6 Old Rifle Range Rd, Townsville	Hazardous contaminant
6	SP150574	41366	31 Archer St, South Townsville	Coal fired power station [1]
2	SP129182	41979	4001 Wharf Area, South Townsville	Petroleum product or oil storage
621	SP157595	42718	78 Perkins St, Townsville	Coal gas works [2]
169	SP164760	46171	Kricker St, South Townsville	Petroleum or petrochemical industries Petroleum product or oil storage
1	SP194928	67416	96 Hubert St, South Townsville	Service station
577	SP194928	67417	96 Hubert St, South Townsville	Service station
1	SP126611	78149	Ross St, South Townsville	Abrasive blasting

Lot	Plan	EMR ID	Address	Notifiable Activity
				Metal treatment or coating
				Waste storage, treatment or disposal

1 An amalgamation of Lots 6 SP143321 and 758 EP2331. Registered Notifiable Activity was determined through discussion with DEHP's Contaminated Land Unit.

2 An amalgamation of Lots 25 EP62, 87 EP320, 430 EP1068 and 621 EP1576. Registered notifiable activity was determined through discussion with DEHP's Contaminated Land Unit.

B.1.3.2.2 Unexploded Ordnance Contamination

Unexploded ordnance (UXO) represents a specific form of land contamination arising from any explosive ordnance (ammunition, bomb, grenade, torpedo, etc.) that has failed to function as intended. Explosive ordnance that has functioned yet contains residual explosive or chemical warfare agent is normally treated as UXO. Derelict or discarded explosive ordnance is also treated similarly to UXO.

As a result of military training and live firing undertaken by Australian and Allied Forces, there are many areas throughout Australia not controlled by the Commonwealth that may be subject to residual UXO contamination. Townsville has a significant Second World War history both as a staging point for Australian and Allied Forces campaigns in the Pacific region against enemy combatants and as a reported target from enemy fire and bombing raids. In accordance with Commonwealth policy, the DoD has undertaken to identify and record sites where there is potential for such contamination.

A review of DoD UXO online mapping (v4.0, June 2010) shows that no identified UXO affected sites are situated in the immediate vicinity of the Project Area. As such, there is no recognised risk to the Project from UXO.

B.1.3.2.3 Sediment Contamination

Existing contamination for nickel and lead has been identified for some of the marine sediment adjacent to the existing Berth 11. Chapter B5 (Marine Sediment Quality) assesses in detail the likely levels of existing contamination in the Project Area, the need for further detailed studies and testing to be undertaken, and plans for onshore and offshore grading of materials prior to dredging, handling and placement.

B.1.3.3 Land Use and Tenure

Land use and tenure describe the human patterns of activity and ownership that have been established and are likely to continue to change because of an area's growth and development. Land use and tenure characteristics are described in terms of:

- native title
- land tenure (port and non-port)
- land uses and facilities surrounding the PEP
- proximity to sensitive land uses
- proximity to environmentally sensitive areas.

B.1.3.3.1 Native Title

The area of seabed to be occupied by the PEP is presently unallocated state land which, although potentially subject to native title rights, it is not currently subject to any native claim or Indigenous land use agreements as indicated by the National Native Title Tribunal Vision Database (NNTT, 2008). POTL intends to apply for a perpetual lease for the reclamation area pursuant to section 24HA of the future provisions of the NT Act. POTL intends to further negotiate an ILUA with appropriate traditional owners at the time it seeks to create freehold title for the reclaimed land as is indicated in Chapter A.2.6.

B.1.3.3.2 Land Tenure

The existing land tenure for the port's strategic port land is identified by the *Port Land Use Plan* as principally freehold title with some perpetual leases. Strategic port land is for port related activity including land identified for buffer areas. Further liaison will be required between POTL and the DNRM regarding future tenure of the site once reclamation has been concluded.

Tenure issues are not expected to directly influence planning outcomes for the PEP. The creation of tenure associated with the PEP once land has been reclaimed will initially be undertaken through the creation of leases under the provisions of the *Land Act 1994* with due consideration to the NT Act. The creation of such leases generally is not assessable development under the SP Act and is enabled administratively by the Minister for Natural Resources and Mines. Creation of this form of tenure is subject to the provisions of the *Coastal Management Policy* and requires assessment against the objectives of the policy by POTL.

Figure B.1.8 shows the different classes of existing key land tenure of land around and including the port, including:

- freehold land
- state leasehold land
- reserves
- state land (i.e. unallocated state land and land that has been vested for a specific purpose).

As shown in Figure B.1.8, the majority of land near the port is freehold. Much of the land around the Port is fragmented into smaller, largely developed lots (i.e. primarily for detached dwelling houses with some medium density development dispersed throughout the area and high density residential development situated within the Palmer Street Precinct.

Some further development potential exists on sites within the Palmer Street Precinct for high density apartments with ground floor commercial/retail premises that primarily support a dining and entertainment function (i.e. similar to other development in the vicinity). Further mixed use development potential exists for land that forms part of the Southbank Development location. The Council has identified the Townsville Railyards and the adjoining Dean Park area to the north as a potential site for a sports stadium and entertainment/convention centre with some supporting short stay accommodation. This proposal is yet to undergo detailed feasibility studies.

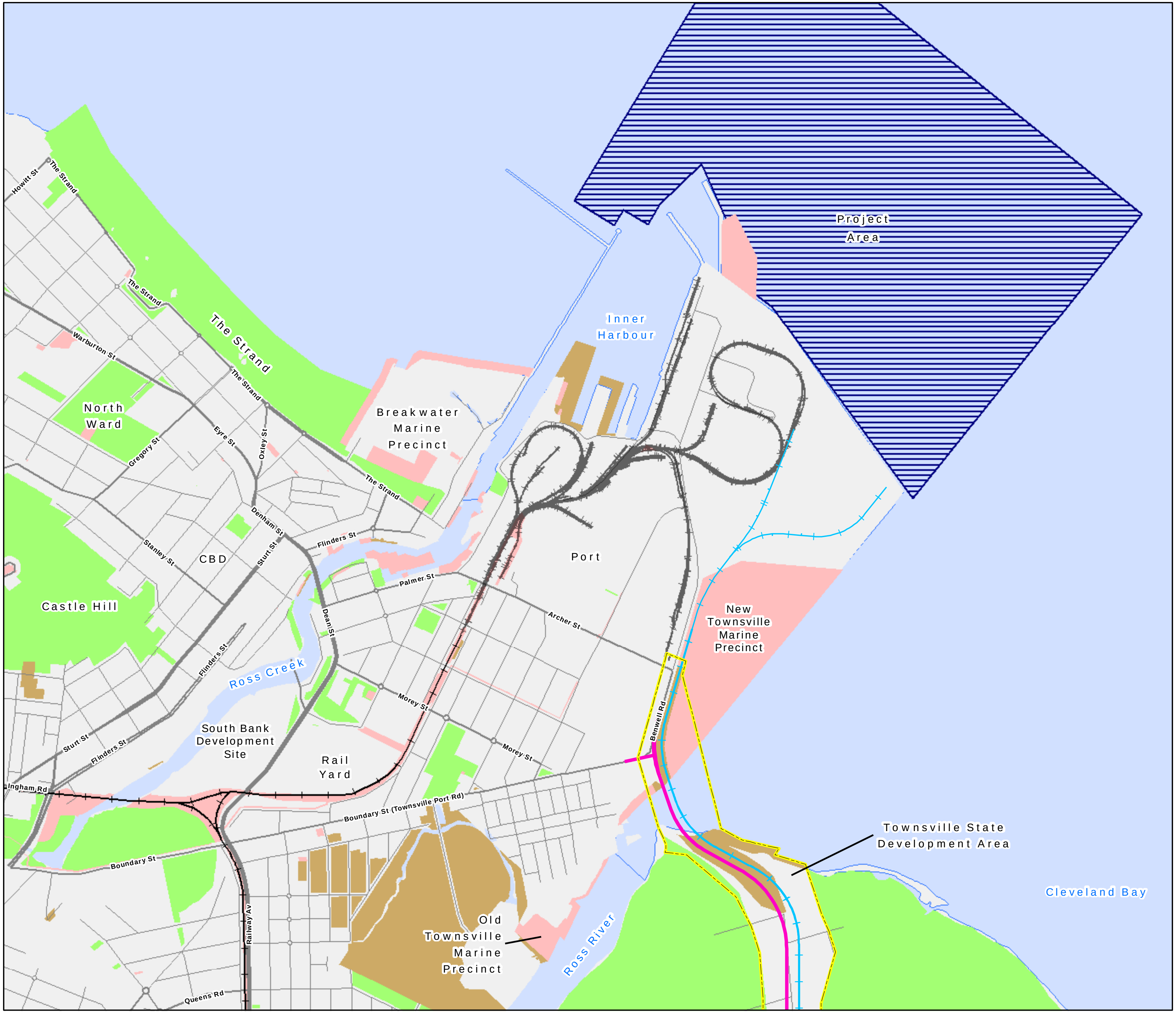
Land tenure within the remainder of South Townsville is primarily reflective of the residential housing that characterises the area. Limited scope exists for any redevelopment of this land under its current land use zoning and due to the fragmented ownership patterns and small lot sizes. Although the land tenure patterns of the surrounding areas can, in principle, accommodate some further development, the scale and location of such development, as is contemplated under the Council's current planning scheme, is not expected to have any significant adverse effects on the PEP or port operations. Any future change in tenure or redevelopment of the Townsville Railyards is yet to be properly assessed by the Council including possible impacts on the rail access to the port which is expected to stay in the area regardless of the outcome for the railyard land and the potential inclusion of a new rail access to the port via the Eastern Access Corridor. Potential impacts of any future railyard development can be best assessed as part of a proper development assessment process, once details of any such proposal are known.

Figure B.1.8 shows that recreational reserves are generally located some distance from the port and are not likely to be adversely affected by the PEP. A large area of state land exists in Railway Estate, which is predominantly wetland and which fronts onto the Ross River. Part of this land is used for the Ross Island Army Barracks, which is DoD land. This area has no appreciable development potential due to its physical constraints and its DoD role. State land is also located around and as part of the TSDA to the east of Ross River. This is identified as environmental protection reserve land due to its coastal process constraints and environmental habitat values.

PORT EXPANSION PROJECT EIS

Key Land Tenure for Land Surrounding and Including Existing Port Land

Figure B.1.8



Legend

- Main Roads
- Local Roads
- Railway Line
- Stage 2 Allignment Proposed Rail Corridor
- Townsville Port Access Road
- Project Area
- Townsville State Development Area

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000

Metres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_019

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Land Tenure - DERM 2012
Stage 2 Allignment Proposed Rail Corridor - AECOM 2011
Townsville Port Access Road - AECOM 2011

B.1.3.3.3 Land Uses and Facilities Surrounding the PEP

Port Land and Marine Areas

The PEP will be located directly adjacent to existing strategic port land and will become an integral part of the port's overall operations. Existing land use activity on strategic port land is consistent with the PEP. Shore-based internal infrastructure facilities, including road, rail and services, are expected to be connected to and integrated with the PEP during construction.

The port presently has nine operational wharves (Berths 1 to 4 and 7 to 11) characterised by a number of specialised facilities, including bulk handling facilities primarily for dry bulk cargoes. Berths are operated on a 7 days a week, 24-hour basis. The berths are generally operated on an exclusive or priority berthing arrangement and it is expected that a similar operating regime will be established for the PEP berths. The PEP will make a greater range of berths available and increase overall activity through greater capacity.

The overall operation of the port is based on the port providing core infrastructure for shipping and goods handling purposes. Lease and licensing agreements provide the operational basis by which individual companies obtain, usually long term, access to the port's facilities and by which cargo handling is regulated. Individual stevedoring companies also have and use their own cargo handling facilities and equipment.

Internal rail and road networks and navigational access are critical to the functioning of the port. Their efficiency is dependent on commensurate adequacy of access and capacity of external connecting infrastructure to and from the port.

Marine areas immediately adjacent to the port and the existing port access channels in Cleveland Bay form part of the port's pilotage area. Navigation restrictions apply to ships in the navigation channel or the harbour areas of the port. The PEP is not located in a currently active harbour area.

The marine area over which the PEP is to be reclaimed and constructed has specifically been identified for such a use in the *Port Land Use Plan*. The area forms part of the seabed of Cleveland Bay within port limits and is unaffected by any land use or marine zonings. The area is largely natural in its characteristics and is small relative to the overall area of Cleveland Bay. The marine ecology of the area, including habitat values, is discussed in detail in Chapter B6 (Marine Ecology).

The dredge material placement area (DMPA) is an existing approved facility in Cleveland Bay for the placement of dredge material from the port's harbour and channel areas. The location is not affected by any zoning provisions of the *Port Land Use Plan*, the TCC planning scheme or the GBRMP Zoning Plan. The DMPA does not directly affect land uses of nearby Magnetic Island nor unduly restrict use of Cleveland Bay other than through general navigation restrictions that apply when dredging operations are underway.

The Port also has land located on the Breakwater Peninsula on the western foreshore of Ross Creek. This land is the location for the existing passenger ferry terminal for services to Magnetic Island, Townsville's largest recreational boat ramp and the Volunteer Coast Guard, which are located on port land off Sir Leslie Thiess Drive on the western foreshore of Ross Creek. The use of this land for its present uses is not expected to be adversely affected by the PEP.

Cleveland Bay

Cleveland Bay forms an integral part of the marine backdrop for Townsville and provides the necessary setting for the safe harbouring of shipping, commercial and recreational fishing, and recreational boating. Ross Creek and Ross River play key roles in providing access for recreational and commercial fishing in Cleveland Bay and the Coral Sea and also provide for a range of boat accommodation facilities for Townsville including:

- marina facilities in the Breakwater Marine Precinct adjacent to Ross Creek, south-west of the port
- marina facilities as part of the Townsville Motor Boat and Yacht Club situated on Plume Street (near Palmer Street) on the eastern side of Ross Creek, catering for in excess of 160 boats ranging in size from 10 to 20 m and with a membership of over 500 people
- commercial fishing facilities situated in the Townsville Marine Precinct, which has commercial marina and slipway facilities located on strategic port land on the western shore of Ross River

- limited marina facilities for private vessels and private berthing facilities attached to residences at Nelly Bay on Magnetic Island
- recreational boat ramp facilities in the Breakwater Marine Precinct fronting onto Ross Creek and off Sixth Avenue in Railway Estate fronting onto Ross River.

Yachting is conducted on both an organised and informal basis. Organised races tend to be located westwards of the main shipping channel and do not rely on waters to be affected by the PEP. Pleasure boating is particularly focused around Magnetic Island, coastal estuaries of Cleveland Bay, nearby Halifax Bay and out to the reef areas of the Coral Sea.

Limited information is available regarding the levels of usage or preferred locations for commercial or recreational fishing in Cleveland Bay. The fisheries assessment prepared as part of the *Townsville Port Expansion Preliminary Engineering and Environment Study* (AECOM, 2009) identified that the area affected by the PEP has limited commercial or recreational fishery importance in the context of Cleveland Bay as a whole and identified the preferred locations for fishing. The map from the fisheries assessment is reproduced in the Chapter B6 (Marine Ecology).

- the key commercial fisheries operating in and around Cleveland Bay are trawl and net fisheries
- trawling operations are focused in the waters immediately north of Magnetic Island and, to a lesser extent, near-shore areas of Cleveland Bay (near the port) as well as waters north and east of Cleveland Bay
- administrative constraints exist on net fishing in Cleveland Bay due to the presence of a Dugong Protection Area, Great Barrier Reef zoning restrictions and a Declared Fish Habitat Area
- key species targeted by the net fishery are mainly pelagic fish that occur in open water
- inshore waters of Cleveland Bay are used heavily for recreational fishing
- recreational fishing is significant along the coastline of Cleveland Bay and Magnetic Island, in estuaries and creeks, and on inshore and offshore reefs
- seawalls in and around the port are popular recreational fishing locations
- fishing is valuable to Indigenous communities in Townsville and Magnetic Island, mainly occurring along coastal foreshores, estuaries and near-shore reefs
- soft sediment habitats have been extensively altered and simplified and may not retain particularly high values compared with more diverse habitats (this is assessed in detail in Chapter B6, Marine Ecology)
- key commercial and recreational fish species identified in the Sea Channel were mackerel and cobia
- the DMPA is part of a more extensive area in Cleveland Bay that has the recorded presence of tuna species
- there are no commercial species recorded in the PEP reclamation area other than some bream species along the outer extremities
- recreational fishing is known to occur immediately adjacent to the existing port in the PEP reclamation area.

General pleasure boating and yachting are key uses of Cleveland Bay. It was estimated in a local newspaper article in April 2011 that Townsville had in excess of 11,500 registered boats (Townsville Bulletin, 2011). Based on this figure, it is estimated that Townsville has a per capita boat ownership of approximately 6%. This compares with the peak body group, Marine Queensland, estimate for Mackay, which it states has the highest per capita boat ownership in Queensland of 12%, with 95% being trailer boats 8 m or under in length (MQ, 2012).

A study of vessel movements in and out of Ross Creek, conducted over a four-month period in 2011 for the port (GHD, 2011b) surveyed 733 vessels leaving Ross Creek. Of these, 66 (9%) travelled to the east or south-east after leaving the mouth of Ross Creek across the area to be occupied by the PEP reclamation. The remainder travelled either northward into Cleveland Bay towards Magnetic Island or to the west.

Greater Townsville Area

The port represents regionally strategic infrastructure that has and continues to play a significant role in shaping the settlement pattern of Townsville and in helping to consolidate the city's credentials as the major regional centre for North Queensland. The overall size of the port and its particular environmental and infrastructure needs has also led to land use planning that does not encourage incompatible development to be located in close proximity to the port, which has influenced the settlement pattern of Townsville over time by:

- assisting the consolidation of the existing CBD through its close proximity with this part of Townsville
- attracting and focusing heavy transport infrastructure (including rail and heavy road transport routes) onto the centre and the port's location
- attracting industry to and around the port
- contributing to the establishment of the TSDA
- facilitating trade for mineral processing facilities in Townsville, including the Sun Metals Zinc Refinery, the Xstrata Copper Refinery and the Yabulu Nickel Refinery.

The PEP is located near existing infill residential development areas centred on the CBD and North Ward and has ready access to major road networks servicing the rapidly growing greater Townsville region. This provides effective access to a range of residential locations for its potential workforce. The port is also ideally situated close to the yet to be developed Rocky Springs development area to the south of the city, which is approximately 15 to 20 minutes away by road. As Rocky Springs approaches its development phase, significant upgrades to the southern arterial road network centred on the Bruce Highway between Rocky Springs, the CBD and others parts of Townsville are planned by Department of Transport and Main Roads and TCC.

Other key land use areas in Townsville that the port is in close proximity to, in terms of vehicular access, include:

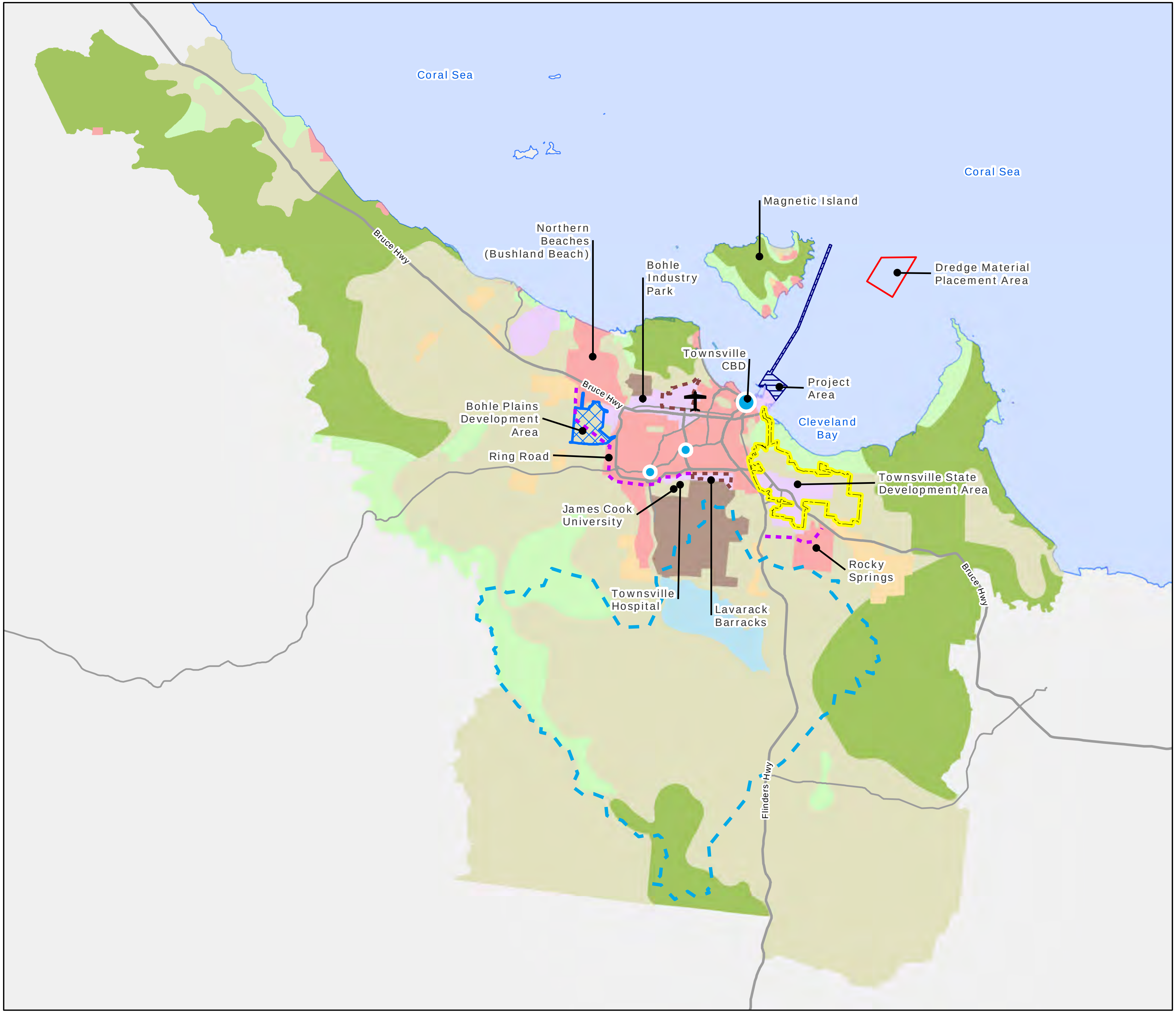
- the Bohle Industrial Area to the north-west (11 km from the PEP)
- the Garbutt Industrial area and the Townsville Airport (a key DoD airport with concurrent regional, interstate and international air transport roles for passengers and freight (approximately 5.5 km from the PEP)
- the TSDA (approximately 10 km from the PEP)
- James Cook University (approximately 13 km from the PEP)
- Lavarack Army Barracks, home of the Australian Army's 3RAR Squadron (approximately 11.5 km from the PEP).

The general settlement pattern for Townsville and the location of key land use areas is shown in Figure B.1.9.

PORT EXPANSION PROJECT EIS

Settlement Pattern of Townsville

Figure B.1.9



Legend

- Airport
- Primary Infill Area
- Secondary Infill Area
- Dam Catchment Area
- Major Defence Land Holdings
- Future Primary Public and Active Transport Corridor
- Critical Conservation Areas
- Major Defence Land Holdings
- Non-Urban Land
- Other Core Economic Activity Areas
- Protected Areas
- Rural Residential Areas
- Urban Area
- Waterbody

N

Scale:1:500,000(when printed at A4)

0 5 10 20

Kilometres

PROJECT ID 60242048

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60242048_PLN_005

Settlement Pattern Map was compiled from Map 1a. Townsville Settlement Pattern (Residential Strategy) map 30 Aug 2011, produced by Townsville City Council and Buckley Vann.

CBD

The CBD includes:

- Business Core centred on Sturt Street
- Retail Core centred along Flinders Street West
- Entertainment Core along Flinders East
- Tourist Core located at the eastern parts of Flinders Street adjacent to the Queensland Tropical Museum and Tropical Aquarium and along Palmer Street adjacent to the port.

The CBD is planned to consolidate its role as the main business centre for Townsville and North Queensland with significant further potential for increased office, retail and higher density residential development.

The Palmer Street CBD Tourist Core, near to the port, provides a stronger focus on tourist accommodation and entertainment than the remainder of the Central City Precinct. Land in the Palmer Street CBD Tourist Core has been developed with hotels, apartments and street-level retail development that are focused on selling meals and speciality stores. Adjacent land has been developed or has a number of approvals for high-density residential apartment development for short and long-term tenancies. The Townsville Motor Boat and Yacht Club, its marina on Ross Creek and the Maritime Museum also form part of the Palmer Street CBD Tourist Core.

The port has recognised the close proximity of the Palmer Street CBD Tourist Core and has ensured, through the zonings of the *Port Land Use Plan*, that only compatible port uses are located adjacent to this important area. Planned redevelopment by the port of the area between Berth 10A and Palmer Street is regarded as a key aspect of the port's continued aim to ensure that effective land use integration between port and non-port activities is achieved without adversely affecting its long-term trade potential. Future planned redevelopment between Berth 10A and Palmer Street is expected to replace older or unused industrial premises with modern commercial offices (i.e. notably for the port's new corporate facilities), integrated ferry facilities, car parking and landscaping. Pedestrian access between Palmer Street and Berth 10A will be accommodated along the foreshore and is expected to form a key feature.

Potential continues to exist for further redevelopment of land along the Palmer Street CBD Tourist Core with a number of development approvals for apartment based development yet to be acted on.

Breakwater Marine Precinct

The reclaimed land of the Breakwater Marine Precinct on the western side of Ross Creek is in close proximity to the port. The land is subject to an Act; the *Breakwater Island Casino Agreement Act 1984*. The area is the site of Jupiters Townsville Hotel and Casino (Jupiters) and the Townsville Entertainment Centre, which are located at the northern end of the precinct. Jupiters represents a key tourist attraction for visitors to Townsville providing controlled gambling, entertainment, dinning and accommodation experiences in close proximity to the CBD and Townsville marine setting.

The precinct also contains a commercial marina and a mix of medium and high-density residential apartments, with some small-lot single dwelling sites located adjacent to the Jupiters car park and on the Breakwater Peninsula on the western side of the precinct. Many of the house lots adjacent to Jupiters have direct private access to the marina. Further expansion of residential uses in the Breakwater Marine Precinct can only occur on the western side adjacent to Jupiters and on the seaward end of the Breakwater Peninsula. Both areas have development approvals for apartment-style development, which have not been acted on. Some existing house lots are also yet to be developed.

The area known as the Future Development Area (also locally referred to as the 'Duck Pond') that is immediately seaward to the north of the existing reclaimed land is subject to legislative provisions (i.e. contained in the *Breakwater Island Casino Agreement Act 1984*) that enable its future development to be considered through an EIS process. Previous consideration had been given by the Coordinator General to a proposed canal based residential development which also incorporated a cruise ship terminal. An in-principle agreement was given by the Coordinator-General for the development of this area subject to additional environmental management, design and infrastructure issues being resolved. The development has not proceeded and the cruise ship terminal plan has been superseded by the redevelopment of Berth 10A for the purpose of an ocean terminal. Any future significant development in the Future Development Area will be subject to environmental impact assessment under the existing legislation affecting the location. The Port is currently considering the utilisation of the Future Development Area as part of its Berth 10 Extension plans..

Existing residential development in the Breakwater Marina area is effectively screened from much of the Project Area through other uses in the precinct (i.e. Jupiters and the entertainment centre) and the port's inner harbour and existing facilities.

South Townsville

South Townsville is located south and directly adjacent to the port between Ross Creek and Ross River. It contains a mix of residential, industrial and commercial uses. Industrial development is focused on Perkins Street, which is adjacent to the existing rail connection into the port, Archer Street directly fronting the port, and along Boundary Street, which forms part of the main road access into the port and which will eventually connect with the TPAR. Some smaller scale and older established industries are located in pockets throughout parts of the residential areas, largely as existing uses.

South Townsville is one of Townsville's older established areas and is a recognised significant 'character precinct' area, which will be subject to specific provisions as part of the new planning scheme. The character largely reflects the older bungalow style Queenslander development of the late 1800s and early 1900s. The character of the area, its proximity to the CBD, the waterfront, and its historical association with the port as a place of employment, services and entertainment (i.e. for seafarers) has maintained its popularity as a place of residence. This interest is still strong and the area is continuing to be a much sought after area to live, with growing interest in the refurbishment and rejuvenation of its older buildings.

Major new private development is planned for land adjacent to Ross Creek, west of the rail yards, for mixed higher density residential development (i.e. Southbank development). The development site is separated from the PEP by existing residential and mixed industrial development in South Townsville, the Palmer Street Precinct to the north of the site, and the existing port to the north-east.

Boundary Street and Benwell Road form the existing, main road haulage route to the port. Boundary Street also connects with Railway Avenue, which leads south to the Bruce Highway. Land uses along Boundary Street are mixed, consisting of some general and other service industry uses (e.g. car repair centres) on its northern side closer towards its intersection with Railway Avenue and Saunders Street, and residences along its eastern extent with some businesses located amongst residences. Boundary Street is currently subject to high levels of road transport servicing the port. Although the road access is expected to continue to enable access to the west and north of the city, heavy vehicular traffic from the south and inland from the west is eventually expected to use the TPAR through the TSDA.

The main rail access to the port is presently located along Railway Avenue, through the Townsville Railyards and along Perkins Street into the port. The rail access is used to service the port with general cargo and mineral products from the North West Region and is expected to remain a key part of the port's supporting infrastructure. The rail link also plays a key role in providing access between the port and the Yabulu nickel processing plant on the northern edge of Townsville. As demand increases, provision has been made for additional rail infrastructure to be considered through the Eastern Access Corridor of the TSDA along the general alignment of the TPAR. This is expected to be supplemented through shared conveyor facilities for minerals handling and the like, which are expected to reduce, but not necessarily remove, demand for rail infrastructure in its existing location.

Stuart

The suburb of Stuart covers a large portion of land to the south of the Ross River and includes the TSDA. The TSDA consists of approximately 4,900 ha located to the south-east of the port. Currently it is largely undeveloped, other than the TCC water treatment and sewerage facilities and the incomplete TPAR, which will establish the main heavy road haulage route to the port via a bridge nearing completion over Ross River.

As demand dictates the areas that are not identified as being environmentally constrained and intended for environmental management purposes are expected to be developed for industry and other associated uses, including those that are dependent on closer proximity to the port. Potential uses range from heavy industry to warehousing and transport logistics. Although the original concept for the TSDA included scope for significant heavy industry (e.g. minerals processing), there is a degree of flexibility in the type of development that can be accommodated in the TSDA.

The development of the TSDA for industry (i.e. either heavy, light or for transport logistics) is consistent with the regional and local land use planning objectives for the area. The development of the TSDA and the expansion of the port are considered to be mutually complementary, with both having the potential of increasing the demand for each other and increasing trade and economic growth for Townsville and the region overall. The development of the TSDA will be subject to approval processes under the provisions of the *State Development and Public Works Organisation Act 1971*. This includes controlling provisions under a Development Plan for any material change of use development and under the council (i.e. for any material change of use) and under the SP Act.

Railway Estate

Railway Estate is located south of South Townsville. The suburb consists predominantly of older style residential development; mainly single dwelling houses with some multiple dwelling developments amongst the houses. Boundary Street forms the northern boundary of the location. Railway Estate is bordered to the south and east by Ross River and much of the area is low lying and subject to minor inundation during king tides. This situation places a significant constraint on the area's redevelopment potential.

Significant uses in this area include the Queensland Rail passenger station, Reid Park, which together with the surrounding area is used once per year as a racing car circuit, Townsville Civic Theatre situated on Boundary Street, and the Ross Island Army Barracks on the eastern side of the area fronting onto Ross River. Railway Avenue, being the current main southern road access connection to the Bruce Highway and the North Coast Rail Line, pass through Railway Estate.

Railway Estate is generally not regarded as being in close proximity to the port or the PEP; therefore, it has limited land use association with the port, other than Boundary Street being the main road transport link to the port and the North Coast Rail Line.

North Ward

North Ward is located to the north-west of the CBD on the seaward side of Castle Hill. The suburb consists of a mix of older style residential development and more modern higher density development closer to and along The Strand. The area has one of Townsville's more vibrant local centres along Gregory Street, which has a range of mixed-use businesses, retail including supermarket and speciality shopping, restaurants and pubs. The centre's close proximity to The Strand, which forms the seaward extent of the North Ward area, makes it a popular location not only for people who live in the vicinity, but also for visitors from elsewhere in Townsville and the region.

The Strand represents a regional passive recreational facility and is approximately 2 km long with park-landscaped pedestrian and cycleway, beaches, park and picnic facilities. The foreshore reserve is used for passive recreation, picnicking, civic celebrations and memorial gatherings, swimming (in netted swimming enclosures, two pools and a children's water park), cultural activities and markets, dining and entertainment and major sports events (e.g. staging location of marathon races). The Strand also incorporates the upper ANZAC Reserve, which is a major war memorial commemorating the Second World War. The park has a nationally significant remembrance shrine and hosts major memorial and other defence services and gatherings.

The Strand has a direct line of sight to the existing port and the PEP. Other than visual effects, there is no direct land use relationship between North Ward and the PEP. The visual significance of the PEP on the use of the surrounding area is considered in detail in Chapter B17 (Scenic Amenity and Lighting).

Magnetic Island

Magnetic Island is located north of the Port of Townsville in Cleveland Bay at the seaward end of the main Sea Channel to the port. The island is largely undeveloped with extensive vegetation cover. There is limited urban development centred on the small communities of Nelly Bay, Picnic Bay, Arcadia and Horseshoe Bay. This consists of residential dwellings, a range of tourist accommodation and marinas. Tourist accommodation is provided for through existing residences as short terms holiday lettings, managed apartment style units, hotel units (including luxury hotel accommodation at Nelly Bay) and backpacker accommodation at Picnic Bay, Nelly Bay, Arcadia and Horseshoe bay.

The primary mode of access to the island is via passenger and vehicular ferry from the passenger ferry terminal which is located on Port land on the western foreshore of Ross Creek and the vehicular ferry terminal situated directly opposite on the eastern shore.

Tourism on Magnetic Island is largely related to the recreational pursuits that the island offers to international and Australian visitors, overseas backpackers, in particular form a key part of tourist visits to the island. Tourism activities include: bushwalking, exploring the islands war history (i.e. bunkers, gun emplacements and observation posts), horse riding, picnicking, cycling and water sports (i.e. snorkelling, scuba diving, swimming, boating, and fishing). The island also acts as a key social hub for Townsville tourists and locals with a range of popular venues and organised entertainment events.

Development on Magnetic Island interacts with the port through the daily transport of passengers between the island and the mainland. The present ferry route directly passes the location of the PEP outer harbour.

B.1.3.3.4 Proximity to Sensitive Land Uses

There are a number of potentially sensitive land uses that are located in the Study Area. The sensitive uses relate to educational facilities for kindergarten, primary and secondary children and are identified due to their potential greater sensitivity to secondary effects from PEP activity during its construction and operation. This includes noise, emissions and traffic related effects due to port related heavy road transport and general increases in traffic. The uses that have been identified and their distance from the PEP are listed in Table B.1.6.

Predicted effects on social and amenity values, such as air quality, noise, vibration and visual, are given in Chapters B9, B10 and B17, respectively.

Table B.1.6 Sensitive Land Uses

Type of Use	Name of Use	Location	Approximate Distance from PEP (km)[1]
Child care centre, preschool/kindergarten	C and K Koolkuna Kindergarten and Preschool	South Townsville	2.5
	Townsville South Preschool	South Townsville	2.0
	South Townsville Primary	South Townsville	2.5
	Village Kids Children's Centre	Railway Estate	3.5
Primary school	St Josephs The Strand	North Ward	3.0
	Townsville Central Primary	North Ward	3.75
Secondary school	Townsville state High School	Railway Estate	4.25
	Townville Grammar School	North Ward	4.0
	St Patricks College	North Ward	2.75

1 Distances provided are direct distances from the landward side of the PEP (i.e. adjacent to existing port land) and have been rounded to the nearest 0.25 km.

The identified uses are well established in their present locations and serve a key role in providing services to the surrounding areas. The PEP will be located further away from the identified sensitive uses than existing port activities. Generally, most of the identified sensitive uses are located away from heavy road transport routes other than Townsville State High School, which is located on Boundary Street, opposite the Townsville Civic Theatre. This part of Boundary Street is a main arterial road for Townsville. The road experiences substantial traffic, which is not all directly attributable to port activity. Traffic characteristics of the area around the port are assessed in detail in Chapter B14.

B.1.3.3.5 Proximity to Environmentally Sensitive Areas

Cleveland Bay and its foreshore areas contain a number of statutory conservation areas:

- GBRMP
- GBRWHA
- dugong protection area
- fish habitat areas
- Bowling Green Bay Ramsar wetland

- Magnetic Island

Of these, only the Bowling Green Bay Ramsar Wetland and Magnetic Island do not directly affect the PEP, although Magnetic Island is in close proximity to the proposed deepening and extension of the northern end of the Sea Channel. The Sea Channel deepening and extension includes sections affecting the Habitat Protection Zone and the General Use Zone of the GBRMP as described in detail in Chapter A1.0. The nature conservation values of environmentally sensitive areas are discussed in detail in the marine ecology assessment in Chapter B6.

B.1.4 Assessment of Potential Impacts

Potential impacts caused by the PEP are assessed in terms of the following aspects:

- ASS
- potential land contamination
- surrounding land uses and human activities
- town planning objectives and controls
- development constraints
- management of land uses in immediate environments
- native title
- land use changes in areas of high conservation value
- proximity of key infrastructure services
- land units that require specific management measures

B.1.4.1 Acid Sulfate Soils

Dredging and excavation of Holocene sediment layers at the seabed's top stratigraphic layers could result in disturbance of PASS (Golder Associates, 2012a). Disturbed Holocene sediments in the outer harbour basin will make up only the top 12 to 14% of the total material excavated and are, on average, self-neutralising (even with a conservative lime fineness factor of 3.0). PASS is only of concern in the generation of sulphuric acid if sediments dry and/or are exposed to oxygen in the atmosphere.

It is not expected that adverse impact to the environment will occur, given that it is planned to place the dredged/excavated PASS Holocene material in the DMPA below LAT (Golder Associates, 2012a) or partly into the reclamation ponds where the material will be kept below LAT. This treatment of PASS material avoids exposure to the atmosphere and oxidation.

The PEP poses a generally low risk of adverse impacts from PASS, provided the management of the dredging, reclamation operations and placement of material in the DMPA is carried out in accordance with the *Construction Environmental Management Plan* (CEMP) in Part C.

B.1.4.2 Potential Land Contamination

B.1.4.2.1 Construction

A number of construction activities have the potential to impact on the existing port land and adjacent coastal waters. These include:

- spills of fuels/oil and other contaminants to ground from machinery
- spills of fuels/oil and other contaminants to water from machinery and marine vessels
- leaks or spills of hazardous materials and/or dangerous goods
- imported contamination in soil and/or fill material.

Due to the necessity to use plant and equipment for construction of the Project, incidents involving fuels/oil spills and other contaminants may cause soil contamination or enter the marine waters of Cleveland Bay. Appropriate siting of storage and handling areas and management of equipment and plant during construction will be incorporated in the CEMP to ensure that such risks are reduced and will be consistent with POTL's existing practices. The CEMP will also include procedures for the management and handling of fuel/oil storage to reduce the risk of incidents.

B.1.4.2.2 Operations

Land contamination issues arising during the operational phase of the PEP may include:

- machinery oil spills
- spills or leaks of goods/cargo (e.g. loose bulk products such as mineral concentrates; petroleum products, liquefied gases, flammable goods and chemicals or other hazardous wastes)
- general waste and debris.

The risk of such activities contaminating land in the PEP reclamation will be managed through the implementation of the *Operation Environmental Management Plan*, environmental licensing and incident management procedures.

B.1.4.3 Surrounding Land Uses and Human Activities

B.1.4.3.1 Port Land Uses

The PEP is a strategically planned extension of the existing port involving additional berthing, loading and other shore-based facilities to support industry and infrastructure. The additional industries and infrastructure have specialised requirements, including siting adjacent to berthing and loading facilities. Some industries also require close proximity to each other for operational and cost efficiency purposes. A general assessment of the PEP site relative to adjoining existing land has been conducted with consideration of a number of different parameters, including noise, dust, other emissions and effects on amenity, to determine the PEP's general suitability as a port facility for intended bulk cargo handling. The potential detailed impacts of future land uses and their operations will be influenced by the detailed design and operating characteristics of the uses and will need to be the subject of detailed assessment for material change of use approval, including for environmentally relevant activities purposes.

The location of the PEP, being seaward of the existing port facilities, reduces any direct adverse land use effects on properties adjoining the port. The PEP does not require any modification to existing land uses adjacent to existing strategic port land. Land use controls that are presently in the *Port Land Use Plan,* which are similarly expected to apply to the PEP, will enable land use integration with the port's other activities.

B.1.4.3.2 Surrounding (Non-Port) Land Uses

The PEP is not expected to lead to direct adverse land use effects on nearby development in view of its location away from such existing uses. The port has a history of co-existence with adjoining residential uses in South Townsville and Railway Estate. The suburbs were established and have largely grown in their earlier years because of port related activity. The rejuvenation and new development along Palmer Street, the development of the Breakwater Marine Precinct (including Jupiters Casino), the refurbishment of The Strand and additional development fronting the road and foreshore reserve have occurred in the presence of the port, largely in its present form, without adverse impact on the ability of those developments to proceed and without reducing their demand or usability. The PEP is not expected to lead to direct changes to this situation in terms of existing land use patterns. Potential effects on visual amenity from surrounding vantage points are assessed in Chapter B17.

Tourism activities, other than water sports are mainly contained on Magnetic Island, many of which do not have a view of the port and will not be visually affected by the Project. Tourism attractions that fall within viewsheds of the port are addressed in Chapter B17. Water sports and recreational activities around the foreshore of Magnetic Island will not be directly affected by the PEP during construction, operation and ongoing maintenance dredging. Channel dredging and extension works are to be located east of the island and will not affect water sport or recreational opportunities on the northern, southern or western foreshores of the island. The proposed channel dredging and extension of the Sea Channel will be located within the existing ship navigation area at least 1km from the eastern foreshores of Magnetic Island. This is outside the current areas that are used by visitors and residents of the island for water sports and recreational activities. Access to the sea channel will be maintained for all recreational boating at all times other than during dredging operations and subject to maritime navigation regulations. Impacts on fringing reefs and water quality surrounding Magnetic Island are assessed in Chapter B6 Marine Ecology and B4 Marine Water.

Potential adverse effects on land uses surrounding the port are likely to be indirect through possible dust, noise and vibration and road safety factors, which have been assessed in detail in Chapters B9, B10 and B14, respectively.

The development of the PEP will result in an increased workforce for the port (Chapter B19). This is expected to have a beneficial effect on local businesses in South Townsville and the Palmer Street Precinct, resulting in increased retail and entertainment trade for the areas.

Much of the industrial development in South Townsville has an association with port activity either in terms of direct trade or by supporting other larger businesses that trade through the port. The PEP will not affect the land use patterns of existing industrial development surrounding the port nor adversely affect the uses in a manner that would make them less viable or stop them from continuing. Beneficial effects on surrounding industries are likely to result from the PEP through the facilitation of additional port related industry and the need for local services.

The PEP will use the port's approved quarry at Graniteville Road, as well as other quarries in the Townsville area. The Graniteville Road quarry is not a listed KRA quarry under SPP 2/07 and will not adversely affect the operation of other quarries (KRA or otherwise). POTL is in the process of obtaining the required approvals for the quarry and will operate within the conditions of those approvals.

B.1.4.3.3 Cleveland Bay Uses and Facilities

Recreational fishing is an important activity for Townsville's residents, much of which is focused on inshore waters and along the coastline of Cleveland Bay and Magnetic Island. The PEP does not affect recreational fishing opportunities in areas other than:

- the direct footprint of the reclamation and harbour areas, including revetments and rock walls, during construction and operation
- the DMPA during its use.

Access to seawalls around the port is already restricted and the PEP will become a part of the port's restricted access areas. The PEP does not affect public access to existing accessible seawalls along Ross Creek or Ross River. The PEP reclamation area will replace some of the marine environment in Cleveland Bay, some of which is presently available for recreational and commercial fishing purposes. The area is small in the context of the overall size of Cleveland Bay and the diversity of areas that are available elsewhere in the bay and offshore areas. The PEP reclamation will not significantly alter or remove more highly valued fisheries in estuaries, creeks or offshore areas.

Change in near-shore marine habitat availability, which may also have an indirect effect on fishing opportunities are described in Chapter B6 (Marine Ecology). Fishing plays an important role in Indigenous communities. Fishing associated with Indigenous cultural activity is primarily undertaken along shorelines and inter-tidal areas in estuaries (e.g. Ross River). These areas are generally not affected by the PEP and no significant impacts are expected to result on Indigenous cultural fishing activity. Chapter B15 considers Indigenous heritage matters in greater detail.

Net fishing is controlled by regulatory constraints in Cleveland Bay due to the presence of GBRMP zones, a fish habitat area and a dugong protection area. The key species targeted by net fishers are pelagic, which occur in open waters, away from the shallow sub-tidal near-shore areas of the PEP.

The likelihood of potential adverse impacts on recreational fishing occurring is 'possible' although the magnitude will be 'negligible' over the time span of the PEP's operation with an overall risk rating of 'negligible'. The impact of construction and operation of the PEP on recreational boating and yachting is expected to have a 'possible' likelihood of concern to recreational boating users with the magnitude of the effects expected to be 'minor' with an overall impact risk of 'low' over time as people become used to the presence of the PEP. The PEP is likely to have the greatest effect on boating wishing to travel in a north-west direction from Ross River and south-east from Ross Creek. In general, the PEP is likely to increase boating travel distances from or to these locations by less than 1 km due to the seaward protrusion of the PEP.

The PEP is expected to have a beneficial impact in terms of providing additional wind and wave protection to waters at the mouth of Ross Creek during south-easterly winds and the mouth of Ross River during north-westerly winds. It is expected that boats heading north from either Ross Creek or Ross River will experience no appreciable increase in travel distance or time. The PEP will not limit yachting opportunities in Cleveland Bay including informal or formal races. Races tend to be held in the waters between Magnetic Island and the mainland, around Magnetic Island or away from Cleveland Bay and do not include the location of the PEP reclamation. Existing restrictions already apply to the DMPA when it is operational and the effect that this has on current boating activity is not expected to change.

The existing passenger and vehicular ferry services will generally not be impacted by the PEP, as it does not adversely affect the route of the established ferry services from Ross Creek seaward. A speed restriction of six knots will apply during the construction phases of the PEP to maintain safety due to the presence of construction vessel traffic. This is not expected to adversely affect ferry traffic as such traffic will generally be able to avoid construction vessel traffic by navigating westward of the Platypus Channel leaving Ross Creek once clear of the western Ross Creek Breakwater.

B.1.4.4 Town Planning Objectives and Controls

The PEP is identified as a key part of the port's planned growth and is consistent with the intent and actions of the *Queensland Regionalisation Strategy*. It will be a key driver in facilitating the strengthening of the regional economy through a strengthening of its connections to markets. The port and the PEP play a key role in growing trade potential for North Queensland and bringing about the beneficial realisation of this aim.

Strategically, the expansion of the port is recognised at the local planning level as being an important part of Townsville's growth, in terms of supporting other industries, services, trade with other markets and in generating employment, which also drives housing construction. The importance of the port is further recognised in that statutory planning controls of the council (i.e. *City Plan 2005*) ensure that only complementary or compatible development is allowed to occur adjacent to port land. The PEP ensures that no changes are required to the current planning directions of the TCC as a result of any direct land use related effects.

Chapter B14 (Traffic and Transport) identifies that some additional traffic will occur during PEP construction and operational phases. This is considered in the context of the Project life over 25 years. The highest levels of additional traffic are expected during Construction Stage D of the Project (i.e. involving completion of berth construction, estimated to be between 2030 and 2035).

The principal effects of increased traffic, including heavy traffic travelling to and from the port are expected to be along Boundary Street. The expected increase in traffic during peak periods due to the PEP is not expected to be greater than 8% at the intersection of Boundary Street and Benwell Road and less than 5% at the intersection of Boundary Street and Saunders Street. Although the PEP is expected to have an impact in terms of additional traffic, it is expected to take place gradually over a long period of time and the effects are expected to be difficult to separate from other non-port related increases in traffic. Overall, the use of the TPAR through the TSDA is expected to significantly ameliorate the effects of increases in heavy vehicle traffic by providing an alternative route to that which is currently used by vehicles along Boundary Street and Benwell Road.

The likelihood of adjoining land uses being impacted through PEP related heavy or other transport – as opposed to the general expected increase in traffic – is 'possible' with the impact expected to be no more than 'minor'. The overall impact is expected to be 'low'. The effects of traffic are considered more fully in Chapter B14 (Traffic and Transport).

Council's planning controls recognise the indirect effects from port activity, including potential adverse effects from increased road transport along Boundary Street. Potential exists for adverse impacts on adjoining residences to occur due to higher volumes of port traffic. This duration is likely to be only short term with traffic from the west and south expected to use the TPAR once it is opened in 2012. Boundary Street is expected to remain a key state-controlled road accessing the port even after the TPAR is opened.

Noise and vibration generated by any increases in rail traffic to and from the port and effects on surrounding land uses, in the longer term, are expected to be mitigated through the construction of the Eastern Access Corridor rail line once sufficient demand is established for the transport of bulk goods.

The council recognises the need for noise buffering adjacent to rail lines in its existing planning scheme. Similar provisions are expected to be incorporated into the new planning scheme. The likelihood of potential adverse impact on residences due to additional PEP-generated rail traffic is expected to occur gradually over the construction and commissioning period of the different phases of the PEP. The impact of rail on the existing network due to the PEP is expected to be negligible once the Eastern Access Corridor is established. Much of the PEP is geared towards catering for rail-dependent bulk goods. In the short to medium term, some additional impact along the existing rail network is ‘possible’ with the expected unmitigated additional impact estimated as being ‘moderate’, relative to the background level of impact of existing rail traffic. The overall risk of this unmitigated impact is ‘medium’.

B.1.4.5 Development Constraints

The effects of physical constraints on the PEP, including flooding and storm surge are assessed in Chapter B3 (Coastal Processes). The PEP does not physically constrain other land uses in the area and it is not adversely affected by existing adjoining land uses. This is particularly due to the presence of the existing port between the PEP and other non-port related land uses (specifically those along Palmer Street and in South Townsville).

The PEP and the port are not likely to be adversely affected by redevelopment of land within South Townsville that is adjacent to the Port, including the Palmer Street Precinct and as is depicted in the CBD Master Plan, provided that the key transport haulage routes along Boundary Street, the TPAR and rail access corridor along Perkins Street do not experience intensification of development that results in significant numbers of residences which may lead to potential amenity conflicts as a result of the need to maintain port transportation needs. The *City Plan 2005*, identifies some land on the southern side of Boundary Street as Mixed Residential Precinct. Although this precinct type can in principle permit some higher density development, the planning scheme generally predicates that higher density development is not encouraged in this location. The importance of Boundary Street as a transport thoroughfare to the port in the future will require that further intensification of residential development is discouraged through appropriate zonings and controls in future planning schemes. The likelihood of further intensification of incompatible development under the existing zoning of land along parts of Boundary Street is ‘possible’ with the resultant potential impact being ‘high’. The overall risk of this unmitigated impact is ‘medium’.

The PEP is likely to have beneficial impacts for development of the TSDA through the generation of more trade potential; subject to supply of product and availability of markets. This is likely to increase the need for additional industrial land situated in close proximity to the port.

Strongly related to land use activity is the adequacy of infrastructure and services. Strong growth and development can place greater demands on available infrastructure networks and services. Much of the development of South Townsville, including much of the development of the Palmer Street Precinct, has relied on the continued augmentation of older infrastructure networks that are primarily provided and maintained by TCC or Ergon. Although this has proved adequate up until now, adequate strategic infrastructure planning is essential for the area, the PEP and the port as a whole to continue to grow and respond to changing demands. Without adequate infrastructure planning there is a risk that the PEP may either have:

- insufficient infrastructure capacity to connect to and be constrained until appropriate provision can be made
- unplanned additional Project costs where infrastructure needs have not been properly forecast.

Either of the above situations could not only cause Project delays and increased costs, but also conflict with other planned development in the area. The likelihood of this happening is considered to be ‘unlikely’ with ‘high’ consequences if either situation did occur. The overall risk of the potential impact is ‘medium’.

B.1.4.6 Management of Land Uses in Immediate Environs

The environmental management of port land uses is initially undertaken through the strategic location of intended port uses so that they maximise the overall and long-term operational efficiency and reduce adverse effects on other non-port uses on adjacent land. These outcomes and controls are regulated through the *Port Land Use Plan*. Detailed control provisions are generally stipulated on development approvals and through a range of environmental licences. The use of land outside of the strategic port land occurs primarily through the TCC planning scheme. State planning controls relating to a range of environmental matters also apply to both areas.

The PEP will be located further away from non-port land uses, including residential development, than existing port development. Land use controls, once the PEP becomes strategic port land and is incorporated into the *Port Land Use Plan*, will at least be similar to the existing land use controls and will incorporate any changes in state requirements that may apply at the time. The PEP will also have a range of environmental management requirements that will apply to its construction and operation that are recommended in Part C to mitigate any potential adverse impacts.

B.1.4.7 Native Title

Section B.1.3.3.1 identified that there are presently no native claims that affect the PEP and no corresponding impacts in terms of any rights that are affected by the *Native Title Act 1993*. The PEP is presently unallocated state land and is subject to the native title provisions. Should a claim be lodged over any PEP land that is not to be converted to freehold title or before any proposed freehold land is converted, the claim must be processed by the National Native Title Tribunal and if the claim is accepted, an Indigenous land use agreement may need to be negotiated with the Traditional Owner claimants.

POTL has practices in place to ensure that close relationships with Traditional Owners and Indigenous representatives are maintained, so that Indigenous concerns can be understood and acted upon.

B.1.4.8 Land Use Changes in Areas of High Conservation Value

The PEP will result in a loss of approximately 100 ha of area due to reclamation works in the GBRWHA that covers Cleveland Bay, which also includes some dugong protection area. The likely impacts on areas of high conservation value, including habitats, flora and fauna, is discussed in Chapters B6 and B7.

B.1.4.9 Proximity of Key Infrastructure Services

The PEP will not adversely affect ferry operations in their current locality. The principal land use related impacts associated with infrastructure apply to indirect effects of potential increased heavy vehicle transport along Boundary Street and increased rail traffic. Some impacts are also expected to result on the need for additional water, sewer and electricity infrastructure as a result of additional demand generated from additional land use activity through the PEP. General ‘trunk’ infrastructure is planned for and facilitated through POTL’s *Priority Infrastructure Plan*, which also links closely to that of the TCC (i.e. water and sewer are provided through TCC trunk networks). The timeframes associated with construction and operation of the PEP are sufficiently long enough to enable effective strategic frameworks and plans to be put in place well in advance of any critical infrastructure requirements. This includes appropriate amendments to POTL’s *Priority Infrastructure Plan* to account for the PEP requirements and negotiations with council to appropriately amend its infrastructure plans.

The PEP will also enable POTL to give greater effect to its overall expansion plans and relocation of key port uses. This will include opportunities for improved separation of non-compatible uses and integration of other uses with existing networks including opportunities to provide for more effective public transport linkages to the port (presently restricted to the use of taxis only).

B.1.4.10 Land Units that Require Specific Management Measures

There are no land units that require specific management in terms of land use or tenure. Issues generally affecting land uses are indirect in nature and are dealt with through other chapters in the EIS. As an expected integral part of the port, the PEP will ensure that its planning controls align with the rest of the port as strategic port land and that this is achieved by inclusion into the *Port Land Use Plan* that is effective at the time.

B.1.5 Mitigation Measures and Residual Impacts

Mitigation measures and residual impacts are assessed for the following aspects of construction and operation:

- ASS
- land and sediment contamination
- land use and tenure

The proposed mitigation measures are summarised in Table B.1.7.

B.1.5.1 Acid Sulfate Soils

PASS are frequently present in Holocene alluvial soil on low-lying floodplains and in sheltered coastal seabed sediments. Work to date indicates the presence of low risk PASS at some locations in the dredge footprint and beneath the reclamation area. Generally the PASS layer in virgin marine sediments of the port expansion area is 1.0 to 3.0 m deep, situated below LAT and overlying benign Pleistocene sediments. The remainder of the PASS layer has excess neutralising capacity and this is the case for the Holocene layer as a whole.

While the risk from ASS during dredging and reclamation processes is low (as PASS material is planned for placement in the DMPA), an *ASS Management Plan* has been developed and will be implemented during and following the construction phase of the Project. The *ASS Management Plan* is in Appendix F2 (Golder Associates, 2012a).

B.1.5.2 Land Contamination

The potential impacts associated with contaminated land in the Project Area are minimal. The PEP will provide future port land and, as such, will be used for similar purposes to adjacent port land.

Construction and operational activities with potential to cause land contamination (e.g. some environmentally relevant activities) will need to obtain appropriate permits and licenses and comply with stringent state and other requirements regarding environmental management, monitoring and notification procedures. Secondary contamination risks due to chemical spills and leaks are also regarded as low. Mitigation for potential effects of Acid Sulphate Solis and spills and leaks during construction of the PEP are addressed separately in the Construction Environmental Management Plan (Chapter C2.2).

If a notifiable activity is undertaken on the PEP, the DEHP must be informed, in accordance with the *Environment Protection Act 1994*. DEHP will decide whether or not to list the land on the EMR. An assessment of PEP related impacts on marine sediments is provided in Chapter B5.

B.1.5.3 Land Use and Tenure

Land use and tenure impacts have been assessed to identify the need for mitigation for aspects including:

- surrounding land uses and human activities, specifically:
  - nearby(non-port) land uses
  - Cleveland Bay uses
- town planning objectives and controls
- development constraints
- environmental management of land uses
- land use changes in areas of high conservation value
- land units that require specific management measures.

Issues that have potential need for mitigation include:

- boating and yachting activity in Cleveland Bay: notably for vessels navigating from Ross River and Ross Creek potentially affected by obstruction to navigation resulting from the PEP's seaward intrusion
- residential and other sensitive land uses along Boundary Street: due to potential reductions in amenity and safety resulting from increases in heavy-haulage vehicle movements and which may warrant planning control changes (Boundary Street is a Department of Transport and Main Roads declared heavy vehicle haulage route and any land use controls under the council's jurisdiction are likely to require recognition of this designation and ensure that land use compatibility is maintained)
- residential and other sensitive land uses along the existing rail corridor to the port: due to potential increased noise and vibration resulting from increases in rail movements to and from the port until the Eastern Access Corridor is operational (incorporation of land use compatibility controls along rail corridors is a matter that forms a part of the state interest review process for draft planning schemes or scheme amendments).

There were no tenure impacts identified, other than the need to consider the presence of native title as new tenure is to be created over land being reclaimed for the PEP. No native title claims currently exist. Further native title searches will be undertaken prior to any proposal to change the tenure of the reclaimed land.

Mitigation measures concerning land uses primarily require:

- community awareness over the PEP's progress and any likely impacts or opportunities that this may have regarding the need for additional workers' housing or land and property for additional industrial or commercial development that is generated by port growth
- ongoing engagement with the TCC over its strategic and statutory planning for the surrounding area to ensure that:
    - the port is recognised as a significant land use of regional and district economic importance
    - controls are stipulated in the new planning scheme to strategically highlight the inappropriateness of land along Boundary Street for further intensification of residential development
    - strict development controls are included for any further development in Boundary Street to assess its relationship and impact on port activity, including transport needs
    - Boundary Street is subject to strict design and management development controls mitigating against potential noise and safety impacts for any development that is to proceed
- development and maintenance of a priority infrastructure plan for the port that ensure that its infrastructure needs are clearly defined and effectively integrated into the council's services for the future in a way that does not impede the port's growth potential and needs
- close liaison with the Department of Transport and Main Roads and TCC regarding transport planning and any related land use planning control needed for development along Boundary Street.

Table B.1.7 Potential Impacts and Recommended Mitigation Measures

Potential Impact	Unmitigated Risk Category	Mitigation Measures	Mitigated Risk Category
Effects of PEP on recreational fishing in Cleveland Bay	Negligible	▪ Provide ongoing awareness of current entry restrictions, available sites of shore-based fishing and POTL plans for maritime activity well in advance of undertaking any works, through POTL's website, newspaper advertisements and temporary signage at boat ramps in Ross Creek and Ross River as may be required.	Negligible
Perceived restriction to boating navigation to and from Ross Creek or Ross River	Low	▪ Provide ongoing awareness to boating community regarding stages for the PEP and potential effects on recreational and other boating into Cleveland Bay from Ross River and Ross Creek. ▪ Inform Townsville boating organisations, including the Townsville Motor Boat and Yacht Club and the Volunteer Marine Rescue, of PEP activity through regular information correspondence. ▪ Liaise with Maritime Safety Queensland for any construction activities that may require a Notice to Mariners.	Negligible
Adequate planning for infrastructure and integration with other providers (e.g. TCC, Ergon)	Medium	▪ Review of the Port's strategic trunk infrastructure needs and liaison with TCC to identify water and sewer needs, required capacity, integration requirements, cost, staging and potential funding. ▪ Continued engagement with council (i.e. through informal discussions and negotiations as well as formal submissions during any stakeholder consultation stages) in relation to the finalisation of the *Priority Infrastructure Plan* as part of the preparation of the council's new planning scheme and any subsequent amendments to ensure that the port's needs are reflected accurately and accounted for. ▪ Undertake early consultation with Ergon to ensure	Low

Potential Impact	Unmitigated Risk Category	Mitigation Measures	Mitigated Risk Category
		that adequate electricity planning and augmentation can occur in advance of PEP being ready to 'come online'.	
Amenity and safety of residences and other uses on Boundary Street due to increased transport and traffic	Low	▪ Continued engagement with Department of Transport and Main Roads and TCC over enhanced traffic management and traffic awareness as part of detailed development planning for the PEP through the implementation of the Road Use Management Plan for the PEP (Chapter B14). ▪ Update the Port Community Forum as required for any transport and safety issues.	Negligible
Future land use compatibility along Boundary Street	Medium	▪ Continued engagement and negotiation with TCC to ensure that planning controls included in its new planning scheme ▪ identify the strategic importance of Boundary Street as access for the port ▪ discourage further intensification of residential development in this location ▪ stipulate strict development controls requiring an assessment of the likely impact on port development or its use ▪ ensure the effectiveness of Boundary Street as a key transport route resulting from new development is not impacted ▪ ensure the design and use of any new buildings to ensure that their amenity and safety is not adversely affected by port related road transport activity and that such development does not adversely affect the safe and efficient operation of the road network in the area; notably Boundary Street-Benwell Road.	Low
Amenity at residences and other land uses along the existing rail corridor to the port in South Townsville Future land use compatibility along the alignment of the existing rail yards	Medium	▪ Monitor plans and timeframes for future access through Eastern Access Corridor. ▪ Encourage the establishment of a buffer zone either side of the existing rail corridor and the rail yards by the state or Council (i.e. as part of the Council's new planning scheme). ▪ Restrict further noise and vibration sensitive or other incompatible development and introduce design controls for the attenuation of external noise in new or renovated buildings. ▪ Update residents about any relevant changes to conditions associated with rail traffic due to PEP construction activity.	Low

B.1.5.4 Residual Impacts

Residual impacts are those impacts that remain after mitigation measures have been applied. Table B.1.7 identifies both the unmitigated risk categorisation and the expected residual risk from any impacts that are unable to be fully mitigated. In general, no land use related impacts are expected to have a residual risk categorisation greater than 'low' as defined in Section A2.4.

B.1.6 Cumulative Impacts

The PEP is a long-term project with its full development, at this stage, not expected to be reached before 2040. During that time Townsville is expected to grow its population by over 50% of its current population, which will result in considerable more demand for housing, including increased density in established areas, services and infrastructure capacity.

Cumulative land use impacts that are likely to result from the PEP primarily relate to the port, its operation and indirect impacts on other port land uses, including increasing demand for infrastructure and services. This will include port infrastructure for the loading and unloading of ships and water, sewer and power infrastructure. The demand for infrastructure is expected to grow as new and additional port industries seek to occupy space provided by the PEP, either directly on newly created PEP land or through the availability of other port land as a result of the integration process between the PEP and the existing port. This demand is also likely to impact council infrastructure as additional PEP development comes 'on line'. Demand will be influenced by the type of development that is proposed and the readiness of the port and the council to adequately accommodate the additional development in light of other demands that will occur between now and when the PEP is at its operational capacity.

The impacts of individual tenant proposals for reclaimed PEP land will be assessed separately by POTL, as assessment manager for development on strategic port land, using the provisions of the *Port Land Use Plan*. Individual developers will be required to address potentially adverse impacts through appropriate location of uses according to the *Port Land Use Plan*, design and operational requirements specified by *the Port Development Code* and conditions that must be met as part of further approvals. Approval conditions for environmentally sensitive activities may be issued by DEHP or TCC, depending on their jurisdiction as an assessment manager for such development, and DEHP as assessment manager for development outside of strategic port land that is not the jurisdiction of the council. The port and tenants also have the opportunity to negotiate infrastructure provision through lease arrangements. In all cases, close liaison and negotiation will be necessary with the TCC.

The PEP is expected to have beneficial cumulative land use impacts on the need for industrial land and industries that support trade activities. This is expected to be most noticeable for land within the TSDA.

B.1.7 Assessment Summary

Potential impacts and recommended mitigation measures have been summarised in Table B.1.7. Generally, the PEP is not expected to have any direct adverse land related impacts. The development is expected to be supported by other development in the area and region; therefore, it is expected to have a beneficial effect in the growth of other service industries and to support land uses as port activity intensifies and businesses establish within the PEP. Existing port land uses are not expected to be adversely affected by the PEP or its uses; the PEP forms an integral part of the port's strategic expansion and operation. The PEP and its bulk goods trading capability, once completed, will be a fully integrated feature of the port and its overall activity as North Queensland's largest multi-purpose port.

Some indirect adverse impacts that may have an effect on land uses surrounding the port have the potential to occur primarily if port related transport activity (both road and rail) intensifies along existing routes. Access to the port is along an existing state-designated heavy-haulage road route (Boundary Street and into Benwell Road). This is to be supplemented by TPAR through the TSDA, which is expected to take much of the current heavy road traffic from the west and south of Townsville. A detailed transport and infrastructure assessment has been undertaken in Chapter B14. The assessment includes recommendations regarding a the implementation of a Road Use Management Plan, which is expected to mitigate concerns regarding safety and the operation of heavy vehicles in the vicinity of the port. Other mitigation measures, which are aimed at maintaining effective community awareness have been proposed in Table B.1.7.

The rail line is an important part of the port's operation. It has been integral in enabling the port to effectively link with the hinterland of North Queensland and the north-west as the principal trade outlet. This has contributed to much of North Queensland's development and prosperity. The rail line to the port is expected to remain a significant feature of its ongoing operation, irrespective of the PEP. As the demand for bulk cargo increases, strategic recognition has already been given towards the eventual augmentation of rail infrastructure to the port through the Eastern Access Corridor, including the use of the TSDA for the handling of rail cargo. This would eventually lead to the reduction of the current dependence on the existing rail line as the only line servicing the port.

Indirect transport related impacts (including those from road and rail) are expected to primarily be related to noise, vibration and dust. The potential effects would primarily be on the amenity of nearby and affected residents. Table B.1.7 identifies appropriate mitigation measures that will reduce the level of risk from these indirect effects. Both Boundary Street and the existing rail line are expected to remain and play an important part in the port's development and use.

The future of the port as strategic infrastructure to service the region's growth and prosperity is heavily influenced by its effective connection to road and rail infrastructure that is able to meet the growing demands for trade and associated port expansion. Therefore, it is important that complimentary planning is undertaken by relevant authorities to ensure that otherwise sensitive or inappropriate development is not permitted to intensify along these routes and, where possible, to encourage existing development to adopt standards that will mitigate any existing incompatibility with transport related activities.

Uses and activities undertaken on Cleveland Bay that are most likely to be perceived as being impacted by the PEP are primarily related to recreational boating and fishing activity. The assessment has identified that fishing, including commercial fishing, is not expected to be significantly impacted as most of the activity is undertaken outside of the areas to be affected by the PEP. Impacts to recreational boating and access to waters that will be occupied by the PEP are expected to be negligible as access to the greater parts of Cleveland Bay and onwards into the Coral Sea will not be restricted. Harbour areas around the port, including areas that are to become part of the PEP reclamation area, are already restricted to the general public under POTL's *Security Plan*. This will continue to be the case during the construction and operational phases of the PEP. Recreational marine activity plays a major part of Townsville's attraction and social wellbeing; considerable public infrastructure investment has been undertaken for recreational boating activity (much of which is provided for on port land along Ross Creek and Ross River). The port has played an active role in facilitating recreational and other boating activity. It is recognised that many of the port's existing public engagement structures will continue to play a significant role in maintaining community awareness about the progress of the PEP, short-term effects that construction may have, and ways of improving boaters' safety and enjoyment.

Port Expansion Project EIS

Part B

Chapter 1.0 - Land

B.1 Land

B.1.1 Relevance of the Project to the Land and its Values

The Port Expansion Project (PEP) proposes a significant expansion of the port's area and its capacity to handle products in and out of Townsville and the region. The PEP will need to reclaim seabed adjacent to the port, which currently has potential recreational and commercial uses. The increase in port activity that the PEP is expected to bring also has the potential to affect surrounding land uses through indirect impacts, notably those involving transport of goods to and from the port via road or rail. The purpose of this chapter is to detail and assess the existing land environment for areas associated with the PEP and to identify potential impacts on land-based characteristics resulting from the construction and operation of the Project. Regional, district and local land characteristics are assessed, including potential impacts on the existing uses in Cleveland Bay. Land characteristics that have been assessed include:

- topography, geology and soils
- land contamination
- land use and tenure.

The key land attributes are assessed in terms of the regional, district and local policy frameworks that identify preferred outcomes for the attributes. The information is used to contextualise the role of the PEP and its potential impacts, direct or indirect on land characteristics using available information that describes those characteristics. The key land characteristics are described in terms of the urban areas and Cleveland Bay that surround and include the existing port and the Project Area. Key urban areas and locations that are assessed are:

- South Townsville
- Railway Estate
- Magnetic Island
- North Ward (including The Strand)
- Townsville CBD (including the Breakwater Marine Precinct)
- Townsville State Development Area (TSDA).

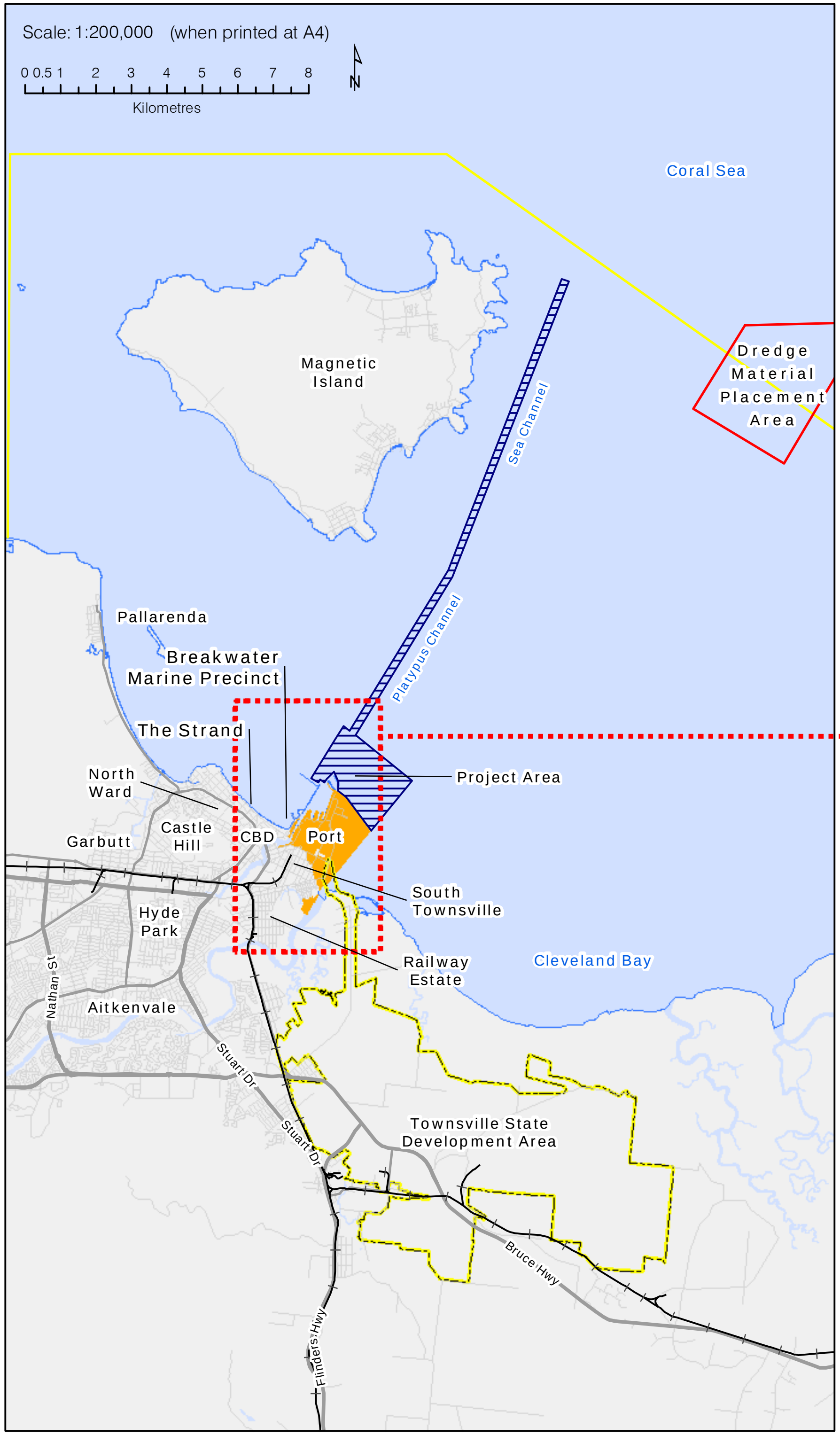
The locations are shown in Figure B.1.1. The location of the project is shown in State, regional and local context in Figure B.1.2.

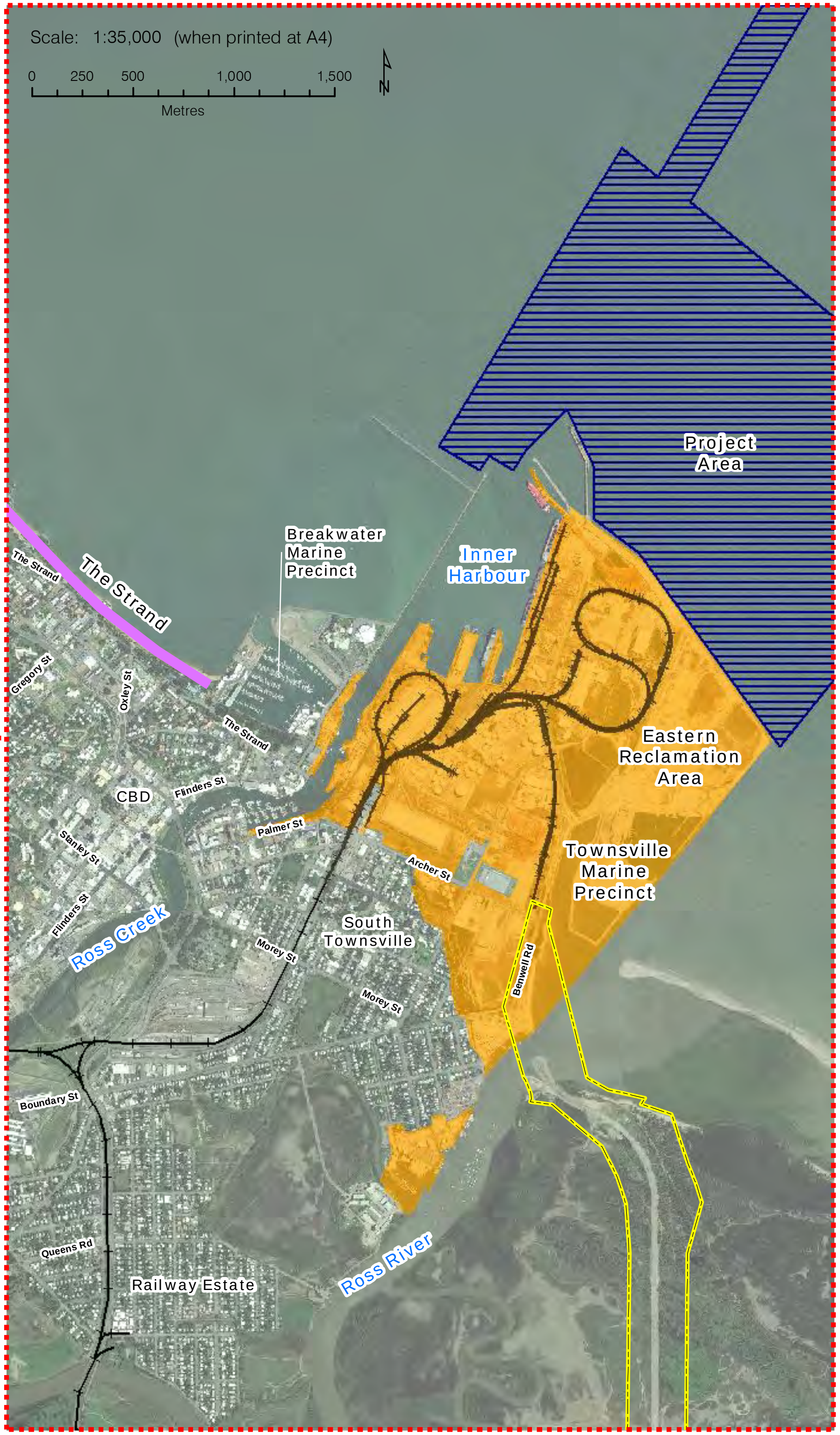
Potential land related impacts of the PEP are primarily assessed in terms of the relationship of the port and the PEP with the surrounding area, including the greater Townsville area, and the future interaction of the Project with the current existing land and marine area uses. Consideration is also given to the likely effects on the displacement of existing land activity and the need for any specific mitigation measures for the management of particular land characteristics (for example, acid sulfate soils or contaminated land) or interaction between PEP related and other land uses. Impacts are identified and described using the general methodology that has been adopted for the Environmental Impact Statement (EIS) in Sections A2.1 to 2.4.

PORT EXPANSION PROJECT EIS

Land Use Assessment Study Area

Figure B.1.1





Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- The Strand
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

PROJECT ID	60161996
LAST MODIFIED	CFS 13-Nov-2012
FILE NAME	60161996_PLN_014

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery (insert) - Port of Townsville 2011.

PORT EXPANSION PROJECT EIS

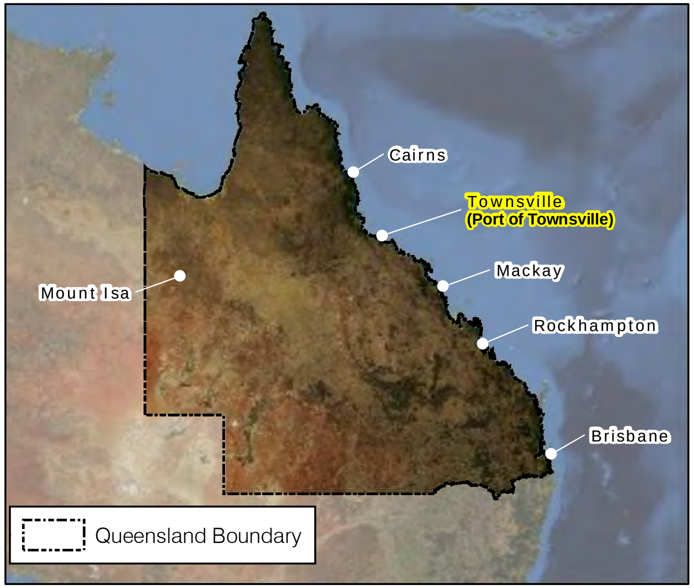
Location of Port of Townsville

Figure B.1.2

Location of the Port of Townsville at State Level

Scale: 1:32,000,000 (when printed at A4)

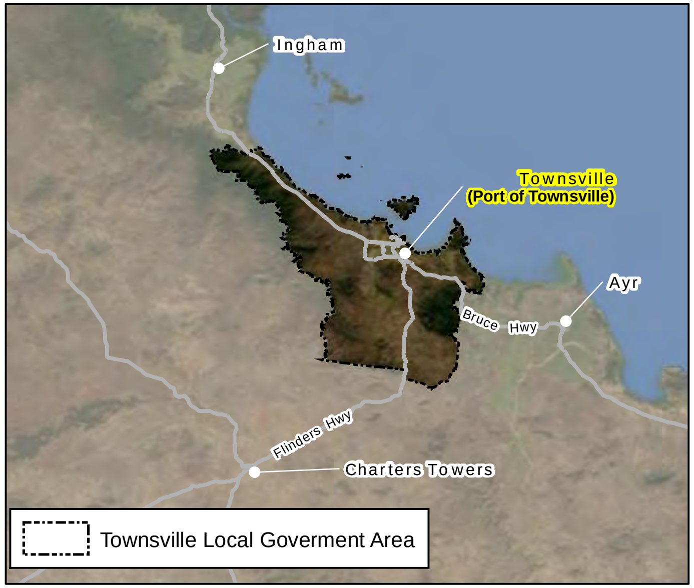
0 250 500 1,000 Kilometres



Location of the Port of Townsville within Townsville's Local Government Area

Scale: 1:3,000,000 (when printed at A4)

0 50 100 Kilometres



Location of the Port of Townsville within Townsville

Scale: 1:250,000 (when printed at A4)

0 5 10 20 Kilometres

Legend

- Highways
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

PROJECT ID 60161996

LAST MODIFIED CFS 08-Mar-2013

FILE NAME 60161996_PLN_146

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Imagery - ESRI 2013

B.1.2 Assessment Frameworks and Statutory Policies

Assessment frameworks and statutory policies are considered for:

- topography, geology and soils (including land contamination)
- land use and tenure.

These frameworks and policies provide an overview of the physical environmental and planning management outcomes for the area and to assist in forming a basis for the assessment of likely impacts, relevant controls and directions for mitigation.

B.1.2.1 Topography, Geology and Soils

The topography and landforms in the Study Area were reviewed using relevant maps, including topographic maps, aerial photography from 1961 to 2010 inclusive, and relevant previous studies.

The geology and soils in the Study Area were assessed based on desktop review of previous investigation reports, aerial photography, geological maps and soil bore logs in the Project footprint and its immediate surroundings.

A range of land investigations have been undertaken at the Port of Townsville including geotechnical and contamination assessments of the seabed sediments at the inner and outer harbours, acid sulfate soils (ASS) and soil investigation studies and groundwater monitoring programs at the existing port. Due to the PEP's location adjacent to marine near-shore and estuarine coastal sediments an ASS study was completed by Golder Associates (2012a) as part of the EIS. This study comprised a desktop review of information provided by Port of Townsville Limited (POTL) and site surveys undertaken in 2008, and is in accordance with the following legislation/guidelines:

- *State Planning Policy 2/02: Planning and Managing Development Involving Acid Sulfate Soils* (SPP 2/02)
- *Queensland Acid Sulfate Soil Technical Manual* (DNRM, 2004)
- *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998*, developed by the Queensland Acid Sulfate Soils Investigation Team (Ahern, Ahern, & Powell, 1998)

The following assessment framework and policy references are applicable for the assessment of contaminated land:

- *National Environmental Protection (Assessment of Site Contamination) Measure* (NEPC, 1999)
- *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (DE, 1998)
- *AS 4482.1:2005 Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil* (Standards Australia, 2005a).

Dredging and disposal of material for reclamation may be considered as disposal on land, which is covered by the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998*. This matter is considered in detail in Coastal Processes (Chapter B3) and Marine Sediment Quality (Chapter B5).

A land contamination desktop review was undertaken of land affected by the PEP and immediately adjacent areas to identify properties that may have been impacted by contamination or that may impact on the PEP footprint. The desktop study comprised:

- review of the Department of Defence (DoD) unexploded ordnance (UXO) mapping
- review of historical aerial photography to determine likely land use classification (e.g. industrial, residential, etc.) and to identify properties for which searches on the Department of Environment and Heritage Protection (DEHP) Environmental Management Register and Contaminated Land Register were required.

Reports that were reviewed as part of this assessment include:

- *Townsville Marine Precinct Project – Environmental Impact Statement*

    - Appendix P - Baseline Groundwater Monitoring (GHD, 2008b)
    - Appendix H - Acid Sulfate Soils Investigation (GHD, 2009b)
- *Summary of Geotechnical Testing Undertaken Within the Port of Townsville Redevelopment Area* (Golder Associates, 2008a).

B.1.2.2 Land Use and Tenure

Assessment frameworks and statutory policies relating to land uses exist at Commonwealth, state and local government levels. These frameworks and policies establish the operational regimes within which land use decisions are made and differ from the legislative frameworks discussed in Section A2.6, which largely establishes the heads of power and procedures in law used to implement land use decision-making.

B.1.2.2.1 Commonwealth Land Use Planning Frameworks and Statutory Policies

Great Barrier Reef World Heritage Area

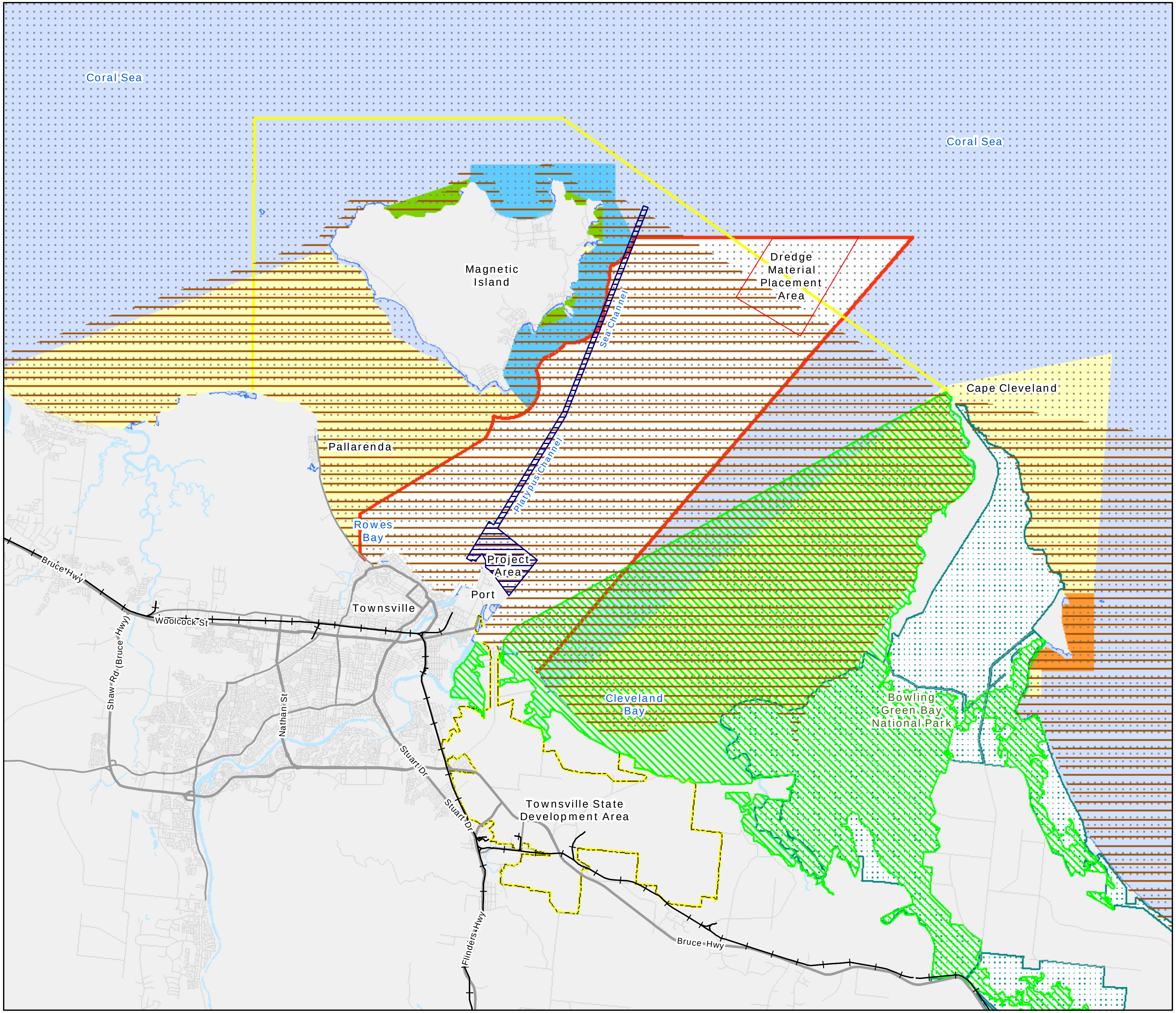
Waters in the vicinity of and including the Project Area are part of the Great Barrier Reef World Heritage Area (GBRWHA). Cleveland Bay, including Magnetic Island, is in the GBRWHA. There are no specific plans or codes that apply to the entire GBRWHA. Assessment of impacts and the determination of specific mitigation methods are primarily determined through environmental assessment processes, including EIS, under the *Environment Protection and Biodiversity Conservation Act 1999*.

Great Barrier Reef Marine Park Zoning Plan 2003

The Great Barrier Reef Marine Park (GBRMP) is under the jurisdiction of the Great Barrier Reef Marine Park Authority (GBRMPA). The principal assessment framework that applies to GBRMP is the *Great Barrier Reef Marine Park Zoning Plan 2003* (GBRMP zoning plan), which is administered by the GBRMPA. The GBRMP zoning plan does not apply to waters affected by the PEP, other than for a small section of shipping channel deepening at the northern end of the Sea Channel.

The GBRMP zoning plan establishes zones over parts of Cleveland Bay, which are intended to protect marine habitat and species as well as permitting other compatible uses to take place relative to the level of habitat protection considered necessary. The three main zones in Cleveland Bay are detailed below and shown in Figure B.1.3.

- General Use Zone
    - The objectives of the General Use Zone are to provide for the conservation of areas of GBRMP, while providing opportunities for reasonable use. The General Use Zone provides for the widest range of uses of any GBRMP zone. The deepening and lengthening of the Sea Channel is an extension of the existing seaway in this zone and is consistent with the intent of the zone.
- Habitat Protection Zone
    - The objectives of the Habitat Protection Zone are to provide for the conservation of areas of GBRMP through the protection and management of sensitive habitats, generally free from potentially damaging activities while also providing opportunities for reasonable use.
- Conservation Park Zone
    - The objectives of the Conservation Park Zone are to provide for the conservation of areas of GBRMP while also providing opportunities for reasonable use and enjoyment, including limited extractive use.



PORT EXPANSION PROJECT EIS

Great Barrier Reef Marine Park Zonings and Environmentally Sensitive Areas in Cleveland Bay

Figure B.1.3

Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Dredge Material Placement Area
- Dugong Protection Area
- Cleveland Bay Fish Habitat Area
- Bowling Green Bay Ramsar Site
- GBRWHA/National Heritage Place

GBRMPA - Zoning

- Conservation Park
- General Use
- Habitat Protection
- Marine National Park
- Scientific Research
- Marine Park Boundary

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 13-Nov-2012
FILE NAME	60161996_PLN_015

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Dugong Protect Area is a representation of GBRMPA's Dugong Protection Areas. Any analysis should use the offical GBRMPA's Dugong Protection Areas for accuracy.

National Strategy for Ecologically Sustainable Development 1992

The *National Strategy for Ecologically Sustainable Development1992* (National ESD Strategy) defines ecologically sustainable development (ESD) as *"using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased"* (ESD Steering Committee, 1992). The strategy sets out a strategic policy framework under which governments cooperatively make decisions and take actions to pursue ESD. The national ESD Strategy was endorsed by the Council of Australian Governments on 7 December 1992 as a factor in future environmental decision making.

Great Barrier Reef Outlook Report 2009

The *Great Barrier Reef Outlook Report 2009* (Outlook Report) defines the current conditions of the Great Barrier Reef, its management and its future outlook. The Outlook Report underpins decision making for the long term protection of the Great Barrier Reef (GBRMPA, 2009). The GBRMPA states the aim is to provide information about:

- *The condition of the ecosystem of the Great Barrier Reef Region (including the ecosystem outside the Region where it affects the Region).*
- *Social and economic factors influencing the Great Barrier Reef ecosystem.*
- *Management effectiveness of the Great Barrier Reef.*
- *Risk-based assessment of the long-term outlook for the Region.*

(GBRMPA, 2009)

The Outlook Report identifies that there is generally "good planning" at individual port levels with most planning for ports and shipping activities appearing to be responsive rather than strategic and proactive. Ports have not been recognised as a specific form of development which is perceived to directly impact on social values of the GBR. Ports and shipping are recognised by the Outlook Report as providing strong social benefits to regional communities and contributes to the economic value of the Great Barrier Reef. Ports and shipping have not been have not been included in the listed in the community perceptions about the direct threats to the Great Barrier Reef ecosystem.

The Outlook Report identifies the use of the GBR region for ports and shipping as making a significant contribution to the environmental, economic and social values of the region, in ways that sustain the fundamental value of the natural resource. Most routine shipping activities are identified as having negligible consequences. Dredging and construction of port facilities can have significant but localised impacts. Overall the impact of Ports and shipping in the GBR region is identified as being of 'low impact'.

B.1.2.2.2 State Land Use Planning Frameworks and Statutory Policies

State assessment frameworks and statutory policies affecting land use planning in the area surrounding and including the PEP, include:

- State planning regulatory provisions (SPRP)
- State planning policies (SPP)
- Regional planning policies
- Local state-based strategies and policies.

State Planning Regulatory Provisions

A SPRP is a planning instrument that is made under the provisions of the *Sustainable Planning Act 2009* (SP Act) for an area to advance any purpose of the Act. A draft SPRP has the same effect as an SPRP once the draft is made. SPRP can include the identification of levels of assessment for defined areas or specific uses, prohibit development, and identify assessment criteria that are required for assessable development. Where other planning instruments may be inconsistent with the provisions of an SPRP (including a draft SPRP), the provisions of the SPRP prevail. Other planning instruments include regional plans, state planning policies, statutory planning guidelines, local planning schemes and temporary planning instruments.

The draft *Coastal Protection State Planning Regulatory Provision* (draft Coastal Protection SPRP) came into effect on 8 October 2012 (DSDIP, 2012). The draft Coastal Protection SPRP replaces *SPP 3/11: Coastal Protection* while the SPP is being reviewed. The provisions of the draft Coastal Protection SPRP apply to the preparation of local planning schemes and scheme amendments, the preparation of regional plans, assessment of proposed community infrastructure, and the assessment of development applications under the Integrated Development Assessment System of SP Act. The draft Coastal Protection SPRP is the only SPRP that applies to land that is to be affected by the PEP.

The draft Coastal Protection SPRP includes assessment provisions that relate to:

- coastal hazards
- development in erosion prone areas
- nature conservation
- areas of high ecological significance
- public access
- coastal-dependent land use
- canals and dry land marinas.

The draft Coastal Protection SPRP specifically notes that:

> *Maritime infrastructure has an important role in the state's economy and is appropriate where there is no net loss of public access to the coast and adverse impacts on coastal resources and their values are avoided where practicable or minimised.*

The provisions of the draft Coastal Protection SPRP do not apply to this stage of the PEP's assessment, but would apply to any future development applications in the coastal zone, should the SPRP still be in place at the time a development application is lodged. At this stage, the Queensland Government has identified that the planning instrument is to apply for an initial period of 12 months.

State Planning Policies

SPP are statutory policies that have been prepared under the provisions of SP Act, which can also have a basis in other related legislation (e.g. environmental legislation). SPP can affect both the preparation of local planning schemes and have provisions that must be considered in the assessment of assessable development regardless of whether those provisions exist in a relevant local planning instrument.

Unlike local government planning schemes, consideration of SPP is not statutorily mandatory for the preparation of a port land use plan, prepared under the provisions of the *Transport Infrastructure Act 1994.* SPP must be considered for any assessable development that is affected by such a plan (i.e. for Strategic Port Land). In this regard, although SPP do not play a statutory role in any amendment of the *Port of Townsville Land Use Plan*, any future assessable development prior to the PEP's inclusion in to Strategic Port Land or development that is made assessable under the plan must have regard for applicable SPP.

Queensland SPP and their relevance to the PEP are listed in Table B.1.1.

Table B.1.1 State Planning Policies that may be Relevant to PEP Assessable Development

SPP Name	Key Characteristics	Application to PEP
SPP 4/11: Protecting wetlands of high ecological significance in Great Barrier Reef catchments	Protects referable wetlands in river catchments, including coastal locations, that drain towards the Great Barrier Reef.	Although there are wetlands of high ecological significance in the Cleveland Bay area, such wetlands do not occupy the development footprint of the PEP and are not in close proximity to impacts from the PEP. The PEP is not expected to have any significant impact on any wetlands affected by SPP 4/11.
SPP 3/11 Coastal Protection and *State Policy for Coastal*	This SPP is presently being reviewed by the Queensland Government. Its provisions have	Draft Coastal Protection SPRP (in lieu of SPP 3/11) is relevant to the PEP where assessable development is

SPP Name	Key Characteristics	Application to PEP
Management (DERM, 2012)	been temporarily replaced by the provisions of the draft Coastal Protection SPRP. SPP3/11 is part of a broader state planning document, the *Queensland Coastal Plan*. This plan consists of two parts: the *State Policy for Coastal Management* and SPP3/11. The *State Policy for Coastal Management* is to be considered for development that does not constitute assessable development under the provisions of SP Act, while SPP 3/11 provides the assessment criteria for assessable development in state coastal land (replaced by draft Coastal Protection SPRP). The *State Policy for Coastal Management* is not an SPP under the provisions of SP Act.	to be considered under the provisions of SP Act. The *State Policy for Coastal Management* applies to the consideration of the PEP at the EIS stage and deals primarily with policy objectives and outcomes for the protection of natural coastal areas such as dune systems and beaches. The policy establishes objectives to ensure that development is not adversely affected by and will not affect coastal processes that can lead to sediment movement, deposition and erosion, as well as ensuring that reasonable public access is maintained to the coastal area. Key aspects of the *State Policy for Coastal Protection* that apply directly to the PEP include requirements for: ▪ management of areas of ecological significance (including sea grass beds) ▪ public access and use of the coast. The policy provides that where impacts from activities, structures and infrastructure cannot feasibly be avoided, management actions are to be taken to reduce impacts and, where possible, rehabilitative actions are to undertaken to ensure there is no overall loss of the impacted values. The mitigations proposed by the technical chapters in Part B and the environmental management actions proposed in Part C provide a detailed basis for the minimisation of adverse impacts. The *State Policy for Coastal Protection* seeks to ensure that tenure decisions for state coastal land (including reclaimed land such as the PEP) do not result in the loss of public access to or use of coastal land or the foreshore. Exceptions may be made where there is an over-riding need in the public interest or to establish or support a public benefit asset. Factors for determining over-riding need in the public interest include: ▪ the overall social, economic and environmental benefits of granting the tenure outweigh the conflict with the policy outcome ▪ the activity for which the tenure is to be granted cannot be located elsewhere so as to avoid conflicting with the policy outcome. The application of this part of the *State Policy for Coastal Management* will apply at the time POTL formally applies for tenure of the Project Area. The EIS addresses the range of social, economic and environmental impacts that the *State Policy for Coastal Management* seeks to avoid or mitigate. The PEP is an integral part of the port's overall expansion and its future in servicing North Queensland and is unable to be effectively located elsewhere. The PEP is not significantly affected by the *State Policy for Coastal Management* in terms of foreshore access effects. The PEP is an extension of the existing port facilities, which already restrict foreshore access. The PEP will not lead to any further restriction of foreshore access.

SPP Name	Key Characteristics	Application to PEP
Temporary SPP 2/11: Planning for stronger, more resilient floodplains	This SPP ensures that development in floodplains is compatible for the flood regimes that are experienced. The SPP provides basic code assessment provisions for assessable development and envisages that provisions that are more detailed will be incorporated into new planning schemes as they are developed or where major amendments are to occur.	The PEP is not expected to significantly contribute to or be affected by existing fluvial flood levels due to its location in the marine environment, beyond the mouths of the Ross River and Ross Creek. This aspect is addressed in detail in Chapter B2 (Water Resources).
SPP 3/10: Acceleration of compliance assessment	Compliance assessment is an expedited level of assessment that is to apply to certain forms of reconfiguring a lot from one lot into two lots in industrial and residential areas.	This SPP does not apply to uses associated with the PEP. This includes future subdivision of land where such creation of title is undertaken through the provisions of the *Land Act 1994.* Any such subdivision of land is generally not defined as assessable development under the provisions of SP Act.
SPP 2/07: Protection of extractive resources	This SPP is for the protection of key resources areas (KRA) identified for their extractive materials including rock quarries. The SPP provides assessment criteria for development in and adjacent to KRA buffer areas.	SPP 2/07 does not directly affect the development of the PEP. The PEP will use significant amounts of quarry material during its construction. POTL has its own approved quarry facilities at Graniteville Road, Pinnacles (on the western outskirts of Townsville) for amour rock used for seawall and revetment construction. The quarry is not a listed KRA. Extraction of material from the quarry will not adversely affect the operation of other quarries in the area in terms of the provisions of the SPP.
SPP 1/03: Mitigating the adverse impacts of flood, bushfire and landslide	This SPP considers physical constraints to development due to bushfire, flooding or land instability.	Based on the PEP's location in Cleveland Bay, it will not be significantly affected by or affect flooding in Ross Creek or Ross River. The PEP is not in a bushfire or land slip prone area. Flood impacts are assessed in Chapter B2 (Water Resources).
SPP 2/02: Planning and managing development involving acid sulfate soils	SPP 2/02 identifies ASS as significant impact constraints to development and environmental protection. Assessment criteria are provided for assessable development in locations that are likely to be affected.	SPP 2/02 applies to the assessable development as part of the PEP and is discussed in Section B.1.3.1.
SPP 1/02: Development in the vicinity of certain airports and aviation facilities	This SPP affects development in proximity of listed airports to ensure that aviation safety is not compromised.	Townsville Airport and surrounding areas are subject to the SPP. The form of development represented by the PEP (i.e. primarily reclamation and ground-based operational works) is not considered by the SPP. Land development for the PEP will consider certain safety requirements, which may include use of safety clearance lighting for tall structures. The SPP is not expected to affect significantly the nature of the PEP.

B.1.2.2.3 Regional Planning Policies

Non-statutory regional policies that are relevant to the PEP and the Port and Townsville include:

- *Queensland Regionalisation Strategy 2011* (DLPG, 2011b)
- *Queensland Infrastructure Plan 2011* (DLPG, 2011a)

- *A Second Capital for Queensland – Townsville Futures Plan 2012* (TFPT, 2011)
- *Northern Economic Triangle Infrastructure Plan 2007-2012* (DI, 2007b)

There are no statutory regional plans that affect the PEP or the surrounding area. The *North West Regional Plan* (DLPG, 2010)is a statutory regional plan that affects the North West Region of Queensland (i.e. the local government areas of Mount Isa, Cloncurry, McKinlay, Richmond and Flinders). Although it has no direct statutory relevance to Townsville or the port area it may indirectly influence outcomes for the Project.

These plans are described in more detail below.

Queensland Regionalisation Strategy

The *Queensland Regionalisation Strategy* recognises the importance of minerals and agricultural exports to the state and the key role that Townsville plays as a focal point for the state's minerals corridor, energy corridor, tropical expertise, Tourism and agriculture. The Port of Townsville was identified as one of Queensland's key ports with (export) tonnages in excess of 5 Mtpa. POTL has estimated that tonnages during the 2010/2011 financial year reached 11 Mtpa, which is expected to more than double to 25 Mtpa by 2015/2016. Apart from facilitating trade, the Port is also about to provide a significant contribution to the region's tourism trade with the redevelopment of Berth 10 for passenger cruise ships.

Queensland Infrastructure Plan

The *Queensland Infrastructure Plan* identifies key infrastructure provision priorities for Queensland. The Port of Townsville is recognised by the plan as 'a high priority, with its proposed expansion opening up Townsville to a higher level of national and international shipping services' (DLPG, 2011a). The plan identifies opportunities for port expansion with an indicative investment amount of $500 million expected between 2011 and 2015.

A Second Capital for Queensland – Townsville Futures Plan

The *Townsville Futures Plan* is a broad-based, non-statutory, strategic planning document for Townsville that describes a vision for the city. It seeks to build on Townsville's comparative advantages and accommodates economic and population growth in its regional, social and economic spheres of influence to realise its vision for Townsville as the 'Second Capital for Queensland'. The plan identifies a range of strategies that are intended to deliver economic prosperity, liveability and sustainability outcomes to accommodate economic and population growth by focusing on:

- infrastructure and services
- business and innovation
- people
- lifestyle
- image and marketing
- leadership and decision-making.

The importance of the port is recognised in maintaining economic prosperity for the region as well as ensuring that Townsville continues to develop into a vibrant and liveable city through good urban design, well-integrated land uses, and maximising functionality and amenity of urban areas.

The plan identifies the need for rejuvenation of the CBD through good urban design and maintaining its integration with The Strand. Key requirements to add to the overall amenity of the area include preserving cultural and recreational benefits, and historic buildings, and promoting the creation of improved access to interesting public places. The plan provides state endorsed planning and community development principles that are reflective of the state's growth management objectives for Townsville and the region. Many of these principles are also encapsulated in the TCC *Land Use Proposal* for its new planning scheme.

Northern Economic Triangle Infrastructure Plan 2007-2012

The *Northern Economic Triangle Infrastructure Plan 2007-2012* establishes directions for economic growth and development of the region bounded by Mount Isa, Townsville and Bowen. This growth was focused on the extensive mining activity in this region and its need for support services in the key identified towns. The vision is:

> *To foster sustainable economic, social and community development and growth through the emergence of Mount Isa, Townsville and Bowen as a triangle of mineral processing and industrial development over the course of the next half century.*

Key strategic objectives are:

- provide access to competitively priced and reliable energy in North West and North Queensland
- exploit the rich mineral resources of North West Queensland
- plan for long-term integrated efficient development with transport and port infrastructure providers
- plan large-scale land and industrial precincts that are 'investor-ready'
- integrate the activities of the triangle's economic centres
- develop sustainable regional communities.

Specific strategies and actions that affect the port include:

Strategy 11: Protect the integrity of the Port of Townsville as the major gateway to North, North West and Far North Queensland by adoption of the *City-Port Strategic Plan*

Action 11.1: Adoption and implementation of the *City-Port Strategic Plan* to guide development to achieve an effective and sustainable interface between Townsville's port area and the adjacent city area

Strategy 12: Ensure future development and efficient operation of the Port of Townsville by adoption and progressive implementation of the *Port of Townsville Master Plan*

Action 12.1: Adoption and progressive implementation of the *Port of Townsville Master Plan* to drive appropriate redevelopment, rationalisation and expansion

Action 12.2: Continue to support transport routes including the Townsville Port Access Road (TPAR) between the Bruce and Flinders highways and the Port of Townsville

The expansion of the port is identified as a key factor for the realisation of the trade potential that exists for minerals predominantly from the North West and the North East Minerals Provinces. Although the PEP has undergone some design modification since its conception, the original PEP concept plan has been recognised in the Northern Economic Triangle Infrastructure Plan.

North West Regional Plan

The North West Regional Plan is the regional planning document that must be considered when making land use planning decisions in the Flinders, Richmond, and McKinlay, Cloncurry or Mount Isa council areas. The plan recognises that '… mining for base metals in the region has the potential to produce state-wide social and economic benefits for decades to come'. Strong communities are regarded as a key objective of the plan. Key values include:

- maintaining stable populations
- access to education and learning opportunities
- social planning and social infrastructure
- provision of social services
- maintaining regional lifestyle, cultural heritage and arts
- promoting health and wellbeing
- leadership, networks and coordination.

Increased trade potential in base metals and other minerals from the region through PEP infrastructure is expected to provide greater revenue and investment into the North West, which is expected to be a catalyst for the realisation of many of the objectives and values of the plan.

B.1.2.2.4 Local State-Based Frameworks and Statutory Policies

Local, state-based frameworks and policies affecting land use near the port include:

- *Townsville City – Port Strategic Plan*
- *Development Scheme for the Townsville State Development Area*

Townsville City – Port Strategic Plan

The *Townsville City – Port Strategic Plan* is a non-statutory plan prepared by the Coordinator-General in 2006, which provides planning outcomes for the integration of the port and its expansion with the surrounding urban area. It includes consideration of transport management issues and forms much of the basis for the construction of the TPAR through the TSDA and across Ross River to service the port's growth needs.

Development Scheme for the Townsville State Development Area

The *Development Scheme for the Townsville State Development Area* (TSDA Development Scheme) provides the statutory controls for material change of use development applications in the TSDA. The Development Scheme is administered by the Coordinator-General and includes code provisions that are considered in the assessment of such applications. The TSDA has been established by the state government to provide land that is suitable for heavy industrial development, well serviced by heavy transport routes and associated infrastructure, and separated from residential areas.

The TSDA Development Scheme identifies a number of land use precincts specifically intended for heavy and other industries that are able to integrate with and compliment port activity. These precincts include:

- heavy industry: recognising existing large-scale industrial development in the region and protecting it from incompatible encroachment from other development
- transport industries and medium industry: recognising existing or proposed Department of Transport and Main Roads infrastructure and associated planning for the area and to enable industry to maximise industry advantage from heavy transport services and proximity
- low impact and light industry: to encourage further light industry and warehousing expansion in Townsville in a manner that takes advantage of the port and other transport proximity while ensuring that adverse encroachment from other industries does not occur
- materials transportation and services corridor: provision of a dedicated route for heavy road transport and key trunk infrastructure (i.e. water, gas, electricity and sewer) and for incorporation of rail when required
- buffer/restricted development: to provide additional protection to heavy industry against other incompatible development through physical separation and to provide areas where flora and fauna may continue to exist in their natural state
- investigation area: to recognise areas suited for continued use for waste water disposal, polishing, recycling and irrigation, and their potential for long-term use for low-key industry and related activity
- open space: to recognise areas that are subject to ongoing environmental rehabilitation works.

B.1.2.2.5 Local Land Use Planning Frameworks and Statutory Policies

Port of Townsville Port Development Plan 2010-2040

This plan provides the overall strategic direction for the port's growth and includes the expansion of its northern area, which generally includes the Project Area. The plan will be amended to more accurately reflect the final outcome of the preferred reclamation, surface infrastructure and berthing arrangements once planning and assessment for the PEP has been finalised.

Port of Townsville Land Use Plan 2010

The Port of Townsville Land Use Plan 2010 (Port Land Use Plan) was prepared pursuant to the provisions of the *Transport Infrastructure Act 1994* and approved by the Minister for Transport and Main Roads. It is the statutory land use plan that affects development on strategic port land.

The Port Land Use Plan identifies strategic port land, proposed strategic land (i.e. land to be designated as strategic port land through the consultation process undertaken for the preparation of the Port Land Use Pplan) and future strategic port land (i.e. land identified as being required to accommodate planned future expansion). The Port Land Use Plan also references the applicable planning codes and guidelines for assessable development and criteria that determine self-assessment for proposed development on strategic port land.

The Port Land Use Plan currently identifies the PEP as future strategic port land. A strategic port land designation makes any development on such land exempt from the provisions of any local planning instrument and makes the port authority (i.e. POTL) the assessment manager under the provisions of SP Act. Strategic and proposed strategic port land is shown in Figure B.1.5.

The Port Land Use Plan contains planning objectives and strategic outcomes that form the basis for detailed controls. The strategic outcomes are categorised according to six key themes, which are summarised in Table B.1.2.

Table B.1.2 Port Land Use Plan 2010 – Strategic Outcomes

Theme	Strategic Outcomes
Land use pattern	▪ Grouping of core port activities into zones and precincts ▪ Protecting the viability of current and future uses from incompatible uses ▪ Ensure that new development supports and does not conflict with land use patterns identified through zones and precincts
Nature conservation	▪ Continue interaction with Commonwealth, state and local authorities to protect environmental values adjacent to the port ▪ Compliance with Commonwealth and state legislation and relevant SPP ▪ Implementation of environmental management plans through the development process to ensure environmental quality is protected ▪ Continual improvement of POTL's environmental policies and practices to reduce environmental impacts of growth ▪ Review of developments, including expansions and major maintenance projects, to ensure they meet appropriate environmental criteria and reduce impacts on lands and waters under POTL's jurisdiction ▪ Promotion and incorporation of sustainable environmental management into POTL's planning, development and operation
Economic development	▪ Grouping of compatible land uses to achieve synergies and economies to maximise existing and planned infrastructure ▪ Maintain the port's role as a key economic generator for the community and the region ▪ Development to increase economic opportunities at the port and promote the port as a 'gateway' for trade throughout the world ▪ Development to optimise the use of, and return on, strategic port land ▪ Promotion and incorporation of sustainable environmental management into POTL's planning, development and operations
Community identity and diversity	▪ Continued cooperation with TCC, relevant state authorities and adjacent residential and commercial communities to reduce adverse impacts ▪ Reduce amenity impacts from development (including, but not limited to noise, light, odour, dust and stormwater) ▪ Provision and maintenance of buffers between port facilities and adjacent urban development ▪ High standard of design that incorporates good site layout, building design, landscaping and sustainability principles

Theme	Strategic Outcomes
	▪ Management, protection and conservation of Indigenous cultural heritage management areas by traditional owners and other Indigenous groups through cultural heritage management plans ▪ Cooperation with port users (port community) to assist them to comply with security and safety requirements for the operation of the port
Infrastructure and services	▪ Ongoing strategic planning based on available data to provide for infrastructure needs for future development ▪ Development is sited in locations that can economically provide and maintain essential infrastructure ▪ Maximisation of port facilities use ▪ Consolidating development in well serviced precincts and the provision of ongoing maintenance of infrastructure ▪ Preparation of plans to obtain fair/equitable contributions during the development process towards the provision of infrastructure
Access and mobility	▪ Ongoing cooperation with the Department of Transport and Main Roads, Queensland Rail, QR National, TCC and other relevant authorities to proactively plan and cater for a coordinated transport system that protects and enhances the operation of the port ▪ Reduce the social and environmental impacts associated with transport systems development and operation ▪ Expansion and maintenance of the port's internal road network ▪ Integration of development with the road and rail Eastern Access Corridor route from the port, through the TSDA to the Bruce and Flinders highways

The strategic outcomes are facilitated through land use zones identified by the Port Land Use Plan. There are five land use zones:

- port operations
- port industry
- marine industry
- special use
- port buffer.

The land use zones for the port are shown in Figure B.1.4. The PEP is to be located adjacent to port industry zoned land. The purpose of the port industry zone is to cater for a wide range of industrial uses that directly support the import and export of cargo, and handling, storage and transportation of cargo. It is anticipated that once tenure of PEP land has been obtained and the land has been incorporated into strategic port land, it will adopt a zoning that is commensurate with existing zones for similar port activity as is anticipated for the PEP.

PORT EXPANSION PROJECT EIS

Port Land Use Zones

Figure B.1.4

Legend

- The Strand
- Railway Line
- Stage 2 Allignment Proposed Rail Corridor
- Townsville Port Access Road
- Project Area
- Townsville State Development Area

Port Zoning 2011-2012

- Marine Industry
- Port Buffer
- Port Industry
- Port Operations
- Special Use

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000 Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_017

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery - Port of Townsville 2011.
Strategic/Proposed Port Land - Port of Townsville Land Use Plan
Stage 2 Allignment Proposed Rail Corridor - AECOM 2012
Townsville Port Access Road - AECOM 2012

PORT EXPANSION PROJECT EIS

Strategic Port Land

Figure B.1.5

Legend
- The Strand
- Railway Line
- Townsville State Development Area
- Proposed Strategic Port Land
- Strategic Port Land
- Future Strategic Port Land

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000
Metres

PROJECT ID 60161996
LAST MODIFIED CFS 05-Oct-2012
FILE NAME 60161996_PLN_016

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery - Port of Townsville 2011.
Strategic/Proposed Port Land - Port of Townsville Land Use Plan

Townsville Community Plan 2011-2021

The *Townsville Community Plan 2011-2021* provides the TCC vision for the community based on key values identified in the plan and summarised under four themes:

- strong, connected community
- environmentally sustainable future
- sustained economic growth
- shaping Townsville.

The plan is an overarching, community-led framework for the council's strategic and statutory decision-making with respect to development. It is intended that the council's new planning scheme, once it is completed, will reflect the broader community values of the Townsville Community Plan. The plan recognises sustainable economic activity as being of strategic importance to Townsville's future and, in so doing, provides the port with a complementary strategic framework for its expansion and facilitation of trade (TCC, 2011a).

Townsville City Plan 2005

The *Townsville City Plan 2005* is the local planning scheme that currently applies to development on land around the port that is not on strategic port land. The planning scheme applies to the area that was previously the TCC area prior to its amalgamation with the City of Thuringowa in 2008. Although the port is recognised in the *Townsville City Plan 2005* for spatial recognition purposes and to identify relationships between development that the council has jurisdiction over and strategic port land, the planning scheme provisions have no direct effect on development on strategic port land under s. 287 of the *Transport Infrastructure Act 1994*.

Desired Environmental Outcomes

The planning scheme has a number of desired environmental outcomes addressing economic vitality, infrastructure and services, transport and mobility, health and safety, sense of place and community, equality and equity, environmental management, heritage and character, and settlement patterns. The desired environmental outcomes are used as the basis for other more detailed planning controls that are reflective of defined planning districts with different planning precincts.

Planning Districts

Planning districts form logical larger planning units within the planning scheme boundary (i.e. the previous TCC area). Four planning districts may be influenced directly or indirectly by the PEP (Figure B.1.6). The port is depicted directly a part of (or abutting) District 1 (Townsville City Centre). The depiction is used to identify the port's relation to adjoining land uses; however, the provisions of the planning scheme do not apply to strategic port land. The districts that are likely to be influenced by the PEP are assessed in greater detail below.

- District 1: Townsville Central City

  The Townsville Central City District represents the main CBD area to the west of Ross Creek and that part of South Townsville that is north of Boundary Street on the eastern side of Ross Creek. Key locations in the district that are likely to be influenced by or have an influence on the PEP include:

  - the Palmer Street tourist and entertainment area that is located adjacent to the port on the eastern side of Ross Creek
  - the Breakwater (Peninsula) Marine Precinct located on the western side of Ross Creek
  - South Townsville
  - port land (including the Townsville Marine Precinct located along the western foreshore of Ross River).

  Overall planning outcomes for the district are identified by the planning scheme to include:

  - maintaining the primary focus of centralised employment, economic, cultural, community, tourism, recreational, commercial and entertainment activities of Townsville
  - mixed-use development

  - maintenance of balance between North Queensland character while transforming other parts of the city into pleasant and distinctive environments
  - protecting green space values
  - promoting passive recreation and effective pedestrian, cycle and public transport access through the CBD.
- District 2: Townsville Inner Suburbs

  Key locations in District 2 that are likely to be influenced by the PEP include North Ward, (including The Strand) and Railway Estate, which is located immediately to the south of South Townsville.

  Overall planning outcomes for the district include:

  - the maintenance of the predominantly residential character of the district for residents' and visitor accommodation
  - residential housing diversity
  - maintenance of existing housing architectural character
  - provision of commercial facilities and services in designated centres that reflect their commercial hierarchy status
  - safe and attractive living environments
  - protection of open spaces areas
  - accommodation of high quality intensive residential development along parts of The Strand
  - maintaining the historic significance of the Jezzine Barracks and Kissing Point areas.
- District 6: Stuart

  District 6 includes the TSDA, which is subject to its own development scheme and is not subject to the provisions of the planning scheme for any material change of use decision. Other forms of development are subject to the planning scheme provisions. The district also includes sensitive environmental areas along the Cleveland Bay foreshore and along Ross Creek, which are important for nature conservation and recreation purposes.

  Overall planning outcomes for the district include:

  - development as a core industrial area while maintaining protection of core environmental conservation areas
  - limiting residential development to Cluden
  - retail development only as an ancillary component of industrial development
  - protection of existing waste water treatment facilities from incompatible development
  - protection against inappropriate development in areas affected by potentially adverse coastal processes.
- District 8: Magnetic Island

  Magnetic Island represents its own district and has a number of settlements, including Horseshoe Bay, Arcadia, Nelly Bay and Picnic Bay. Nelly Bay represents the main tourist area on the island and is the location for the main ferry terminal, the tourist core and significant marina-side apartment based development. With the exception of the settlements, most of the island is in a natural state, with steep forested terrain consisting of dry tropical forest and some rainforest-like pockets of vegetation.

  Overall planning outcomes for the district identified by the planning scheme include

  - continuation of residential development only in established village areas
  - protection of the natural landscape and habitat values
  - recognition and protection of the island's heritage and historic buildings and facilities

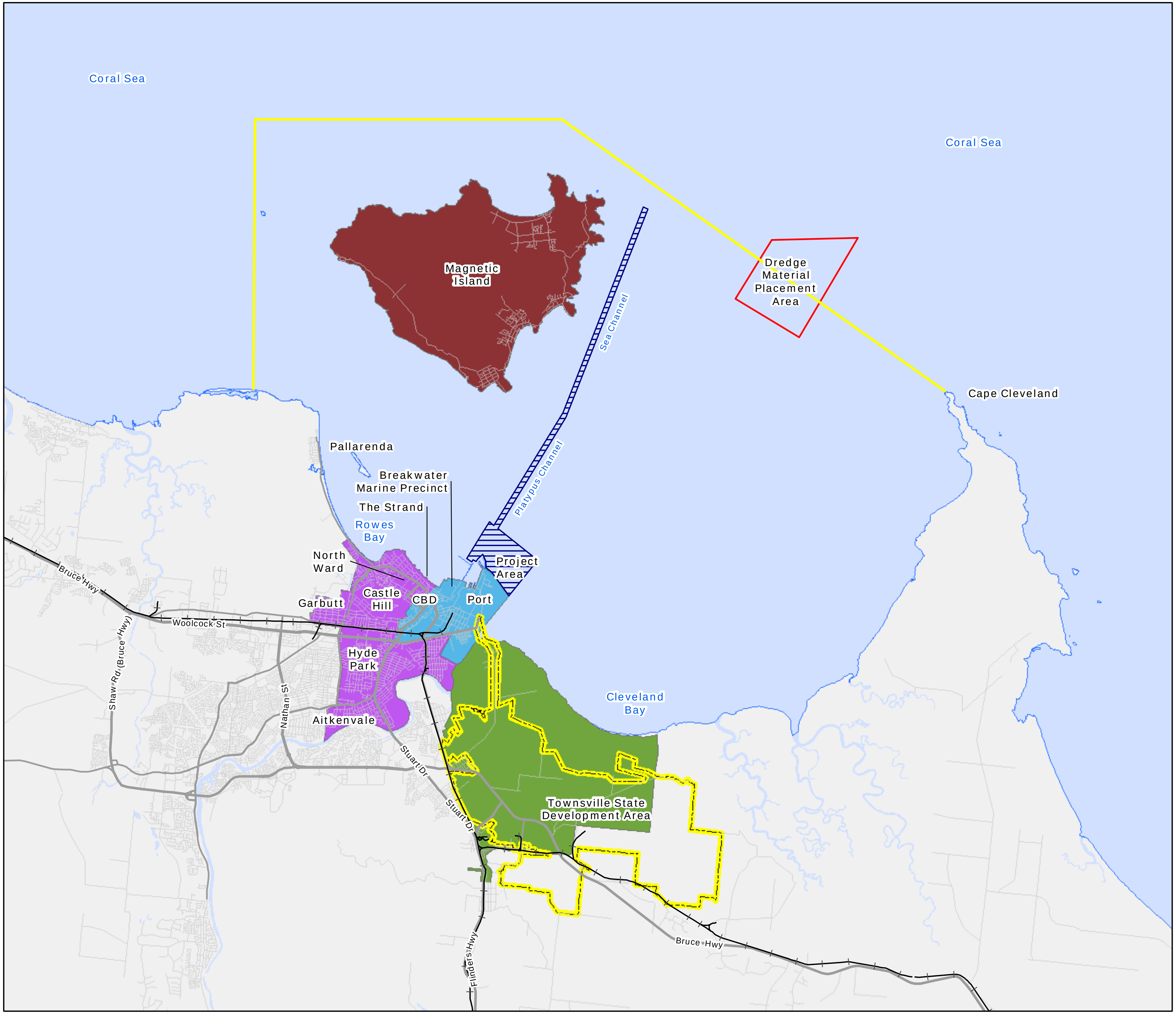
- protection of the world heritage values of Magnetic Island and the Great Barrier Reef
- provision of a variety of accommodation experiences and choices.

Planning Precincts

Each planning district is affected by a range of planning precincts that act as land use zones. The planning precincts identify different levels of assessment for development, an overall precinct outcome, and specific outcomes for different aspects of development, acceptable solutions and assessment code provisions. Districts share the range of precincts that are identified by the planning scheme. The planning precincts provide a guide as to the type of land uses that are considered acceptable, as well as precinct code provisions to control the form of development and provision of services. The precincts are summarised in terms of their planning intent for the location in Table B.1.3 and shown in Figure B.1.6.

Table B.1.3 Townsville City Plan 2005 Planning Precincts Affecting Land in the Vicinity of the PEP

Precinct	Planning Intent Based on Precinct Specific Outcomes
CBD business core	Primarily accommodates offices for business, administration and business support services, together with mixed-use residential and tourist accommodation.
CBD retail core	Primarily for retail outlets (including major department stores, comparison and convenience shopping), restaurants and arts and craft centres, together with entertainment uses (such as wine bars), and mixed-use residential and tourist accommodation.
CBD entertainment core	Indoor recreation (other than cinemas), museums, art galleries, hotels, bars, pinball parlours, restaurants, markets, tourist facilities, mixed-use residential and tourist accommodation, including backpackers hostels, (particularly on upper levels), boat charter and ferry terminal facilities.
CBD tourist core	Quality restaurants, art and craft centres, museums/cultural heritage, entertainment uses and mixed-use tourist accommodation, motels, multiple dwellings and hotels.
Breakwater	Marina facilities and medium to high density residential development, mixed tourist activities, entertainment and dining facilities supporting the marina.
Cultural centre	A variety of community and cultural services such as theatres, cultural facilities, galleries and studios, Townsville Cultural Centre.
Education, heritage and business park	University or other educational establishments and complementary commercial functions including knowledge based business activities and supporting retail activities.
Neighbourhood centre	Primarily relates to North Ward Shopping Centre with smaller centres in Railway Estate and on Magnetic Island. Intended for small-scale shopping centres servicing their immediate area with some mixed residential and commercial uses.
Centre frame	Intended for offices, service industries, shops, child care centres, places of worship, and the like including uses that complement the CBD and other nearby centres requiring larger sites, generate higher traffic volumes but do not need a centre location.
Business and industry	Small-scale, light industry to service the needs of the surrounding community (such as sales or hire yards, service industries, storage or contractors' yards and the like), business support services servicing the surrounding area and dining and eating facilities to service workers in the locality.
Traditional residential	Primarily for detached houses on individual lots. Non-residential uses serve their local neighbourhood.
Neighbourhood residential	Primarily for low to medium density residential development and uses directly servicing residents.
Mixed residential	Residential development of a wide variety of urban housing forms ranging from detached houses and dual occupancies to multiple dwellings and accommodation buildings.
City view slopes residential	Stanton Hill and Melton Hill for residential development, which is consistent with the topography and visual prominence of this location.
Medium density residential	Capitalises on the precinct's proximity to Ross Creek and the wide range of amenities available in the city centre.
Rural	Agricultural related uses and existing low intensive uses of land. The precinct only relates to the Stuart location, which forms part of the TSDA.
Community and government	A variety of community and social services such as educational establishments, hospitals or major utilities.
Not subject to planning scheme	Denotes locations that are not subject to the provisions of the planning scheme.
Green space	Primarily accommodate parkland and recreational activities and ancillary structures.



PORT EXPANSION PROJECT EIS

Townsville City Council Planning Scheme 2005 - Planning Districts Influenced by the PEP

Figure B.1.6

Legend

- Highways
- Main Roads
- Minor Roads
- Local Roads
- Railway Line
- Port Limits
- Townsville State Development Area
- Dredge Material Placement Area
- District 1 - Townsville Central City
- District 2 - Inner Suburbs
- District 6 - Stuart
- District 8 - Magnetic Island

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8
Kilometres

PROJECT ID 60161996
LAST MODIFIED CFS 05-Oct-2012
FILE NAME 60161996_PLN_119

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Townsville City Council Planning Scheme 2005 - Planning Districts, derived from Townsville City Plan Maps - TCC 2012

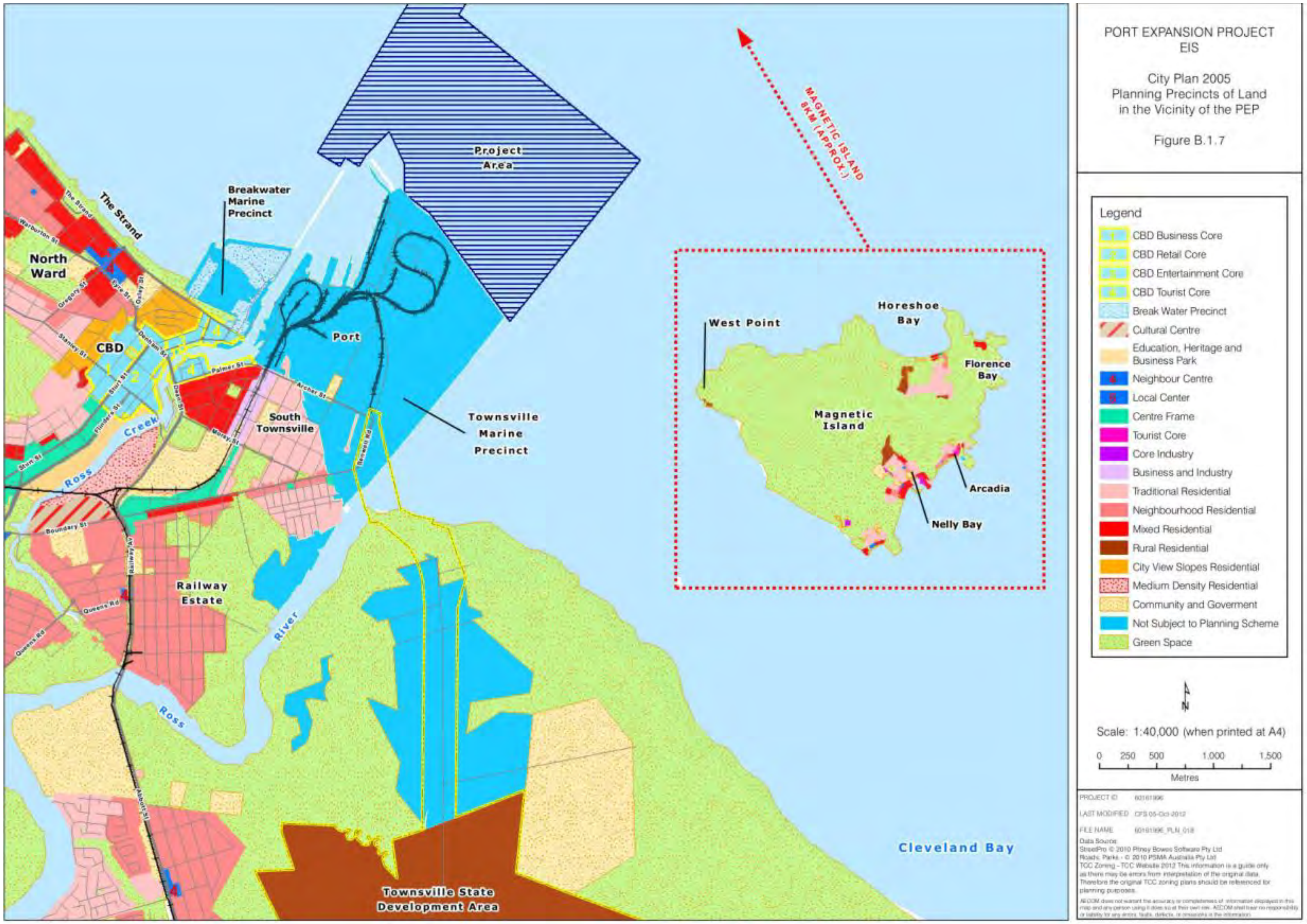


Figure B.1.7 City Plan 2005 Planning Precincts of Land in the Vicinity of the PEP

Draft Townsville Land Use Proposal 2011-2032

The *Townsville Land Use Proposal 2011-2036* (TCC, 2011b) has been prepared by TCC to provide the strategic intent for its new planning scheme and help inform consultation. The Townsville Land Use Proposal identifies key land use themes, strategic outcomes and policies to be accounted for in the preparation of the new planning scheme. The key themes and strategic outcomes are shown in Table B.1.4.

Table B.1.4 Townsville Land Use Proposal Themes and Proposed Policies

Theme	Strategic Outcomes Overview
Shaping Townsville	▪ The promotion and development adherence to a hierarchy of planned centres ▪ Accessible and affordable lifestyle and housing opportunities ▪ Containment of residential development in designated areas ▪ Recognition and protection of the cultural heritage of Townsville ▪ Provision of efficient reliable and safe passenger and freight transport networks to support the city's population and economic growth ▪ Efficient provision of infrastructure
Strong, connected community	▪ Protection and enhancement of community character in urban and rural areas of Townsville ▪ Protection of architectural, cultural, scenic, natural, social or spiritual qualities of places ▪ Accessibility to community services and facilities ▪ High quality open space provision ▪ Urban design that reinforces community spirit and identity
Environmentally sustainable future	▪ Conservation of natural values for future generations ▪ Retention and restoration of habitat areas and corridors for biodiversity protection ▪ Waterways and wetlands are protected from development to maintain water quality and water health' ▪ Protection of coastal land ▪ Minimisation of risk to people and property from natural hazards and climate change ▪ Reduce impacts of development on the natural environment
Sustaining economic growth	▪ Economic and employment growth through identified centres and precincts of core economic activity, including the CBD, the major industrial areas, the Port of Townsville, the Townsville Airport and knowledge precincts around the university and hospital ▪ Industrial activity in identified industrial areas and with timely release of land and efficient provision of services and infrastructure ▪ Facilitation of more efficient transport networks through clustering of activities and employment in defined centres ▪ Development adjacent to extractive and other resource areas does not prejudice their continued use ▪ Establishment of tourist accommodation and attractions in approved locations to reduce conflict with surrounding uses

The port, the Stuart industrial precinct (District 6) and TSDA are recognised as being the city's key productive precincts for industry. These areas are seen as instrumental in enabling the city to maintain its quality of life and achieve economic growth. A specific outcome for industrial land in the plan is:

> *The existing and future safety and operational efficiency of Townsville Airport, Port of Townsville and Defence Land holdings are not fettered as a result of encroachment of potentially sensitive development.*

Strategies to protect the port and other major productive precincts include:

- the planning scheme will recognise these important institutions for their particular strategic and economic value to the community

- council will ensure that new development near these areas and the transport/freight routes that serve them is compatible with the physical and operational characteristics of the use
- new development will be required to be located and designed to reduce potential impacts
- the planning scheme will identify key component facilities and relevant operational areas or buffers (as appropriate) for the airport, DoD land and the port, and will avoid the introduction of more intensive development in these areas.

B.1.3 Existing Values, Uses and Characteristics

Existing values and characteristics of the area surrounding the PEP are described in the following sections:

- topography, geology and soils
- land contamination
- land use and tenure

B.1.3.1 Topography, Geology and Soils

B.1.3.1.1 Topography

The coastal topography near the port has a natural ground level typically between 0 and 3 m Australian height datum (AHD). The reclamation area, which presently forms part of the bed of Cleveland Bay, is immediately adjacent to Lot 601 on EP1802 and Lot 791 on EP2348. The port land that the PEP is to adjoin was previously reclaimed. To the south lies the mouth of Ross River, low sand dunes and tidal mud flats with mangroves close to shore.

The local topography is dominated by a coastal escarpment located 5 to 10 km inland from the coast, the narrow coastal plain and the estuaries of Ross River (south-east) and Ross Creek (west) (Golder Associates, 2012a).

B.1.3.1.2 Geology

The geomorphological history of the Townsville coastal plain is described in detail by Hopley (1970). He described the area, being situated below the escarpment in the hinterland, as consisting of younger coastal plain deposits formed through a combination of the redistribution of marine sediments and from the deposition of eroded hinterland escarpment deposits. These deposits are at their widest near the mouths of streams (e.g. Ross River and Ross Creek) and in the southern parts of Cleveland Bay.

Holocene outwash fans composed of leached white sands overly coarse water worn gravels. These largely uncemented deposits overlie much older Pleistocene fan deposits which at their landward end are presently being actively eroded by numerous short coastal streams and which contribute to contemporary coastal depositional within Cleveland Bay.

The Recent geology of landward deposits is complex consisting of a mix of Pleistocene and Holocene deposits including older reworked fluvial deposits resulting in a variety geomorphological features including incised deposits, old river terraces and elevated (stranded) river levees. Stream diversions are relatively common in the Recent geomorphological record. Deposits in watercourses consist primarily of sands and gravel.

Mangroves and salt marsh are not extensive along the coast. Mangroves are limited to the small creeks draining the beach ridge areas. Of the major streams, only the Bohle River [not the Ross] has extensive mangroves at its mouth. Salt marsh and salt pan are found behind the beach ridges in areas of formerly impounded tidal drainage. Some areas may have originated as small lagoons. These are most extensive in the south eastern part of Cleveland Bay. Beach ridges have built up along the entire coast, many of them showing distinct signs of developing as spits under the influence of a strong south to north littoral drift. The ridges are generally closely spaced and overlie a variety of deposits including little modified Pleistocene clay plain, mangrove muds, beach rock and unconsolidated gravels.

Parts of the Cleveland Bay tidal flats are also characterised by extensive coastal Chenier deposits. These consist of a range of materials including gravels, pumice, coral rubble and some vegetation matter and lie on top of the tidal deposits. They are thought to be primarily the result of much higher wave energy and elevated sea levels most likely during severe weather events including cyclones. Beach recession appears to be taking place along much, of this coast and the present shoreline truncates the trend of the older ridges. This is especially so just north of Rollingstone Creek where excellent sections in the ridges are exposed in a low cliff. The outer ridges have a core of shingle and coral fragments with a dune capping of about three feet.

Geological mapping information for Townsville (Tile 8259) (Trezise, Holmes, & Cooper, 1986) at a scale of 1:100,000 indicates that the near surface lithology in the vicinity of the Project Area comprises Quaternary-aged (Holocene) sediments including silt, mud and sand, described as coastal tidal flats, mangrove flats, supra-tidal flats saltpans and grassland. The underlying bedrock comprises Permian-age biotite leucogranite and microgranite (Golder Associates, 2012a).

In the dredge and reclamation areas, the geology/lithology encountered during seabed drilling comprised Holocene ‘surface’ seabed sediments (silt and clay with sand zones, ranging in thickness from 0.8 to 3 m), underlain by Pleistocene sediments (sandy clays, clayey sands and clays ranging in thickness from 2 to 4 m). Seismic analysis of the Project Area undertaken in 2008 and more recently in 2011 confirmed the presence of relatively shallow density (soft) sediments (implied as Holocene) generally matching the stratigraphy identified by the drilling programs conducted by Golder Associates (2008a) and GHD (2008b). According to the Golder Associates’ investigation offshore of the north-east boundary of the existing port land, bedrock is probably at least 16.5 m below the seabed.

B.1.3.1.3 Soils

General

Soils beneath the Project Area are sub-tidal marine sediments. The soil profile in the Platypus and Sea channels is broadly similar to that of the harbour and reclamation area. Along the Platypus Channel, prior to the 1993 dredging event, the reported surface sediment thickness generally ranged from 1 to 3 m. The soft surface sediments vary in thickness, but are relatively thin and are thought to arise from tidal and seasonal movement of the marine sediments. The underlying in situ material is generally comprised of very stiff to hard grey and brown sandy clay and medium to coarse grained clayey sand.

Geological information of the reclamation area and dredge footprint is presented in Golders Geotechnical Review Report (2012a) as Appendix F1, including specific depths of sediments (sections 5.2 and 5.3) and the suitability of dredged material for use as fill (section 6.2.3).

The terms of reference (TOR) specify that “*soils should be described and mapped at a suitable scale and described according to the* Guidelines for Surveying Soil and Land Resources *(McKenzie et al. 2008) and* Australian soil classification *(Isbell & CSIRO, 2002)*”. However both publications relate to describing the characteristics of *in-situ* soils which, although important considerations for terrestrial projects, are not relevant here given the project area is currently a marine environment.

Consideration of the engineering properties of the fill that will be imported to the project area is essential, to ensure the materials are suitable for conditions at the site (including tidal influence as well as capacity to support planned and likely future infrastructure). Such consideration will be/is typically undertaken during the preconstruction phase of the project, as the responsibility of the contractor.

Acid Sulfate Soils

The TCC ASS map (Amendment No. 2005, 15) (Golder Associates , 2012) indicates that the existing port land is located in a low-lying area (< 5 m AHD); therefore, mapped as potential acid sulfate soil (PASS).

An ASS investigation undertaken by Golder Associates in 2008, using the pH/pH_{FOX} screening method, demonstrated the absence of actual acidity and absence of PASS or excess buffering capacity, except in 4 of 31 samples. Overall, Golder Associates concluded that there is a low risk of PASS at some locations in the outer harbour and reclamation areas. Generally, the PASS layer corresponds with the Holocene deposits 1 to 3 m below natural surface, situated below lowest astronomical tide (LAT) and overlying benign Pleistocene sediments. The remainder of the PASS layer has excess acid neutralising capacity and this is the case for the Holocene layer as a whole.

Golder Associates (2008a) referred to selected boreholes (those nearest to the PEP) of a GHD (2008b) study to extend the 2008 data set for characterisation of the PEP reclamation area. The data set applicable for the Project Area includes samples from nine representative locations.

Results of the borehole programme and screening tests confirm the presence of moderate potential acidity, in excess of action criteria, in Holocene sediments from the dredge and reclamation areas. These sediments display characteristics typical of PASS (i.e. generally dark grey, saturated clays and silts). They do not display any actual acidity as the sediments were from below LAT. Stratigraphy obtained from boreholes and seismic analysis confirm that the Holocene layer is generally 1 to 3 m thick in the area to be disturbed and forms a consistent layer containing relatively uniform amounts of acid neutralising capacity from calcareous materials. A similar depth of Holocene sediments was identified by previous seismic analysis along the Platypus Channel. The depth of recent sediment has been reduced by dredging carried out in 1993 and recent cyclonic activity (confirmed by the recent seismic investigations), and now appears to be absent altogether (Golder Associates , 2012).

B.1.3.2 Land Contamination

B.1.3.2.1 Chemical Contamination

Activities identified as being likely to cause land contamination are listed as 'notifiable activities' in Schedule 3 of the *Environmental Protection Act 1994* (Qld). Common land uses that can cause contamination include chemical storage, fuel storage, and loading/unloading goods in bulk.

The following searches and reviews were undertaken to identify potentially contaminating activities near the Project Area that may adversely impact on the PEP.

- Environmental Management Register (EMR): a land use planning and management register. Land that has been or is being used for a notifiable activity, and about which DEHP has been notified, is recorded on the EMR. Twenty-nine lots near in the Project Area were searched for entry on the EMR; twenty of these were listed. Details of the properties listed on the EMR are presented in Table B.1.5. The register search indicated that other than Lot 791 which is the eastern reclaimed land and which is directly adjacent to the PEP, none of the land directly adjacent to or to be affected by the PEP is listed on the EMR. As such, there is no recognised risk to the Project from the notifiable activities on these properties.
- Contaminated Land Register: a register of 'risk' sites; that are proven contaminated land that are causing or may cause serious environmental harm. Land is recorded on the Contaminated Land Register when scientific investigation shows it is contaminated and action needs to be taken to remediate or manage the land. The register search found that none of the identified EMR listings are on the Contaminated Land Register.

Table B.1.5 Lots in the Study Area Listed on the EMR

Lot	Plan	EMR ID	Address	Notifiable Activity
430	EP1068	14025	Benwell Rd, South Townsville	Coal gas works
594	EP1758	14027	Benwell Rd, South Townsville	Coal gas works
11	T118191	14028	17 Archer St, South Townsville	Chemical storage
601	EP1802	14184	4001 Wharf Area, South Townsville	Petroleum product or oil storage
318	EP2024	14186	4001 Wharf Area, South Townsville	Petroleum product or oil storage
4	T118185	14218	78 Perkins St, Townsville	Petroleum product or oil storage
8	T118185	14219	78 Perkins St, Townsville	Petroleum product or oil storage
791	EP2348	28030	Benwell Rd, South Townsville	Chemical storage
578	CP896279	28524	Lennon Drive, Townsville	Chemical storage
10	SP130956	30445	94 Hubert St, Townsville	Coal fired power station
758	SP130956	30447	94 Hubert St, Townsville	Coal fired power station
5	SP143321	38478	6 Old Rifle Range Rd, Townsville	Hazardous contaminant
6	SP150574	41366	31 Archer St, South Townsville	Coal fired power station [1]
2	SP129182	41979	4001 Wharf Area, South Townsville	Petroleum product or oil storage
621	SP157595	42718	78 Perkins St, Townsville	Coal gas works [2]
169	SP164760	46171	Kricker St, South Townsville	Petroleum or petrochemical industries Petroleum product or oil storage
1	SP194928	67416	96 Hubert St, South Townsville	Service station
577	SP194928	67417	96 Hubert St, South Townsville	Service station
1	SP126611	78149	Ross St, South Townsville	Abrasive blasting

Lot	Plan	EMR ID	Address	Notifiable Activity
				Metal treatment or coating
				Waste storage, treatment or disposal

1 An amalgamation of Lots 6 SP143321 and 758 EP2331. Registered Notifiable Activity was determined through discussion with DEHP's Contaminated Land Unit.

2 An amalgamation of Lots 25 EP62, 87 EP320, 430 EP1068 and 621 EP1576. Registered notifiable activity was determined through discussion with DEHP's Contaminated Land Unit.

B.1.3.2.2 Unexploded Ordnance Contamination

Unexploded ordnance (UXO) represents a specific form of land contamination arising from any explosive ordnance (ammunition, bomb, grenade, torpedo, etc.) that has failed to function as intended. Explosive ordnance that has functioned yet contains residual explosive or chemical warfare agent is normally treated as UXO. Derelict or discarded explosive ordnance is also treated similarly to UXO.

As a result of military training and live firing undertaken by Australian and Allied Forces, there are many areas throughout Australia not controlled by the Commonwealth that may be subject to residual UXO contamination. Townsville has a significant Second World War history both as a staging point for Australian and Allied Forces campaigns in the Pacific region against enemy combatants and as a reported target from enemy fire and bombing raids. In accordance with Commonwealth policy, the DoD has undertaken to identify and record sites where there is potential for such contamination.

A review of DoD UXO online mapping (v4.0, June 2010) shows that no identified UXO affected sites are situated in the immediate vicinity of the Project Area. As such, there is no recognised risk to the Project from UXO.

B.1.3.2.3 Sediment Contamination

Existing contamination for nickel and lead has been identified for some of the marine sediment adjacent to the existing Berth 11. Chapter B5 (Marine Sediment Quality) assesses in detail the likely levels of existing contamination in the Project Area, the need for further detailed studies and testing to be undertaken, and plans for onshore and offshore grading of materials prior to dredging, handling and placement.

B.1.3.3 Land Use and Tenure

Land use and tenure describe the human patterns of activity and ownership that have been established and are likely to continue to change because of an area's growth and development. Land use and tenure characteristics are described in terms of:

- native title
- land tenure (port and non-port)
- land uses and facilities surrounding the PEP
- proximity to sensitive land uses
- proximity to environmentally sensitive areas.

B.1.3.3.1 Native Title

The area of seabed to be occupied by the PEP is presently unallocated state land which, although potentially subject to native title rights, it is not currently subject to any native claim or Indigenous land use agreements as indicated by the National Native Title Tribunal Vision Database (NNTT, 2008). POTL intends to apply for a perpetual lease for the reclamation area pursuant to section 24HA of the future provisions of the NT Act. POTL intends to further negotiate an ILUA with appropriate traditional owners at the time it seeks to create freehold title for the reclaimed land as is indicated in Chapter A.2.6.

B.1.3.3.2 Land Tenure

The existing land tenure for the port's strategic port land is identified by the *Port Land Use Plan* as principally freehold title with some perpetual leases. Strategic port land is for port related activity including land identified for buffer areas. Further liaison will be required between POTL and the DNRM regarding future tenure of the site once reclamation has been concluded.

Tenure issues are not expected to directly influence planning outcomes for the PEP. The creation of tenure associated with the PEP once land has been reclaimed will initially be undertaken through the creation of leases under the provisions of the *Land Act 1994* with due consideration to the NT Act. The creation of such leases generally is not assessable development under the SP Act and is enabled administratively by the Minister for Natural Resources and Mines. Creation of this form of tenure is subject to the provisions of the *Coastal Management Policy* and requires assessment against the objectives of the policy by POTL.

Figure B.1.8 shows the different classes of existing key land tenure of land around and including the port, including:

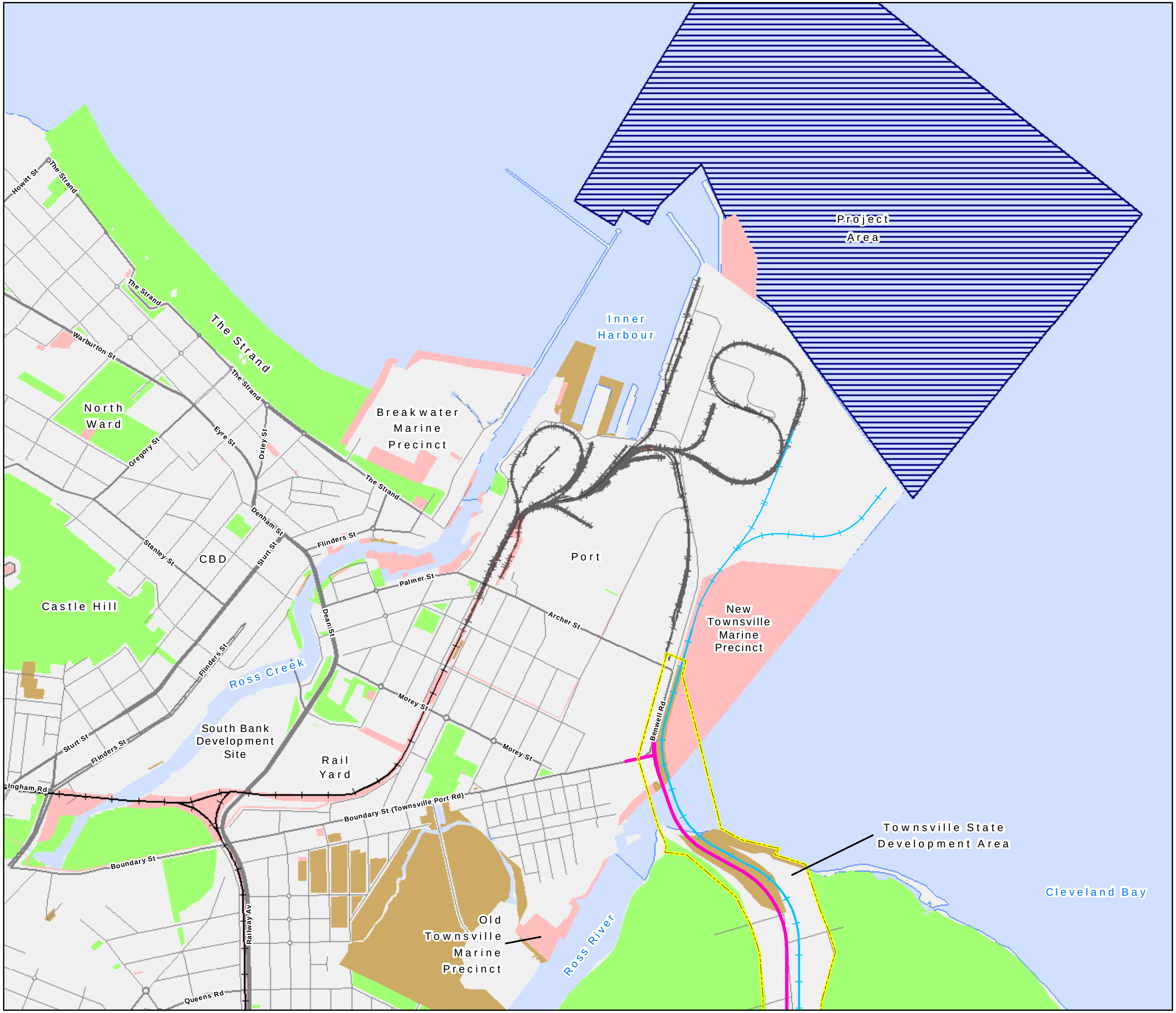
- freehold land
- state leasehold land
- reserves
- state land (i.e. unallocated state land and land that has been vested for a specific purpose).

As shown in Figure B.1.8, the majority of land near the port is freehold. Much of the land around the Port is fragmented into smaller, largely developed lots (i.e. primarily for detached dwelling houses with some medium density development dispersed throughout the area and high density residential development situated within the Palmer Street Precinct.

Some further development potential exists on sites within the Palmer Street Precinct for high density apartments with ground floor commercial/retail premises that primarily support a dining and entertainment function (i.e. similar to other development in the vicinity). Further mixed use development potential exists for land that forms part of the Southbank Development location. The Council has identified the Townsville Railyards and the adjoining Dean Park area to the north as a potential site for a sports stadium and entertainment/convention centre with some supporting short stay accommodation. This proposal is yet to undergo detailed feasibility studies.

Land tenure within the remainder of South Townsville is primarily reflective of the residential housing that characterises the area. Limited scope exists for any redevelopment of this land under its current land use zoning and due to the fragmented ownership patterns and small lot sizes. Although the land tenure patterns of the surrounding areas can, in principle, accommodate some further development, the scale and location of such development, as is contemplated under the Council's current planning scheme, is not expected to have any significant adverse effects on the PEP or port operations. Any future change in tenure or redevelopment of the Townsville Railyards is yet to be properly assessed by the Council including possible impacts on the rail access to the port which is expected to stay in the area regardless of the outcome for the railyard land and the potential inclusion of a new rail access to the port via the Eastern Access Corridor. Potential impacts of any future railyard development can be best assessed as part of a proper development assessment process, once details of any such proposal are known.

Figure B.1.8 shows that recreational reserves are generally located some distance from the port and are not likely to be adversely affected by the PEP. A large area of state land exists in Railway Estate, which is predominantly wetland and which fronts onto the Ross River. Part of this land is used for the Ross Island Army Barracks, which is DoD land. This area has no appreciable development potential due to its physical constraints and its DoD role. State land is also located around and as part of the TSDA to the east of Ross River. This is identified as environmental protection reserve land due to its coastal process constraints and environmental habitat values.



PORT EXPANSION PROJECT
EIS

Key Land Tenure for Land Surrounding and Including Existing Port Land

Figure B.1.8

Legend

- Main Roads
- Local Roads
- Railway Line
- Stage 2 Allignment Proposed Rail Corridor
- Townsville Port Access Road
- Project Area
- Townsville State Development Area

Land Tenure

- Freehold
- Lands Lease
- Reserve
- State Land

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000
Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_019

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Land Tenure - DERM 2012
Stage 2 Allignment Proposed Rail Corridor - AECOM 2011
Townsville Port Access Road - AECOM 2011

B.1.3.3.3 Land Uses and Facilities Surrounding the PEP

Port Land and Marine Areas

The PEP will be located directly adjacent to existing strategic port land and will become an integral part of the port's overall operations. Existing land use activity on strategic port land is consistent with the PEP. Shore-based internal infrastructure facilities, including road, rail and services, are expected to be connected to and integrated with the PEP during construction.

The port presently has nine operational wharves (Berths 1 to 4 and 7 to 11) characterised by a number of specialised facilities, including bulk handling facilities primarily for dry bulk cargoes. Berths are operated on a 7 days a week, 24-hour basis. The berths are generally operated on an exclusive or priority berthing arrangement and it is expected that a similar operating regime will be established for the PEP berths. The PEP will make a greater range of berths available and increase overall activity through greater capacity.

The overall operation of the port is based on the port providing core infrastructure for shipping and goods handling purposes. Lease and licensing agreements provide the operational basis by which individual companies obtain, usually long term, access to the port's facilities and by which cargo handling is regulated. Individual stevedoring companies also have and use their own cargo handling facilities and equipment.

Internal rail and road networks and navigational access are critical to the functioning of the port. Their efficiency is dependent on commensurate adequacy of access and capacity of external connecting infrastructure to and from the port.

Marine areas immediately adjacent to the port and the existing port access channels in Cleveland Bay form part of the port's pilotage area. Navigation restrictions apply to ships in the navigation channel or the harbour areas of the port. The PEP is not located in a currently active harbour area.

The marine area over which the PEP is to be reclaimed and constructed has specifically been identified for such a use in the *Port Land Use Plan*. The area forms part of the seabed of Cleveland Bay within port limits and is unaffected by any land use or marine zonings. The area is largely natural in its characteristics and is small relative to the overall area of Cleveland Bay. The marine ecology of the area, including habitat values, is discussed in detail in Chapter B6 (Marine Ecology).

The dredge material placement area (DMPA) is an existing approved facility in Cleveland Bay for the placement of dredge material from the port's harbour and channel areas. The location is not affected by any zoning provisions of the *Port Land Use Plan*, the TCC planning scheme or the GBRMP Zoning Plan. The DMPA does not directly affect land uses of nearby Magnetic Island nor unduly restrict use of Cleveland Bay other than through general navigation restrictions that apply when dredging operations are underway.

The Port also has land located on the Breakwater Peninsula on the western foreshore of Ross Creek. This land is the location for the existing passenger ferry terminal for services to Magnetic Island, Townsville's largest recreational boat ramp and the Volunteer Coast Guard, which are located on port land off Sir Leslie Thiess Drive on the western foreshore of Ross Creek. The use of this land for its present uses is not expected to be adversely affected by the PEP.

Cleveland Bay

Cleveland Bay forms an integral part of the marine backdrop for Townsville and provides the necessary setting for the safe harbouring of shipping, commercial and recreational fishing, and recreational boating. Ross Creek and Ross River play key roles in providing access for recreational and commercial fishing in Cleveland Bay and the Coral Sea and also provide for a range of boat accommodation facilities for Townsville including:

- marina facilities in the Breakwater Marine Precinct adjacent to Ross Creek, south-west of the port
- marina facilities as part of the Townsville Motor Boat and Yacht Club situated on Plume Street (near Palmer Street) on the eastern side of Ross Creek, catering for in excess of 160 boats ranging in size from 10 to 20 m and with a membership of over 500 people
- commercial fishing facilities situated in the Townsville Marine Precinct, which has commercial marina and slipway facilities located on strategic port land on the western shore of Ross River

- limited marina facilities for private vessels and private berthing facilities attached to residences at Nelly Bay on Magnetic Island
- recreational boat ramp facilities in the Breakwater Marine Precinct fronting onto Ross Creek and off Sixth Avenue in Railway Estate fronting onto Ross River.

Yachting is conducted on both an organised and informal basis. Organised races tend to be located westwards of the main shipping channel and do not rely on waters to be affected by the PEP. Pleasure boating is particularly focused around Magnetic Island, coastal estuaries of Cleveland Bay, nearby Halifax Bay and out to the reef areas of the Coral Sea.

Limited information is available regarding the levels of usage or preferred locations for commercial or recreational fishing in Cleveland Bay. The fisheries assessment prepared as part of the *Townsville Port Expansion Preliminary Engineering and Environment Study* (AECOM, 2009) identified that the area affected by the PEP has limited commercial or recreational fishery importance in the context of Cleveland Bay as a whole and identified the preferred locations for fishing. The map from the fisheries assessment is reproduced in the Chapter B6 (Marine Ecology).

- the key commercial fisheries operating in and around Cleveland Bay are trawl and net fisheries
- trawling operations are focused in the waters immediately north of Magnetic Island and, to a lesser extent, near-shore areas of Cleveland Bay (near the port) as well as waters north and east of Cleveland Bay
- administrative constraints exist on net fishing in Cleveland Bay due to the presence of a Dugong Protection Area, Great Barrier Reef zoning restrictions and a Declared Fish Habitat Area
- key species targeted by the net fishery are mainly pelagic fish that occur in open water
- inshore waters of Cleveland Bay are used heavily for recreational fishing
- recreational fishing is significant along the coastline of Cleveland Bay and Magnetic Island, in estuaries and creeks, and on inshore and offshore reefs
- seawalls in and around the port are popular recreational fishing locations
- fishing is valuable to Indigenous communities in Townsville and Magnetic Island, mainly occurring along coastal foreshores, estuaries and near-shore reefs
- soft sediment habitats have been extensively altered and simplified and may not retain particularly high values compared with more diverse habitats (this is assessed in detail in Chapter B6, Marine Ecology)
- key commercial and recreational fish species identified in the Sea Channel were mackerel and cobia
- the DMPA is part of a more extensive area in Cleveland Bay that has the recorded presence of tuna species
- there are no commercial species recorded in the PEP reclamation area other than some bream species along the outer extremities
- recreational fishing is known to occur immediately adjacent to the existing port in the PEP reclamation area.

General pleasure boating and yachting are key uses of Cleveland Bay. It was estimated in a local newspaper article in April 2011 that Townsville had in excess of 11,500 registered boats (Townsville Bulletin, 2011). Based on this figure, it is estimated that Townsville has a per capita boat ownership of approximately 6%. This compares with the peak body group, Marine Queensland, estimate for Mackay, which it states has the highest per capita boat ownership in Queensland of 12%, with 95% being trailer boats 8 m or under in length (MQ, 2012).

A study of vessel movements in and out of Ross Creek, conducted over a four-month period in 2011 for the port (GHD, 2011b) surveyed 733 vessels leaving Ross Creek. Of these, 66 (9%) travelled to the east or south-east after leaving the mouth of Ross Creek across the area to be occupied by the PEP reclamation. The remainder travelled either northward into Cleveland Bay towards Magnetic Island or to the west.

Greater Townsville Area

The port represents regionally strategic infrastructure that has and continues to play a significant role in shaping the settlement pattern of Townsville and in helping to consolidate the city's credentials as the major regional centre for North Queensland. The overall size of the port and its particular environmental and infrastructure needs has also led to land use planning that does not encourage incompatible development to be located in close proximity to the port, which has influenced the settlement pattern of Townsville over time by:

- assisting the consolidation of the existing CBD through its close proximity with this part of Townsville
- attracting and focusing heavy transport infrastructure (including rail and heavy road transport routes) onto the centre and the port's location
- attracting industry to and around the port
- contributing to the establishment of the TSDA
- facilitating trade for mineral processing facilities in Townsville, including the Sun Metals Zinc Refinery, the Xstrata Copper Refinery and the Yabulu Nickel Refinery.

The PEP is located near existing infill residential development areas centred on the CBD and North Ward and has ready access to major road networks servicing the rapidly growing greater Townsville region. This provides effective access to a range of residential locations for its potential workforce. The port is also ideally situated close to the yet to be developed Rocky Springs development area to the south of the city, which is approximately 15 to 20 minutes away by road. As Rocky Springs approaches its development phase, significant upgrades to the southern arterial road network centred on the Bruce Highway between Rocky Springs, the CBD and others parts of Townsville are planned by Department of Transport and Main Roads and TCC.

Other key land use areas in Townsville that the port is in close proximity to, in terms of vehicular access, include:

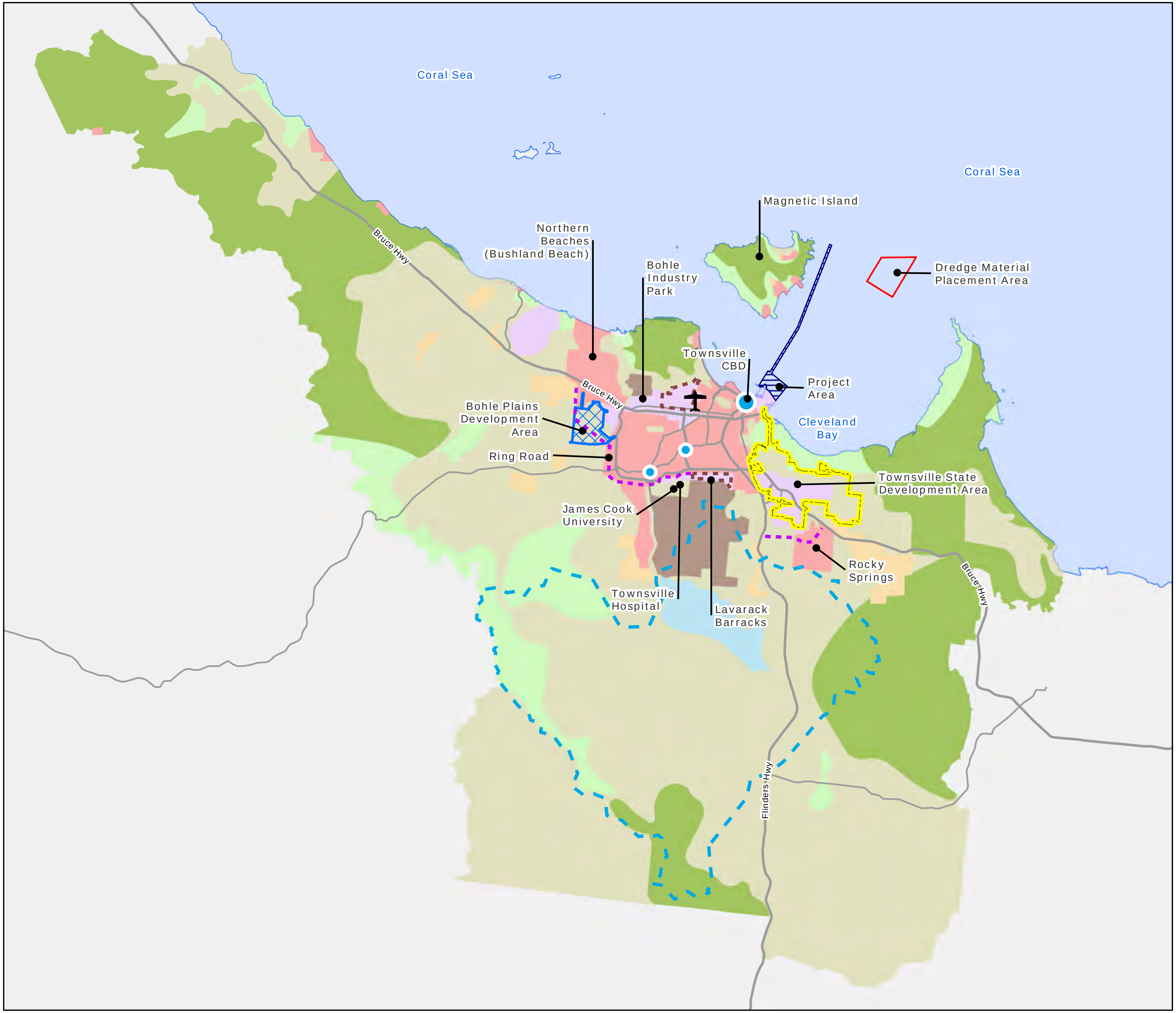
- the Bohle Industrial Area to the north-west (11 km from the PEP)
- the Garbutt Industrial area and the Townsville Airport (a key DoD airport with concurrent regional, interstate and international air transport roles for passengers and freight (approximately 5.5 km from the PEP)
- the TSDA (approximately 10 km from the PEP)
- James Cook University (approximately 13 km from the PEP)
- Lavarack Army Barracks, home of the Australian Army's 3RAR Squadron (approximately 11.5 km from the PEP).

The general settlement pattern for Townsville and the location of key land use areas is shown in Figure B.1.9.

PORT EXPANSION PROJECT EIS

Settlement Pattern of Townsville

Figure B.1.9



Legend

- Airport
- Primary Infill Area
- Secondary Infill Area
- Dam Catchment Area
- Major Defence Land Holdings
- Future Primary Public and Active Transport Corridor
- Critical Conservation Areas
- Major Defence Land Holdings
- Non-Urban Land
- Other Core Economic Activity Areas
- Protected Areas
- Rural Residential Areas
- Urban Area
- Waterbody

N

Scale:1:500,000(when printed at A4)

0 5 10 20

Kilometres

PROJECT ID	60242048
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60242048_PLN_005

Settlement Pattern Map was compiled from Map 1a. Townsville Settlement Pattern (Residential Strategy) map 30 Aug 2011, produced by Townsville City Council and Buckley Vann.

CBD

The CBD includes:

- Business Core centred on Sturt Street
- Retail Core centred along Flinders Street West
- Entertainment Core along Flinders East
- Tourist Core located at the eastern parts of Flinders Street adjacent to the Queensland Tropical Museum and Tropical Aquarium and along Palmer Street adjacent to the port.

The CBD is planned to consolidate its role as the main business centre for Townsville and North Queensland with significant further potential for increased office, retail and higher density residential development.

The Palmer Street CBD Tourist Core, near to the port, provides a stronger focus on tourist accommodation and entertainment than the remainder of the Central City Precinct. Land in the Palmer Street CBD Tourist Core has been developed with hotels, apartments and street-level retail development that are focused on selling meals and speciality stores. Adjacent land has been developed or has a number of approvals for high-density residential apartment development for short and long-term tenancies. The Townsville Motor Boat and Yacht Club, its marina on Ross Creek and the Maritime Museum also form part of the Palmer Street CBD Tourist Core.

The port has recognised the close proximity of the Palmer Street CBD Tourist Core and has ensured, through the zonings of the *Port Land Use Plan*, that only compatible port uses are located adjacent to this important area. Planned redevelopment by the port of the area between Berth 10A and Palmer Street is regarded as a key aspect of the port's continued aim to ensure that effective land use integration between port and non-port activities is achieved without adversely affecting its long-term trade potential. Future planned redevelopment between Berth 10A and Palmer Street is expected to replace older or unused industrial premises with modern commercial offices (i.e. notably for the port's new corporate facilities), integrated ferry facilities, car parking and landscaping. Pedestrian access between Palmer Street and Berth 10A will be accommodated along the foreshore and is expected to form a key feature.

Potential continues to exist for further redevelopment of land along the Palmer Street CBD Tourist Core with a number of development approvals for apartment based development yet to be acted on.

Breakwater Marine Precinct

The reclaimed land of the Breakwater Marine Precinct on the western side of Ross Creek is in close proximity to the port. The land is subject to an Act; the *Breakwater Island Casino Agreement Act 1984*. The area is the site of Jupiters Townsville Hotel and Casino (Jupiters) and the Townsville Entertainment Centre, which are located at the northern end of the precinct. Jupiters represents a key tourist attraction for visitors to Townsville providing controlled gambling, entertainment, dinning and accommodation experiences in close proximity to the CBD and Townsville marine setting.

The precinct also contains a commercial marina and a mix of medium and high-density residential apartments, with some small-lot single dwelling sites located adjacent to the Jupiters car park and on the Breakwater Peninsula on the western side of the precinct. Many of the house lots adjacent to Jupiters have direct private access to the marina. Further expansion of residential uses in the Breakwater Marine Precinct can only occur on the western side adjacent to Jupiters and on the seaward end of the Breakwater Peninsula. Both areas have development approvals for apartment-style development, which have not been acted on. Some existing house lots are also yet to be developed.

The area known as the Future Development Area (also locally referred to as the 'Duck Pond') that is immediately seaward to the north of the existing reclaimed land is subject to legislative provisions (i.e. contained in the *Breakwater Island Casino Agreement Act 1984*) that enable its future development to be considered through an EIS process. Previous consideration had been given by the Coordinator General to a proposed canal based residential development which also incorporated a cruise ship terminal. An in-principle agreement was given by the Coordinator-General for the development of this area subject to additional environmental management, design and infrastructure issues being resolved. The development has not proceeded and the cruise ship terminal plan has been superseded by the redevelopment of Berth 10A for the purpose of an ocean terminal. Any future significant development in the Future Development Area will be subject to environmental impact assessment under the existing legislation affecting the location. The Port is currently considering the utilisation of the Future Development Area as part of its Berth 10 Extension plans..

Existing residential development in the Breakwater Marina area is effectively screened from much of the Project Area through other uses in the precinct (i.e. Jupiters and the entertainment centre) and the port's inner harbour and existing facilities.

South Townsville

South Townsville is located south and directly adjacent to the port between Ross Creek and Ross River. It contains a mix of residential, industrial and commercial uses. Industrial development is focused on Perkins Street, which is adjacent to the existing rail connection into the port, Archer Street directly fronting the port, and along Boundary Street, which forms part of the main road access into the port and which will eventually connect with the TPAR. Some smaller scale and older established industries are located in pockets throughout parts of the residential areas, largely as existing uses.

South Townsville is one of Townsville's older established areas and is a recognised significant 'character precinct' area, which will be subject to specific provisions as part of the new planning scheme. The character largely reflects the older bungalow style Queenslander development of the late 1800s and early 1900s. The character of the area, its proximity to the CBD, the waterfront, and its historical association with the port as a place of employment, services and entertainment (i.e. for seafarers) has maintained its popularity as a place of residence. This interest is still strong and the area is continuing to be a much sought after area to live, with growing interest in the refurbishment and rejuvenation of its older buildings.

Major new private development is planned for land adjacent to Ross Creek, west of the rail yards, for mixed higher density residential development (i.e. Southbank development). The development site is separated from the PEP by existing residential and mixed industrial development in South Townsville, the Palmer Street Precinct to the north of the site, and the existing port to the north-east.

Boundary Street and Benwell Road form the existing, main road haulage route to the port. Boundary Street also connects with Railway Avenue, which leads south to the Bruce Highway. Land uses along Boundary Street are mixed, consisting of some general and other service industry uses (e.g. car repair centres) on its northern side closer towards its intersection with Railway Avenue and Saunders Street, and residences along its eastern extent with some businesses located amongst residences. Boundary Street is currently subject to high levels of road transport servicing the port. Although the road access is expected to continue to enable access to the west and north of the city, heavy vehicular traffic from the south and inland from the west is eventually expected to use the TPAR through the TSDA.

The main rail access to the port is presently located along Railway Avenue, through the Townsville Railyards and along Perkins Street into the port. The rail access is used to service the port with general cargo and mineral products from the North West Region and is expected to remain a key part of the port's supporting infrastructure. The rail link also plays a key role in providing access between the port and the Yabulu nickel processing plant on the northern edge of Townsville. As demand increases, provision has been made for additional rail infrastructure to be considered through the Eastern Access Corridor of the TSDA along the general alignment of the TPAR. This is expected to be supplemented through shared conveyor facilities for minerals handling and the like, which are expected to reduce, but not necessarily remove, demand for rail infrastructure in its existing location.

Stuart

The suburb of Stuart covers a large portion of land to the south of the Ross River and includes the TSDA. The TSDA consists of approximately 4,900 ha located to the south-east of the port. Currently it is largely undeveloped, other than the TCC water treatment and sewerage facilities and the incomplete TPAR, which will establish the main heavy road haulage route to the port via a bridge nearing completion over Ross River.

As demand dictates the areas that are not identified as being environmentally constrained and intended for environmental management purposes are expected to be developed for industry and other associated uses, including those that are dependent on closer proximity to the port. Potential uses range from heavy industry to warehousing and transport logistics. Although the original concept for the TSDA included scope for significant heavy industry (e.g. minerals processing), there is a degree of flexibility in the type of development that can be accommodated in the TSDA.

The development of the TSDA for industry (i.e. either heavy, light or for transport logistics) is consistent with the regional and local land use planning objectives for the area. The development of the TSDA and the expansion of the port are considered to be mutually complementary, with both having the potential of increasing the demand for each other and increasing trade and economic growth for Townsville and the region overall. The development of the TSDA will be subject to approval processes under the provisions of the *State Development and Public Works Organisation Act 1971*. This includes controlling provisions under a Development Plan for any material change of use development and under the council (i.e. for any material change of use) and under the SP Act.

Railway Estate

Railway Estate is located south of South Townsville. The suburb consists predominantly of older style residential development; mainly single dwelling houses with some multiple dwelling developments amongst the houses. Boundary Street forms the northern boundary of the location. Railway Estate is bordered to the south and east by Ross River and much of the area is low lying and subject to minor inundation during king tides. This situation places a significant constraint on the area's redevelopment potential.

Significant uses in this area include the Queensland Rail passenger station, Reid Park, which together with the surrounding area is used once per year as a racing car circuit, Townsville Civic Theatre situated on Boundary Street, and the Ross Island Army Barracks on the eastern side of the area fronting onto Ross River. Railway Avenue, being the current main southern road access connection to the Bruce Highway and the North Coast Rail Line, pass through Railway Estate.

Railway Estate is generally not regarded as being in close proximity to the port or the PEP; therefore, it has limited land use association with the port, other than Boundary Street being the main road transport link to the port and the North Coast Rail Line.

North Ward

North Ward is located to the north-west of the CBD on the seaward side of Castle Hill. The suburb consists of a mix of older style residential development and more modern higher density development closer to and along The Strand. The area has one of Townsville's more vibrant local centres along Gregory Street, which has a range of mixed-use businesses, retail including supermarket and speciality shopping, restaurants and pubs. The centre's close proximity to The Strand, which forms the seaward extent of the North Ward area, makes it a popular location not only for people who live in the vicinity, but also for visitors from elsewhere in Townsville and the region.

The Strand represents a regional passive recreational facility and is approximately 2 km long with park-landscaped pedestrian and cycleway, beaches, park and picnic facilities. The foreshore reserve is used for passive recreation, picnicking, civic celebrations and memorial gatherings, swimming (in netted swimming enclosures, two pools and a children's water park), cultural activities and markets, dining and entertainment and major sports events (e.g. staging location of marathon races). The Strand also incorporates the upper ANZAC Reserve, which is a major war memorial commemorating the Second World War. The park has a nationally significant remembrance shrine and hosts major memorial and other defence services and gatherings.

The Strand has a direct line of sight to the existing port and the PEP. Other than visual effects, there is no direct land use relationship between North Ward and the PEP. The visual significance of the PEP on the use of the surrounding area is considered in detail in Chapter B17 (Scenic Amenity and Lighting).

Magnetic Island

Magnetic Island is located north of the Port of Townsville in Cleveland Bay at the seaward end of the main Sea Channel to the port. The island is largely undeveloped with extensive vegetation cover. There is limited urban development centred on the small communities of Nelly Bay, Picnic Bay, Arcadia and Horseshoe Bay. This consists of residential dwellings, a range of tourist accommodation and marinas. Tourist accommodation is provided for through existing residences as short terms holiday lettings, managed apartment style units, hotel units (including luxury hotel accommodation at Nelly Bay) and backpacker accommodation at Picnic Bay, Nelly Bay, Arcadia and Horseshoe bay.

The primary mode of access to the island is via passenger and vehicular ferry from the passenger ferry terminal which is located on Port land on the western foreshore of Ross Creek and the vehicular ferry terminal situated directly opposite on the eastern shore.

Tourism on Magnetic Island is largely related to the recreational pursuits that the island offers to international and Australian visitors, overseas backpackers, in particular form a key part of tourist visits to the island. Tourism activities include: bushwalking, exploring the islands war history (i.e. bunkers, gun emplacements and observation posts), horse riding, picnicking, cycling and water sports (i.e. snorkelling, scuba diving, swimming, boating, and fishing). The island also acts as a key social hub for Townsville tourists and locals with a range of popular venues and organised entertainment events.

Development on Magnetic Island interacts with the port through the daily transport of passengers between the island and the mainland. The present ferry route directly passes the location of the PEP outer harbour.

B.1.3.3.4 Proximity to Sensitive Land Uses

There are a number of potentially sensitive land uses that are located in the Study Area. The sensitive uses relate to educational facilities for kindergarten, primary and secondary children and are identified due to their potential greater sensitivity to secondary effects from PEP activity during its construction and operation. This includes noise, emissions and traffic related effects due to port related heavy road transport and general increases in traffic. The uses that have been identified and their distance from the PEP are listed in Table B.1.6.

Predicted effects on social and amenity values, such as air quality, noise, vibration and visual, are given in Chapters B9, B10 and B17, respectively.

Table B.1.6 Sensitive Land Uses

Type of Use	Name of Use	Location	Approximate Distance from PEP (km)[1]
Child care centre, preschool/kindergarten	C and K Koolkuna Kindergarten and Preschool	South Townsville	2.5
	Townsville South Preschool	South Townsville	2.0
	South Townsville Primary	South Townsville	2.5
	Village Kids Children's Centre	Railway Estate	3.5
Primary school	St Josephs The Strand	North Ward	3.0
	Townsville Central Primary	North Ward	3.75
Secondary school	Townsville state High School	Railway Estate	4.25
	Townville Grammar School	North Ward	4.0
	St Patricks College	North Ward	2.75

1 Distances provided are direct distances from the landward side of the PEP (i.e. adjacent to existing port land) and have been rounded to the nearest 0.25 km.

The identified uses are well established in their present locations and serve a key role in providing services to the surrounding areas. The PEP will be located further away from the identified sensitive uses than existing port activities. Generally, most of the identified sensitive uses are located away from heavy road transport routes other than Townsville State High School, which is located on Boundary Street, opposite the Townsville Civic Theatre. This part of Boundary Street is a main arterial road for Townsville. The road experiences substantial traffic, which is not all directly attributable to port activity. Traffic characteristics of the area around the port are assessed in detail in Chapter B14.

B.1.3.3.5 Proximity to Environmentally Sensitive Areas

Cleveland Bay and its foreshore areas contain a number of statutory conservation areas:

- GBRMP
- GBRWHA
- dugong protection area
- fish habitat areas
- Bowling Green Bay Ramsar wetland

- Magnetic Island

Of these, only the Bowling Green Bay Ramsar Wetland and Magnetic Island do not directly affect the PEP, although Magnetic Island is in close proximity to the proposed deepening and extension of the northern end of the Sea Channel. The Sea Channel deepening and extension includes sections affecting the Habitat Protection Zone and the General Use Zone of the GBRMP as described in detail in Chapter A1.0. The nature conservation values of environmentally sensitive areas are discussed in detail in the marine ecology assessment in Chapter B6.

B.1.4 Assessment of Potential Impacts

Potential impacts caused by the PEP are assessed in terms of the following aspects:

- ASS
- potential land contamination
- surrounding land uses and human activities
- town planning objectives and controls
- development constraints
- management of land uses in immediate environments
- native title
- land use changes in areas of high conservation value
- proximity of key infrastructure services
- land units that require specific management measures

B.1.4.1 Acid Sulfate Soils

Dredging and excavation of Holocene sediment layers at the seabed's top stratigraphic layers could result in disturbance of PASS (Golder Associates, 2012a). Disturbed Holocene sediments in the outer harbour basin will make up only the top 12 to 14% of the total material excavated and are, on average, self-neutralising (even with a conservative lime fineness factor of 3.0). PASS is only of concern in the generation of sulphuric acid if sediments dry and/or are exposed to oxygen in the atmosphere.

It is not expected that adverse impact to the environment will occur, given that it is planned to place the dredged/excavated PASS Holocene material in the DMPA below LAT (Golder Associates, 2012a) or partly into the reclamation ponds where the material will be kept below LAT. This treatment of PASS material avoids exposure to the atmosphere and oxidation.

The PEP poses a generally low risk of adverse impacts from PASS, provided the management of the dredging, reclamation operations and placement of material in the DMPA is carried out in accordance with the *Construction Environmental Management Plan* (CEMP) in Part C.

B.1.4.2 Potential Land Contamination

B.1.4.2.1 Construction

A number of construction activities have the potential to impact on the existing port land and adjacent coastal waters. These include:

- spills of fuels/oil and other contaminants to ground from machinery
- spills of fuels/oil and other contaminants to water from machinery and marine vessels
- leaks or spills of hazardous materials and/or dangerous goods
- imported contamination in soil and/or fill material.

Due to the necessity to use plant and equipment for construction of the Project, incidents involving fuels/oil spills and other contaminants may cause soil contamination or enter the marine waters of Cleveland Bay. Appropriate siting of storage and handling areas and management of equipment and plant during construction will be incorporated in the CEMP to ensure that such risks are reduced and will be consistent with POTL's existing practices. The CEMP will also include procedures for the management and handling of fuel/oil storage to reduce the risk of incidents.

B.1.4.2.2 Operations

Land contamination issues arising during the operational phase of the PEP may include:

- machinery oil spills
- spills or leaks of goods/cargo (e.g. loose bulk products such as mineral concentrates; petroleum products, liquefied gases, flammable goods and chemicals or other hazardous wastes)
- general waste and debris.

The risk of such activities contaminating land in the PEP reclamation will be managed through the implementation of the *Operation Environmental Management Plan*, environmental licensing and incident management procedures.

B.1.4.3 Surrounding Land Uses and Human Activities

B.1.4.3.1 Port Land Uses

The PEP is a strategically planned extension of the existing port involving additional berthing, loading and other shore-based facilities to support industry and infrastructure. The additional industries and infrastructure have specialised requirements, including siting adjacent to berthing and loading facilities. Some industries also require close proximity to each other for operational and cost efficiency purposes. A general assessment of the PEP site relative to adjoining existing land has been conducted with consideration of a number of different parameters, including noise, dust, other emissions and effects on amenity, to determine the PEP's general suitability as a port facility for intended bulk cargo handling. The potential detailed impacts of future land uses and their operations will be influenced by the detailed design and operating characteristics of the uses and will need to be the subject of detailed assessment for material change of use approval, including for environmentally relevant activities purposes.

The location of the PEP, being seaward of the existing port facilities, reduces any direct adverse land use effects on properties adjoining the port. The PEP does not require any modification to existing land uses adjacent to existing strategic port land. Land use controls that are presently in the *Port Land Use Plan,* which are similarly expected to apply to the PEP, will enable land use integration with the port's other activities.

B.1.4.3.2 Surrounding (Non-Port) Land Uses

The PEP is not expected to lead to direct adverse land use effects on nearby development in view of its location away from such existing uses. The port has a history of co-existence with adjoining residential uses in South Townsville and Railway Estate. The suburbs were established and have largely grown in their earlier years because of port related activity. The rejuvenation and new development along Palmer Street, the development of the Breakwater Marine Precinct (including Jupiters Casino), the refurbishment of The Strand and additional development fronting the road and foreshore reserve have occurred in the presence of the port, largely in its present form, without adverse impact on the ability of those developments to proceed and without reducing their demand or usability. The PEP is not expected to lead to direct changes to this situation in terms of existing land use patterns. Potential effects on visual amenity from surrounding vantage points are assessed in Chapter B17.

Tourism activities, other than water sports are mainly contained on Magnetic Island, many of which do not have a view of the port and will not be visually affected by the Project. Tourism attractions that fall within viewsheds of the port are addressed in Chapter B17. Water sports and recreational activities around the foreshore of Magnetic Island will not be directly affected by the PEP during construction, operation and ongoing maintenance dredging. Channel dredging and extension works are to be located east of the island and will not affect water sport or recreational opportunities on the northern, southern or western foreshores of the island. The proposed channel dredging and extension of the Sea Channel will be located within the existing ship navigation area at least 1km from the eastern foreshores of Magnetic Island. This is outside the current areas that are used by visitors and residents of the island for water sports and recreational activities. Access to the sea channel will be maintained for all recreational boating at all times other than during dredging operations and subject to maritime navigation regulations. Impacts on fringing reefs and water quality surrounding Magnetic Island are assessed in Chapter B6 Marine Ecology and B4 Marine Water.

Potential adverse effects on land uses surrounding the port are likely to be indirect through possible dust, noise and vibration and road safety factors, which have been assessed in detail in Chapters B9, B10 and B14, respectively.

The development of the PEP will result in an increased workforce for the port (Chapter B19). This is expected to have a beneficial effect on local businesses in South Townsville and the Palmer Street Precinct, resulting in increased retail and entertainment trade for the areas.

Much of the industrial development in South Townsville has an association with port activity either in terms of direct trade or by supporting other larger businesses that trade through the port. The PEP will not affect the land use patterns of existing industrial development surrounding the port nor adversely affect the uses in a manner that would make them less viable or stop them from continuing. Beneficial effects on surrounding industries are likely to result from the PEP through the facilitation of additional port related industry and the need for local services.

The PEP will use the port's approved quarry at Graniteville Road, as well as other quarries in the Townsville area. The Graniteville Road quarry is not a listed KRA quarry under SPP 2/07 and will not adversely affect the operation of other quarries (KRA or otherwise). POTL is in the process of obtaining the required approvals for the quarry and will operate within the conditions of those approvals.

B.1.4.3.3 Cleveland Bay Uses and Facilities

Recreational fishing is an important activity for Townsville's residents, much of which is focused on inshore waters and along the coastline of Cleveland Bay and Magnetic Island. The PEP does not affect recreational fishing opportunities in areas other than:

- the direct footprint of the reclamation and harbour areas, including revetments and rock walls, during construction and operation
- the DMPA during its use.

Access to seawalls around the port is already restricted and the PEP will become a part of the port's restricted access areas. The PEP does not affect public access to existing accessible seawalls along Ross Creek or Ross River. The PEP reclamation area will replace some of the marine environment in Cleveland Bay, some of which is presently available for recreational and commercial fishing purposes. The area is small in the context of the overall size of Cleveland Bay and the diversity of areas that are available elsewhere in the bay and offshore areas. The PEP reclamation will not significantly alter or remove more highly valued fisheries in estuaries, creeks or offshore areas.

Change in near-shore marine habitat availability, which may also have an indirect effect on fishing opportunities are described in Chapter B6 (Marine Ecology). Fishing plays an important role in Indigenous communities. Fishing associated with Indigenous cultural activity is primarily undertaken along shorelines and inter-tidal areas in estuaries (e.g. Ross River). These areas are generally not affected by the PEP and no significant impacts are expected to result on Indigenous cultural fishing activity. Chapter B15 considers Indigenous heritage matters in greater detail.

Net fishing is controlled by regulatory constraints in Cleveland Bay due to the presence of GBRMP zones, a fish habitat area and a dugong protection area. The key species targeted by net fishers are pelagic, which occur in open waters, away from the shallow sub-tidal near-shore areas of the PEP.

The likelihood of potential adverse impacts on recreational fishing occurring is 'possible' although the magnitude will be 'negligible' over the time span of the PEP's operation with an overall risk rating of 'negligible'. The impact of construction and operation of the PEP on recreational boating and yachting is expected to have a 'possible' likelihood of concern to recreational boating users with the magnitude of the effects expected to be 'minor' with an overall impact risk of 'low' over time as people become used to the presence of the PEP. The PEP is likely to have the greatest effect on boating wishing to travel in a north-west direction from Ross River and south-east from Ross Creek. In general, the PEP is likely to increase boating travel distances from or to these locations by less than 1 km due to the seaward protrusion of the PEP.

The PEP is expected to have a beneficial impact in terms of providing additional wind and wave protection to waters at the mouth of Ross Creek during south-easterly winds and the mouth of Ross River during north-westerly winds. It is expected that boats heading north from either Ross Creek or Ross River will experience no appreciable increase in travel distance or time. The PEP will not limit yachting opportunities in Cleveland Bay including informal or formal races. Races tend to be held in the waters between Magnetic Island and the mainland, around Magnetic Island or away from Cleveland Bay and do not include the location of the PEP reclamation. Existing restrictions already apply to the DMPA when it is operational and the effect that this has on current boating activity is not expected to change.

The existing passenger and vehicular ferry services will generally not be impacted by the PEP, as it does not adversely affect the route of the established ferry services from Ross Creek seaward. A speed restriction of six knots will apply during the construction phases of the PEP to maintain safety due to the presence of construction vessel traffic. This is not expected to adversely affect ferry traffic as such traffic will generally be able to avoid construction vessel traffic by navigating westward of the Platypus Channel leaving Ross Creek once clear of the western Ross Creek Breakwater.

B.1.4.4 Town Planning Objectives and Controls

The PEP is identified as a key part of the port's planned growth and is consistent with the intent and actions of the *Queensland Regionalisation Strategy*. It will be a key driver in facilitating the strengthening of the regional economy through a strengthening of its connections to markets. The port and the PEP play a key role in growing trade potential for North Queensland and bringing about the beneficial realisation of this aim.

Strategically, the expansion of the port is recognised at the local planning level as being an important part of Townsville's growth, in terms of supporting other industries, services, trade with other markets and in generating employment, which also drives housing construction. The importance of the port is further recognised in that statutory planning controls of the council (i.e. *City Plan 2005*) ensure that only complementary or compatible development is allowed to occur adjacent to port land. The PEP ensures that no changes are required to the current planning directions of the TCC as a result of any direct land use related effects.

Chapter B14 (Traffic and Transport) identifies that some additional traffic will occur during PEP construction and operational phases. This is considered in the context of the Project life over 25 years. The highest levels of additional traffic are expected during Construction Stage D of the Project (i.e. involving completion of berth construction, estimated to be between 2030 and 2035).

The principal effects of increased traffic, including heavy traffic travelling to and from the port are expected to be along Boundary Street. The expected increase in traffic during peak periods due to the PEP is not expected to be greater than 8% at the intersection of Boundary Street and Benwell Road and less than 5% at the intersection of Boundary Street and Saunders Street. Although the PEP is expected to have an impact in terms of additional traffic, it is expected to take place gradually over a long period of time and the effects are expected to be difficult to separate from other non-port related increases in traffic. Overall, the use of the TPAR through the TSDA is expected to significantly ameliorate the effects of increases in heavy vehicle traffic by providing an alternative route to that which is currently used by vehicles along Boundary Street and Benwell Road.

The likelihood of adjoining land uses being impacted through PEP related heavy or other transport – as opposed to the general expected increase in traffic – is 'possible' with the impact expected to be no more than 'minor'. The overall impact is expected to be 'low'. The effects of traffic are considered more fully in Chapter B14 (Traffic and Transport).

Council's planning controls recognise the indirect effects from port activity, including potential adverse effects from increased road transport along Boundary Street. Potential exists for adverse impacts on adjoining residences to occur due to higher volumes of port traffic. This duration is likely to be only short term with traffic from the west and south expected to use the TPAR once it is opened in 2012. Boundary Street is expected to remain a key state-controlled road accessing the port even after the TPAR is opened.

Noise and vibration generated by any increases in rail traffic to and from the port and effects on surrounding land uses, in the longer term, are expected to be mitigated through the construction of the Eastern Access Corridor rail line once sufficient demand is established for the transport of bulk goods.

The council recognises the need for noise buffering adjacent to rail lines in its existing planning scheme. Similar provisions are expected to be incorporated into the new planning scheme. The likelihood of potential adverse impact on residences due to additional PEP-generated rail traffic is expected to occur gradually over the construction and commissioning period of the different phases of the PEP. The impact of rail on the existing network due to the PEP is expected to be negligible once the Eastern Access Corridor is established. Much of the PEP is geared towards catering for rail-dependent bulk goods. In the short to medium term, some additional impact along the existing rail network is 'possible' with the expected unmitigated additional impact estimated as being 'moderate', relative to the background level of impact of existing rail traffic. The overall risk of this unmitigated impact is 'medium'.

B.1.4.5 Development Constraints

The effects of physical constraints on the PEP, including flooding and storm surge are assessed in Chapter B3 (Coastal Processes). The PEP does not physically constrain other land uses in the area and it is not adversely affected by existing adjoining land uses. This is particularly due to the presence of the existing port between the PEP and other non-port related land uses (specifically those along Palmer Street and in South Townsville).

The PEP and the port are not likely to be adversely affected by redevelopment of land within South Townsville that is adjacent to the Port, including the Palmer Street Precinct and as is depicted in the CBD Master Plan, provided that the key transport haulage routes along Boundary Street, the TPAR and rail access corridor along Perkins Street do not experience intensification of development that results in significant numbers of residences which may lead to potential amenity conflicts as a result of the need to maintain port transportation needs. The *City Plan 2005*, identifies some land on the southern side of Boundary Street as Mixed Residential Precinct. Although this precinct type can in principle permit some higher density development, the planning scheme generally predicates that higher density development is not encouraged in this location. The importance of Boundary Street as a transport thoroughfare to the port in the future will require that further intensification of residential development is discouraged through appropriate zonings and controls in future planning schemes. The likelihood of further intensification of incompatible development under the existing zoning of land along parts of Boundary Street is 'possible' with the resultant potential impact being 'high'. The overall risk of this unmitigated impact is 'medium'.

The PEP is likely to have beneficial impacts for development of the TSDA through the generation of more trade potential; subject to supply of product and availability of markets. This is likely to increase the need for additional industrial land situated in close proximity to the port.

Strongly related to land use activity is the adequacy of infrastructure and services. Strong growth and development can place greater demands on available infrastructure networks and services. Much of the development of South Townsville, including much of the development of the Palmer Street Precinct, has relied on the continued augmentation of older infrastructure networks that are primarily provided and maintained by TCC or Ergon. Although this has proved adequate up until now, adequate strategic infrastructure planning is essential for the area, the PEP and the port as a whole to continue to grow and respond to changing demands. Without adequate infrastructure planning there is a risk that the PEP may either have:

- insufficient infrastructure capacity to connect to and be constrained until appropriate provision can be made
- unplanned additional Project costs where infrastructure needs have not been properly forecast.

Either of the above situations could not only cause Project delays and increased costs, but also conflict with other planned development in the area. The likelihood of this happening is considered to be 'unlikely' with 'high' consequences if either situation did occur. The overall risk of the potential impact is 'medium'.

B.1.4.6 Management of Land Uses in Immediate Environs

The environmental management of port land uses is initially undertaken through the strategic location of intended port uses so that they maximise the overall and long-term operational efficiency and reduce adverse effects on other non-port uses on adjacent land. These outcomes and controls are regulated through the *Port Land Use Plan*. Detailed control provisions are generally stipulated on development approvals and through a range of environmental licences. The use of land outside of the strategic port land occurs primarily through the TCC planning scheme. State planning controls relating to a range of environmental matters also apply to both areas.

The PEP will be located further away from non-port land uses, including residential development, than existing port development. Land use controls, once the PEP becomes strategic port land and is incorporated into the *Port Land Use Plan*, will at least be similar to the existing land use controls and will incorporate any changes in state requirements that may apply at the time. The PEP will also have a range of environmental management requirements that will apply to its construction and operation that are recommended in Part C to mitigate any potential adverse impacts.

B.1.4.7 Native Title

Section B.1.3.3.1 identified that there are presently no native claims that affect the PEP and no corresponding impacts in terms of any rights that are affected by the *Native Title Act 1993*. The PEP is presently unallocated state land and is subject to the native title provisions. Should a claim be lodged over any PEP land that is not to be converted to freehold title or before any proposed freehold land is converted, the claim must be processed by the National Native Title Tribunal and if the claim is accepted, an Indigenous land use agreement may need to be negotiated with the Traditional Owner claimants.

POTL has practices in place to ensure that close relationships with Traditional Owners and Indigenous representatives are maintained, so that Indigenous concerns can be understood and acted upon.

B.1.4.8 Land Use Changes in Areas of High Conservation Value

The PEP will result in a loss of approximately 100 ha of area due to reclamation works in the GBRWHA that covers Cleveland Bay, which also includes some dugong protection area. The likely impacts on areas of high conservation value, including habitats, flora and fauna, is discussed in Chapters B6 and B7.

B.1.4.9 Proximity of Key Infrastructure Services

The PEP will not adversely affect ferry operations in their current locality. The principal land use related impacts associated with infrastructure apply to indirect effects of potential increased heavy vehicle transport along Boundary Street and increased rail traffic. Some impacts are also expected to result on the need for additional water, sewer and electricity infrastructure as a result of additional demand generated from additional land use activity through the PEP. General ‘trunk’ infrastructure is planned for and facilitated through POTL’s *Priority Infrastructure Plan*, which also links closely to that of the TCC (i.e. water and sewer are provided through TCC trunk networks). The timeframes associated with construction and operation of the PEP are sufficiently long enough to enable effective strategic frameworks and plans to be put in place well in advance of any critical infrastructure requirements. This includes appropriate amendments to POTL’s *Priority Infrastructure Plan* to account for the PEP requirements and negotiations with council to appropriately amend its infrastructure plans.

The PEP will also enable POTL to give greater effect to its overall expansion plans and relocation of key port uses. This will include opportunities for improved separation of non-compatible uses and integration of other uses with existing networks including opportunities to provide for more effective public transport linkages to the port (presently restricted to the use of taxis only).

B.1.4.10 Land Units that Require Specific Management Measures

There are no land units that require specific management in terms of land use or tenure. Issues generally affecting land uses are indirect in nature and are dealt with through other chapters in the EIS. As an expected integral part of the port, the PEP will ensure that its planning controls align with the rest of the port as strategic port land and that this is achieved by inclusion into the *Port Land Use Plan* that is effective at the time.

B.1.5 Mitigation Measures and Residual Impacts

Mitigation measures and residual impacts are assessed for the following aspects of construction and operation:

- ASS
- land and sediment contamination
- land use and tenure

The proposed mitigation measures are summarised in Table B.1.7.

B.1.5.1 Acid Sulfate Soils

PASS are frequently present in Holocene alluvial soil on low-lying floodplains and in sheltered coastal seabed sediments. Work to date indicates the presence of low risk PASS at some locations in the dredge footprint and beneath the reclamation area. Generally the PASS layer in virgin marine sediments of the port expansion area is 1.0 to 3.0 m deep, situated below LAT and overlying benign Pleistocene sediments. The remainder of the PASS layer has excess neutralising capacity and this is the case for the Holocene layer as a whole.

While the risk from ASS during dredging and reclamation processes is low (as PASS material is planned for placement in the DMPA), an *ASS Management Plan* has been developed and will be implemented during and following the construction phase of the Project. The *ASS Management Plan* is in Appendix F2 (Golder Associates, 2012a).

B.1.5.2 Land Contamination

The potential impacts associated with contaminated land in the Project Area are minimal. The PEP will provide future port land and, as such, will be used for similar purposes to adjacent port land.

Construction and operational activities with potential to cause land contamination (e.g. some environmentally relevant activities) will need to obtain appropriate permits and licenses and comply with stringent state and other requirements regarding environmental management, monitoring and notification procedures. Secondary contamination risks due to chemical spills and leaks are also regarded as low. Mitigation for potential effects of Acid Sulphate Solis and spills and leaks during construction of the PEP are addressed separately in the Construction Environmental Management Plan (Chapter C2.2).

If a notifiable activity is undertaken on the PEP, the DEHP must be informed, in accordance with the *Environment Protection Act 1994*. DEHP will decide whether or not to list the land on the EMR. An assessment of PEP related impacts on marine sediments is provided in Chapter B5.

B.1.5.3 Land Use and Tenure

Land use and tenure impacts have been assessed to identify the need for mitigation for aspects including:

- surrounding land uses and human activities, specifically:
  - nearby(non-port) land uses
  - Cleveland Bay uses
- town planning objectives and controls
- development constraints
- environmental management of land uses
- land use changes in areas of high conservation value
- land units that require specific management measures.

Issues that have potential need for mitigation include:

- boating and yachting activity in Cleveland Bay: notably for vessels navigating from Ross River and Ross Creek potentially affected by obstruction to navigation resulting from the PEP's seaward intrusion
- residential and other sensitive land uses along Boundary Street: due to potential reductions in amenity and safety resulting from increases in heavy-haulage vehicle movements and which may warrant planning control changes (Boundary Street is a Department of Transport and Main Roads declared heavy vehicle haulage route and any land use controls under the council's jurisdiction are likely to require recognition of this designation and ensure that land use compatibility is maintained)
- residential and other sensitive land uses along the existing rail corridor to the port: due to potential increased noise and vibration resulting from increases in rail movements to and from the port until the Eastern Access Corridor is operational (incorporation of land use compatibility controls along rail corridors is a matter that forms a part of the state interest review process for draft planning schemes or scheme amendments).

There were no tenure impacts identified, other than the need to consider the presence of native title as new tenure is to be created over land being reclaimed for the PEP. No native title claims currently exist. Further native title searches will be undertaken prior to any proposal to change the tenure of the reclaimed land.

Mitigation measures concerning land uses primarily require:

- community awareness over the PEP's progress and any likely impacts or opportunities that this may have regarding the need for additional workers' housing or land and property for additional industrial or commercial development that is generated by port growth
- ongoing engagement with the TCC over its strategic and statutory planning for the surrounding area to ensure that:
  - the port is recognised as a significant land use of regional and district economic importance
  - controls are stipulated in the new planning scheme to strategically highlight the inappropriateness of land along Boundary Street for further intensification of residential development
  - strict development controls are included for any further development in Boundary Street to assess its relationship and impact on port activity, including transport needs
  - Boundary Street is subject to strict design and management development controls mitigating against potential noise and safety impacts for any development that is to proceed
- development and maintenance of a priority infrastructure plan for the port that ensure that its infrastructure needs are clearly defined and effectively integrated into the council's services for the future in a way that does not impede the port's growth potential and needs
- close liaison with the Department of Transport and Main Roads and TCC regarding transport planning and any related land use planning control needed for development along Boundary Street.

Table B.1.7 Potential Impacts and Recommended Mitigation Measures

Potential Impact	Unmitigated Risk Category	Mitigation Measures	Mitigated Risk Category
Effects of PEP on recreational fishing in Cleveland Bay	Negligible	▪ Provide ongoing awareness of current entry restrictions, available sites of shore-based fishing and POTL plans for maritime activity well in advance of undertaking any works, through POTL's website, newspaper advertisements and temporary signage at boat ramps in Ross Creek and Ross River as may be required.	Negligible
Perceived restriction to boating navigation to and from Ross Creek or Ross River	Low	▪ Provide ongoing awareness to boating community regarding stages for the PEP and potential effects on recreational and other boating into Cleveland Bay from Ross River and Ross Creek. ▪ Inform Townsville boating organisations, including the Townsville Motor Boat and Yacht Club and the Volunteer Marine Rescue, of PEP activity through regular information correspondence. ▪ Liaise with Maritime Safety Queensland for any construction activities that may require a Notice to Mariners.	Negligible
Adequate planning for infrastructure and integration with other providers (e.g. TCC, Ergon)	Medium	▪ Review of the Port's strategic trunk infrastructure needs and liaison with TCC to identify water and sewer needs, required capacity, integration requirements, cost, staging and potential funding. ▪ Continued engagement with council (i.e. through informal discussions and negotiations as well as formal submissions during any stakeholder consultation stages) in relation to the finalisation of the *Priority Infrastructure Plan* as part of the preparation of the council's new planning scheme and any subsequent amendments to ensure that the port's needs are reflected accurately and accounted for. ▪ Undertake early consultation with Ergon to ensure	Low

Potential Impact	Unmitigated Risk Category	Mitigation Measures	Mitigated Risk Category
		that adequate electricity planning and augmentation can occur in advance of PEP being ready to 'come online'.	
Amenity and safety of residences and other uses on Boundary Street due to increased transport and traffic	Low	▪ Continued engagement with Department of Transport and Main Roads and TCC over enhanced traffic management and traffic awareness as part of detailed development planning for the PEP through the implementation of the Road Use Management Plan for the PEP (Chapter B14). ▪ Update the Port Community Forum as required for any transport and safety issues.	Negligible

Future land use compatibility along Boundary Street	Medium	▪ Continued engagement and negotiation with TCC to ensure that planning controls included in its new planning scheme
		  ▪ identify the strategic importance of Boundary Street as access for the port
		  ▪ discourage further intensification of residential development in this location
		  ▪ stipulate strict development controls requiring an assessment of the likely impact on port development or its use
		  ▪ ensure the effectiveness of Boundary Street as a key transport route resulting from new development is not impacted
		  ▪ ensure the design and use of any new buildings to ensure that their amenity and safety is not adversely affected by port related road transport activity and that such development does not adversely affect the safe and efficient operation of the road network in the area; notably Boundary Street-Benwell Road.
			Low

Amenity at residences and other land uses along the existing rail corridor to the port in South Townsville Future land use compatibility along the alignment of the existing rail yards	Medium	▪ Monitor plans and timeframes for future access through Eastern Access Corridor. ▪ Encourage the establishment of a buffer zone either side of the existing rail corridor and the rail yards by the state or Council (i.e. as part of the Council's new planning scheme). ▪ Restrict further noise and vibration sensitive or other incompatible development and introduce design controls for the attenuation of external noise in new or renovated buildings. ▪ Update residents about any relevant changes to conditions associated with rail traffic due to PEP construction activity.	Low

B.1.5.4 Residual Impacts

Residual impacts are those impacts that remain after mitigation measures have been applied. Table B.1.7 identifies both the unmitigated risk categorisation and the expected residual risk from any impacts that are unable to be fully mitigated. In general, no land use related impacts are expected to have a residual risk categorisation greater than 'low' as defined in Section A2.4.

B.1.6 Cumulative Impacts

The PEP is a long-term project with its full development, at this stage, not expected to be reached before 2040. During that time Townsville is expected to grow its population by over 50% of its current population, which will result in considerable more demand for housing, including increased density in established areas, services and infrastructure capacity.

Cumulative land use impacts that are likely to result from the PEP primarily relate to the port, its operation and indirect impacts on other port land uses, including increasing demand for infrastructure and services. This will include port infrastructure for the loading and unloading of ships and water, sewer and power infrastructure. The demand for infrastructure is expected to grow as new and additional port industries seek to occupy space provided by the PEP, either directly on newly created PEP land or through the availability of other port land as a result of the integration process between the PEP and the existing port. This demand is also likely to impact council infrastructure as additional PEP development comes 'on line'. Demand will be influenced by the type of development that is proposed and the readiness of the port and the council to adequately accommodate the additional development in light of other demands that will occur between now and when the PEP is at its operational capacity.

The impacts of individual tenant proposals for reclaimed PEP land will be assessed separately by POTL, as assessment manager for development on strategic port land, using the provisions of the *Port Land Use Plan*. Individual developers will be required to address potentially adverse impacts through appropriate location of uses according to the *Port Land Use Plan*, design and operational requirements specified by *the Port Development Code* and conditions that must be met as part of further approvals. Approval conditions for environmentally sensitive activities may be issued by DEHP or TCC, depending on their jurisdiction as an assessment manager for such development, and DEHP as assessment manager for development outside of strategic port land that is not the jurisdiction of the council. The port and tenants also have the opportunity to negotiate infrastructure provision through lease arrangements. In all cases, close liaison and negotiation will be necessary with the TCC.

The PEP is expected to have beneficial cumulative land use impacts on the need for industrial land and industries that support trade activities. This is expected to be most noticeable for land within the TSDA.

B.1.7 Assessment Summary

Potential impacts and recommended mitigation measures have been summarised in Table B.1.7. Generally, the PEP is not expected to have any direct adverse land related impacts. The development is expected to be supported by other development in the area and region; therefore, it is expected to have a beneficial effect in the growth of other service industries and to support land uses as port activity intensifies and businesses establish within the PEP. Existing port land uses are not expected to be adversely affected by the PEP or its uses; the PEP forms an integral part of the port's strategic expansion and operation. The PEP and its bulk goods trading capability, once completed, will be a fully integrated feature of the port and its overall activity as North Queensland's largest multi-purpose port.

Some indirect adverse impacts that may have an effect on land uses surrounding the port have the potential to occur primarily if port related transport activity (both road and rail) intensifies along existing routes. Access to the port is along an existing state-designated heavy-haulage road route (Boundary Street and into Benwell Road). This is to be supplemented by TPAR through the TSDA, which is expected to take much of the current heavy road traffic from the west and south of Townsville. A detailed transport and infrastructure assessment has been undertaken in Chapter B14. The assessment includes recommendations regarding a the implementation of a Road Use Management Plan, which is expected to mitigate concerns regarding safety and the operation of heavy vehicles in the vicinity of the port. Other mitigation measures, which are aimed at maintaining effective community awareness have been proposed in Table B.1.7.

The rail line is an important part of the port's operation. It has been integral in enabling the port to effectively link with the hinterland of North Queensland and the north-west as the principal trade outlet. This has contributed to much of North Queensland's development and prosperity. The rail line to the port is expected to remain a significant feature of its ongoing operation, irrespective of the PEP. As the demand for bulk cargo increases, strategic recognition has already been given towards the eventual augmentation of rail infrastructure to the port through the Eastern Access Corridor, including the use of the TSDA for the handling of rail cargo. This would eventually lead to the reduction of the current dependence on the existing rail line as the only line servicing the port.

Indirect transport related impacts (including those from road and rail) are expected to primarily be related to noise, vibration and dust. The potential effects would primarily be on the amenity of nearby and affected residents. Table B.1.7 identifies appropriate mitigation measures that will reduce the level of risk from these indirect effects. Both Boundary Street and the existing rail line are expected to remain and play an important part in the port's development and use.

The future of the port as strategic infrastructure to service the region's growth and prosperity is heavily influenced by its effective connection to road and rail infrastructure that is able to meet the growing demands for trade and associated port expansion. Therefore, it is important that complimentary planning is undertaken by relevant authorities to ensure that otherwise sensitive or inappropriate development is not permitted to intensify along these routes and, where possible, to encourage existing development to adopt standards that will mitigate any existing incompatibility with transport related activities.

Uses and activities undertaken on Cleveland Bay that are most likely to be perceived as being impacted by the PEP are primarily related to recreational boating and fishing activity. The assessment has identified that fishing, including commercial fishing, is not expected to be significantly impacted as most of the activity is undertaken outside of the areas to be affected by the PEP. Impacts to recreational boating and access to waters that will be occupied by the PEP are expected to be negligible as access to the greater parts of Cleveland Bay and onwards into the Coral Sea will not be restricted. Harbour areas around the port, including areas that are to become part of the PEP reclamation area, are already restricted to the general public under POTL's *Security Plan*. This will continue to be the case during the construction and operational phases of the PEP. Recreational marine activity plays a major part of Townsville's attraction and social wellbeing; considerable public infrastructure investment has been undertaken for recreational boating activity (much of which is provided for on port land along Ross Creek and Ross River). The port has played an active role in facilitating recreational and other boating activity. It is recognised that many of the port's existing public engagement structures will continue to play a significant role in maintaining community awareness about the progress of the PEP, short-term effects that construction may have, and ways of improving boaters' safety and enjoyment.

Port Expansion Project EIS

Part B

Section B2 – Water Resources

AECOM BMT WBM

B.2 Water Resources

B.2.1 Relevance of the Project to Water Resources

This chapter addresses Section 5.1.1 and Section 5.6 of the *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement* and specifically describes:

- the surface water environmental values that may be affected by the Project, the potential impacts on water resources and its values and proposed management and mitigation measures;
- groundwater that may be affected by the Project, the potential impacts on groundwater and proposed management and mitigation measures.

Related Project aspects that are not addressed in the chapter are addressed in the following chapters:

- Chapter B3: Coastal Processes
- Chapter B4: Marine Water Quality
- Chapter B5: Marine Sediment Quality
- Chapter B6: Marine Ecology and Conservation
- Chapter B8: Climate and Natural Disaster Risks.

B.2.1.1 Methodology

B.2.1.1.1 Surface Water Assessment

The surface water assessment scope of work and methodology included the following tasks.

Desktop Review

- review of the relevant available surface water reports, data and information
- review of the draft environmental values and water quality objectives of the Ross River Basin
- review of the draft *Groundwater Guidelines for the Townsville Region (Black and Ross River Basins)*.

Flooding Assessment

A flooding assessment (*Townsville Port Expansion Project EIS: Flood Impacts Study)* was carried out by and is presented in Appendix G1. The study was undertaken to:

- quantify potential flood impacts on properties surrounding and external to the Project Area from redirection or concentration of flows
- identify likely increased flood levels, increased flow velocities or increased time of flood inundation as a result of the Port Expansion Project (PEP).

In *Townsville Flood Hazard Assessment* (Maunsell, 2005a), Phase 2, Volume 1 (for Townsville City Council), the catchment downstream of Ross River Dam was delineated and XP-RAFTS was used to simulate the hydrological response of the following major sub-catchments:

- Ross River local watercourse catchments (and Lower Ross River)
- Annandale and Douglas areas
- Gordon Creek
- Stuart Creek.

The XP-RAFTS hydrological modelling package was used as a numerical means to model watercourses and their catchments that route along the waterway. The catchments are represented by nodes that are inter-connected by links that represent flow paths. The model is able to predict flows for catchments containing both urban and rural land uses and takes into account for surface roughness, catchment slope, soil infiltration and depression storage losses. Output hydrographs from the hydrological models were incorporated into the hydraulic model as input to determine flood extents, water surfaces, water depths, flows and velocities for the 50 and 100-year ARI (average recurrence interval) storm events. Details of a flood assessment are provided in Appendix G1.

Hydraulic structures in the Study Area were represented using the 1D MIKE11 model elements that were coupled to the 2D MIKE21 grid to better represent the structures with respect to geometry and roughness. All major bridges and culverts along the Eastern Access Corridor and Stuart Bypass were added to the baseline model from as-constructed plans. The parameters used to determine the size and locations of the infrastructure were similar to the parameters verified during the development of previous design studies, including:

- Maunsell Australia Pty Ltd, *Townsville Industrial Land Suitability Study – Flood Modelling Assessment*, prepared for The Coordinator General (Maunsell, 2006)
- Maunsell AECOM, *Townsville Port Access Road Eastern Access Corridor Hydraulic Study* (Maunsell, 2008a).

To quantify potential flooding impacts of the Port of Townsville Limited (POTL) Port Expansion Project, the nature of flooding behaviour under baseline conditions was first determined. Potential flood impacts including changes to surface water elevations, flow velocities and times of inundation resulting from the Project were assessed by comparisons.

Water Quality Assessment

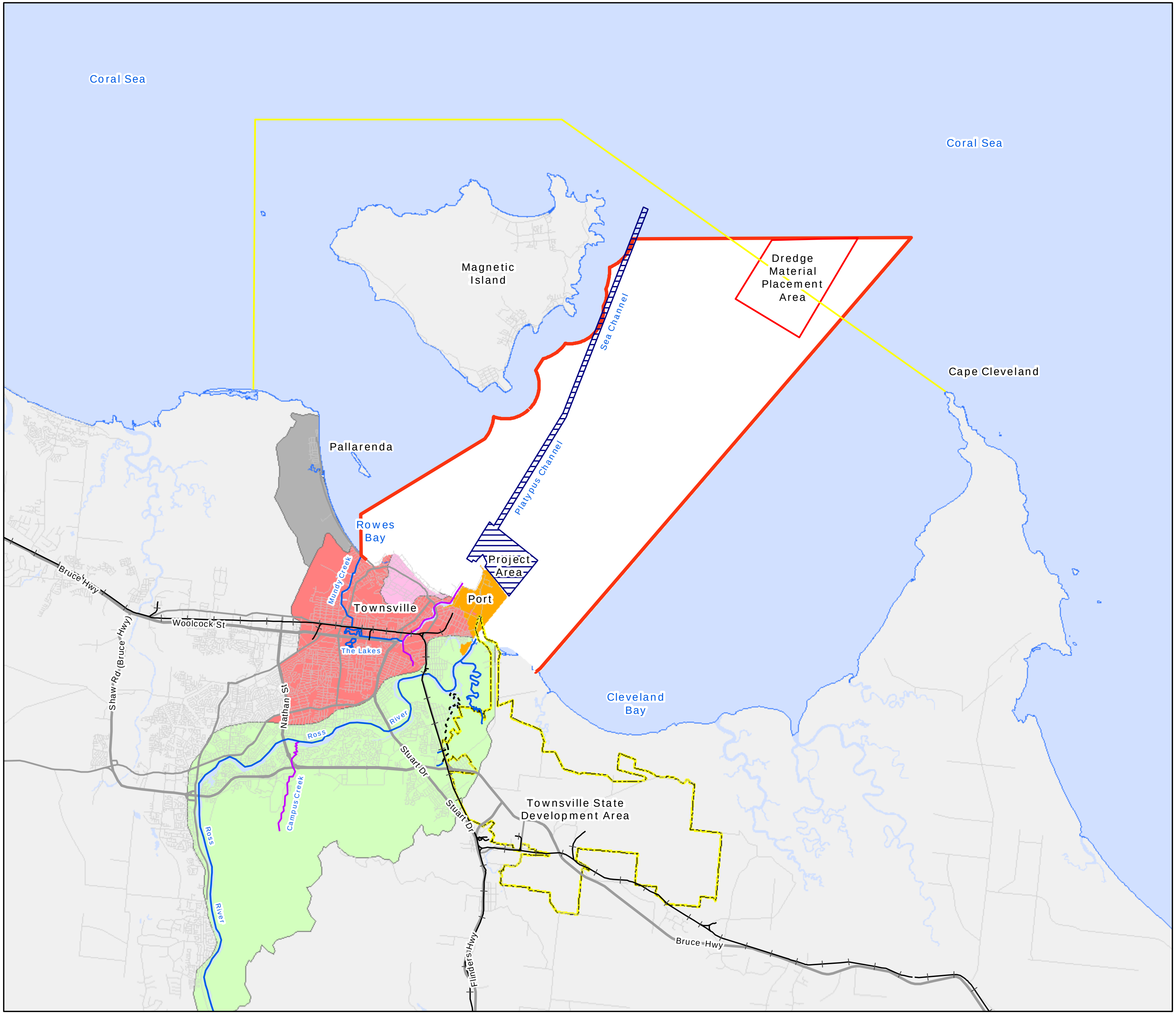
An assessment of the water quality for the Black and Ross rivers basins was undertaken by Connell Wagner Pty Ltd in 2008 on behalf of the Townsville City Council as part of the Creek to Coral Coastal Catchment Initiative (Connell Wagner, 2008). The results of the assessment for the Lower Ross River sub-basin (Figure B.2.1) can be summarised as:

- The assessment was performed against the guidelines for the lowland stream water type. Data sources for this sub-basin included Townsville City Council, Citiwater, Conservation Volunteers Australia–Creekwatch, Department of Environment and Heritage Protection (DEHP), Australian Centre for Tropical Freshwater Research, Great Barrier Reef Marine Park Authority and Department of Natural Resources and Water. Data for this sub-basin included monitoring undertaken from August 1980 to March 2008.
- The assessment for the Lower Ross River basin indicated that the water quality was moderately to heavily impacted. Poor water quality in The Lakes was the main reason that the Lower Ross Creek was assessed as heavily impacted. While the Ross River below the dam was assessed as being slightly impacted the recent data was not consistent with the historical data. Recent data indicated Ross River water quality was at least moderately impacted.

PORT EXPANSION PROJECT EIS

Lower Ross River Sub-Basin and Watercourse

Figure B.2.1



Legend

- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary

Drainage - Ecological Impact

- No Data
- Insufficient Data
- Healthy/Slightly Impacted
- Slightly/Moderately Impacted
- Moderately/Heavily Impacted

Catchments - Ecological Impact

- No Data
- Insufficient Data
- Healthy/Slightly Impacted
- Slightly/Moderately Impacted
- Moderately/Heavily Impacted

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_WIS_108

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012
Ecological Impact - Lower Ross River Sub-Basin Fact Sheet
Townsville City Council -2012

The data range for guideline parameters for Ross Creek is presented in Figure B.2.2.

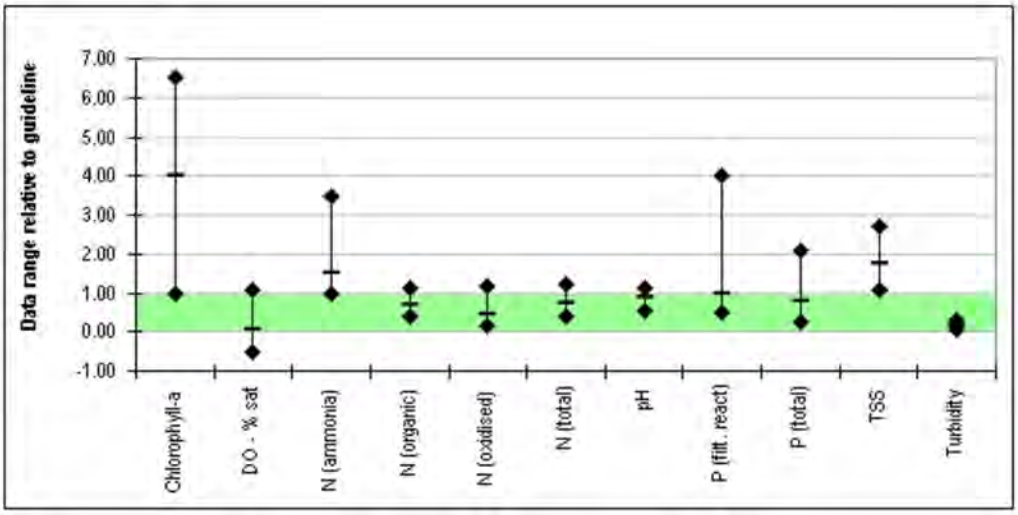


Figure B.2.2 Summary of Water Quality for Ross Creek (Connell Wagner, 2008)

Given the fact that the Project Area is located between the tidal mouths of the Ross River and Ross Creek, the site-specific assessment of water quality has been incorporated in Chapter B4 (Marine Water Quality).

B.2.1.1.2 Groundwater Assessment

A desktop review was undertaken to determine the existing groundwater environment, its beneficial uses and its environmental values, to assess potential impacts and to determine potential management/mitigation measures. The scope of the desktop review included:

- a reviews of existing investigations reports
- searches of the Queensland Groundwater Bore Database (DERM, 2012d)
- review of the Digital Geological Map for Townsville (Tile 8259), scale 1:100,000
- assessment of the Queensland groundwater vulnerability mapping (Stenson & DNRM, 2002), scale 1:500,000.

B.2.2 Assessment Framework and Statutory Policies

A brief summary of the legislation and policies relevant to water resources for the PEP is provided. There are currently no water resource plans or resource operation plans for the basins in the Study Area.

B.2.2.1 Queensland Legislation

B.2.2.1.1 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) is intended to protect Queensland's environment while allowing for development that improves total quality of life, now and in the future, by encouraging ecologically sustainable development. The Act regulates environmentally relevant activities, under the EP Regulation and some of these activities will require a permit. There are several policies published under the Act that govern the requirement for management of some environmental issues such as noise, air and water. These policies determine objectives to be achieved in various environments with reference to sensitive receptors.

The Project is required to comply with the *Environmental Protection (Water) Policy 2009* during construction. The requirement for environmentally relevant activities will be determined at the detailed design stage and/or as tenants commence operation.

B.2.2.1.2 Water Act 2000 and Water Regulation 2002

The purpose of the *Water Act 2000* is to provide for the sustainable management of water and other resources. Under s. 266 of the *Water Act 2000*, a riverine protection permit is required from the DEHP to:

- destroy vegetation in a watercourse, lake or spring
- excavate in a watercourse, lake or spring
- place fill in a watercourse, lake or spring.

The *Water Act 2000* defines a watercourse as:

- river, creek or stream in which water flows permanently or intermittently in a natural channel, whether artificially improved or not
- an artificial channel that has changed the course of the watercourse.

It also includes the bed and banks and any other element of a river, creek or stream confining or containing water.

The *Water Act 2000* has been developed to fulfil Queensland's responsibilities under the 1994 *Water Resources Policy* of the Council of Australian Governments. It aims to address legislative requirements for the majority of Queensland's non-tidal waters. The *Water Act 2000* sets out the law with respect to rights to surface and groundwater, the control of works with respect to surface and groundwater conservation and protection, and control of irrigation, water supply, drainage and flooding.

B.2.2.1.3 Sustainable Planning Act 2009

The purpose of the *Sustainable Planning Act 2009* is to seek to achieve ecological sustainability by:

- managing the process by which development takes place, including ensuring the process is accountable, effective and efficient and delivers sustainable outcomes
- managing the effects of development on the environment, including managing the use of premises
- continuing the coordination and integration of planning at the local, regional and state levels.

Advancing the Act's purpose includes ensuring the sustainable use of renewable natural resources and the prudent use of non-renewable natural resources by, for example, considering alternatives to the use of non-renewable natural resources.

The definition of natural resources used in the Act includes water resources that are important to economic development because of their contribution to employment generation and wealth creation.

B.2.2.1.4 Environmental Protection (Water) Policy 2009

The *Environmental Protection (Water) Policy 2009* commenced on 28 August 2009 and replaces the original policy first released in 1997.

The *Environmental Protection (Water) Policy 2009* seeks to achieve the object of the EP Act in relation to Queensland waters, i.e. to protect Queensland's waters while allowing for development that is ecologically sustainable. Queensland waters include water in rivers, streams, wetlands, lakes, aquifers, estuaries and coastal areas.

This purpose is achieved in a framework (Part 2, Section 6): that includes:

- identifying environmental values for aquatic ecosystems and for human uses (e.g. water for drinking, farm supply, agriculture, industry and recreational use)
- determining water quality guidelines and water quality objectives to enhance or protect the environmental values
- making consistent and equitable decisions about Queensland waters that promote efficient use of resources and best practice environmental management
- involving the community through consultation and education, and promoting community responsibility.

In June 2012, the DEHP released draft documents for public consultation:

- Draft *Ross River basin environmental values and water quality objectives* (DEHP, 2012b)
- Draft *groundwater guidelines for Townsville region (Black and Ross River basins)* (DEHP, 2012a).

While these documents are still in draft, they have been taken in consideration when assessing potential impacts on the water resources environmental values.

B.2.2.2 Relevant Guidelines

Guidelines and standards relevant for the assessment of the water resources impacts include:

- *Australia and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000)
- *Queensland Water Quality Guidelines 2009* (DERM, 2009a)
- *Water Quality Guidelines for the Great Barrier Reef* (GBRMPA, 2010)
- *Queensland Urban Drainage Manual* (DNRW, 2007).

B.2.3 Existing Values, Uses and Characteristics

B.2.3.1 Surface Water

B.2.3.1.1 Waterways and Catchments

The Ross River Basin has an area of 1,707 km² and flows into the ocean at Townsville. The main rivers are the Bohle, Little Bohle and Ross rivers. The basin is bordered by Hervey Range to the west and the ocean to the east. The only major city in the basin is Townsville and the major storage the Ross River Dam (full capacity 420,000 ML) (ANRA, 2009).

The Ross River Basin is the largest in the Townsville Local Government Area . The majority of the Ross River Basin is upstream of Ross River Dam with approximately 760 km² draining to the dam. Downstream of the dam a further 145 km² drains to Ross River through the tributaries of Stuart Creek, Gordon Creek, Annandale Drains and University Creek. Minimal inflows are received from the left bank of the river because of a natural levee for most of the river length.

Ross Creek drains most of the urban area of Townsville City, including the suburbs of South Townsville, Hyde Park, Mundingburra, Gulliver, Currajong, Pimlico, Mysterton, Aitkenvale, Vincent and Cranbrook. With the exception of Castle Hill, the catchment area is flat and almost completely urbanised.

B.2.3.1.2 Climate

Rainfall in the Townsville region is seasonal with most rainfall occurring during the wet season months between December and March. Storms are produced from the southern movement of unstable air (i.e. wet season monsoon) into northern Australia along the inter-tropical convergence zone. As a consequence, rainfall events during the wet season months can be of high intensity. The average annual rainfall as measured at Townsville Airport is approximately 1,144 mm (BOM, 2011a) and is significantly lower compared to other areas along the Queensland coast, primarily as a result of the region's east south-east/west north-west orientation. Monthly rainfall statistics are detailed below in Figure B.2.3.

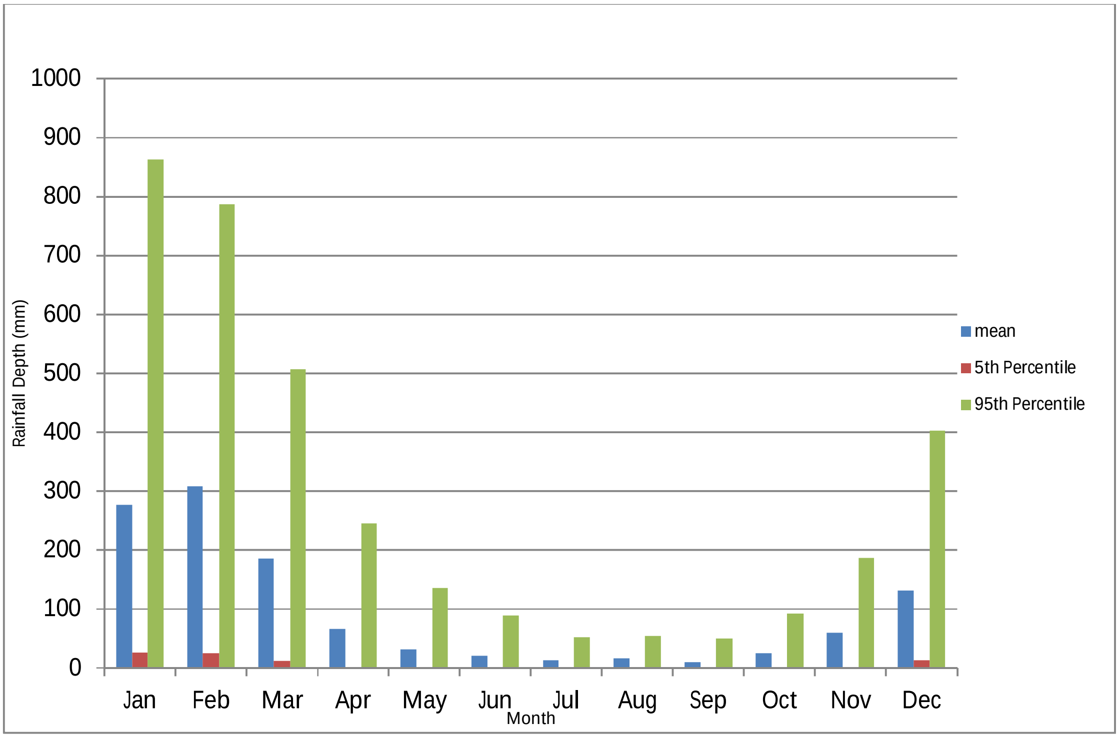


Figure B.2.3 Monthly Rainfall for the Mean, 5th and 95th Percentile Statistics (BOM, 2011a)

B.2.3.1.3 Townsville Flooding Potential

The city of Townsville is built on the natural low-lying coastal floodplains of the Ross and Bohle rivers in tropical North Queensland. Low-lying areas of the city are susceptible to inundation by a combination of heavy rainfall and/or high tides.

During the wet season Townsville commonly experiences intense and heavy rainfall often resulting from a severe depression forming in the vicinity of the monsoon trough and crossing the coastline. The heavy rainfall generally occurs between November and April, with the months January and February usually being the wettest.

The highest predicted tides occur during the wet and dry seasons when the earth, moon and sun are aligned (perigean spring tides). The high tides occurring in the wet season often have a more significant impact due to the likely coincidence with heavy rain and/or strong onshore winds. A recent example of this was on the mornings of 11 to 13 January 2009 when storm surge and heavy rainfall coincided with king tides. Recorded water levels exceeded the predicted tidal level by up to 0.7 m and peak water levels exceeded the highest astronomical tide level by approximately 0.37 m. Overflows from the Ross River and Ross Creeks caused significant inundation around Port of Townsville, Townsville CBD, South Townsville, Railway Estate and Oonoonba.

B.2.3.1.4 Surface Water Use

Data on water use in the Ross River Basin is available from the Australian Natural Resources Atlas (ANRA, 2009), which provides information collected during the 2000 to 2002 national land and water resources audit assessments. Under these assessments water use data for Australian catchments was presented for the years 1983/84 and 1996/97 to illustrate change in water use over that period.

Table B.2.1 presents a summary of the 1996/97 surface water usage in the Ross River Basin as presented in the ANRA (2009).

Table B.2.1 Summary of 1996/97 Surface Water Use in Ross River Basin (ANRA, 2009)

Use Type	Diversion Volume (ML/yr)	Allocation (ML/yr)	Diversion : Allocation Ratio (%)
Irrigation	**708**	**708**	**100**
▪ pasture	681	681	100
▪ other crop	27	27	100
Rural	**60**	**60**	**100**
▪ stock	60	60	100
Urban/Industrial	**48,850**	**45,833**	**93.82**
▪ domestic	28,750	25,952	90.27
▪ industrial	20,000	19,781	98.91
▪ power	100	100	100
Total	**49,618**	**46,601**	

The data indicates that more than 98% of the surface water use is for urban/industrial purposes (e.g. town water supply for Townsville), with less than 2% used for irrigation.

B.2.3.1.5 Surface Water Environmental Values and Water Quality Objectives

The draft *Ross River Basin Environmental Values and Water Quality Objectives* (DEHP, 2012b) indicates that spatially the Study Area falls in the Magnetic Island Coastal waters. Spatially the most relevant fresh/estuarine waters as defined under this document are the Ross Creek and tributaries waters. The Ross Creek has been classified as middle estuary water type. The identified environmental values for the Ross Creek and tributaries waters are:

- aquatic ecosystems
- human consumers
- primary recreation
- secondary recreation
- visual recreation
- cultural and spiritual values

Proposed water quality objectives for the protection of aquatic ecosystems in the Ross Creek and tributaries waters are:

- non-toxicants
    - ammonia nitrogen <10 µg/L
    - oxidised nitrogen <10 µg/L
    - dissolved inorganic nitrogen <20 µg/L
    - organic nitrogen <260 µg/L
    - total nitrogen <300 µg/L
    - filterable reactive phosphorus <8 µg/L
    - total phosphorus <25 µg/L
    - chlorophyll a <4 µg/L
    - dissolved oxygen saturation 85% to 100%
    - turbidity <8 NTU
    - Secchi depth >1 m
    - suspended solids <20 mg/L

  - pH 7.0 to 8.4
- Toxicants
  - Toxicants in water as per the *Australia and New Zealand Guidelines for Fresh and Marine Water Quality* (AWQG) (ANZECC & ARMCANZ, 2000), Section 3.4 (Water Quality Guidelines for Toxicants, including tables 3.4.1, 3.4.2, and Figure 3.4.1) and Volume 2 (Section 8).

For waters identified as being mid estuary and occurring in the inter-tidal zone adjacent to the enclosed coastal/lower estuary water type, these waters may have water quality characteristics more in common with the adjacent enclosed coastal/lower estuary water type. Under such circumstances, reference should be made to the water quality objectives for enclosed coastal/lower estuary water type.

Proposed water quality objectives for the other identified environmental values include:

- protection of the human consumer: Objectives as per AWQG and *Australia New Zealand Food Standards Code* (FSANZ, 2007)and updates
- protection of cultural and spiritual values: protect or restore Indigenous and non-Indigenous cultural heritage consistent with relevant policies and plans
- suitability for primary contact recreation: objectives as per *Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008), including:
  - water free of physical (floating and submerged) hazards
  - temperature range: 16 to 34°C
  - pH range: 6.5 to 8.5
  - dissolved oxygen: >80%
  - faecal contamination: designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin
  - intestinal enterococci: 95th percentile ≤40 organisms per 100 mL (for healthy adults)
  - direct contact with venomous or dangerous aquatic organisms should be avoided; recreational water bodies should be reasonably free of, or protected from, venomous organisms (e.g. box jellyfish and bluebottles)
  - waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.
- suitability for secondary contact recreation: objectives as per *Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008), including:
  - intestinal enterococci: 95th percentile ≤40 organisms per 100 mL (for healthy adults)
  - cyanobacteria/algae.
- suitability for visual recreation: objectives as per *Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008), including:
  - recreational water bodies should be aesthetically acceptable to recreational users; the water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life.
  - cyanobacteria/algae: refer to water quality objectives for primary recreation.

The water quality parameters and objectives of relevance are described in further detail in Chapter B5 Marine water quality.

B.2.3.2 Groundwater

B.2.3.2.1 Geology and Aquifers

Review of the Department of Mines *1:250,000 scale geological map of the Townsville Region* indicates that the Port of Townsville is underlain by Quaternary alluvium and colluvium sediments, which in turn overlie basement geology comprising late Palaeozoic granite (Golder Associates, 2012b).

Geological mapping information of Townsville at 1:100,000 scale indicates that the near surface lithology in the vicinity of the Project Area comprises Quaternary (Holocene) sediments including silt, mud and sand, described as coastal tidal flats, mangrove flats, supra-tidal flats saltpans and grassland (Qhct).

Flood plain deposits comprising Pleistocene (Qpa) silt, sand, gravel have been mapped a few hundred metres south-west from the limits between units Qhct and Qhcb in the south-west corner of the Project Area.The underlying bedrock comprises Permian (Pgc) biotite leucogranite and microgranite.

Natural geological conditions are further described in Chapter B1 Land.

Table B.2.2 summarises the geological units that occur in the vicinity of the PEP which is a gauge of the propensity for shallow aquifer systems.

Table B.2.2 Geological units

Stratigraphic Order	Unit	Age	Lithological Description
Coastal tidal flats, mangrove plats, supratidal flats	Qhct	Holocene	Silt, mud and sand, minor salt
Beach ridges and cheniers	Qhc	Holocene	Moderately well sorted, fine to coarse-grained quartzose to shelly sand and some gravel
Flood plains alluvium on high terraces	Qpa	Pleistocene	Clay, silt, sand, gravel
Undifferentiated granite	Pgc	Permian	Biotite leucogranite, microgranite, minor granophyre, granodiorite

Based on the above information and review of the bore logs from registered groundwater bores near the coastal in the vicinity of the Study Area, it can be concluded that a shallow aquifer system is present in Holocene and Pleistocene sediments (predominantly in the sandy and gravelly deposits) underlying the near coastal area of the Ross River.

B.2.3.2.2 Registered Groundwater Bores

A search of the Queensland Digital Groundwater Database (DERM, 2012d), maintained by the Department of Environment and Resource Management, was undertaken to identify registered groundwater bores within a 5 km radius of the Project Area. Nine registered groundwater bores were identified, as summarised in Table B.2.3 and shown on Figure B.2.4.

The database has limited information on water quality and aquifer zones for these bores, but information suggests that water sources for these bores include weathered granite, gravels, sand and clayey sand. None of the registered bores are located in the port.

Table B.2.3 Nearest Registered Bores to Project Area

Registered Number	Construction Year	Easting	Northing	Aquifer Top (m)	Aquifer Bottom (m)	Water Quality	Yield (L/s)	Water Source Interval	Distance from the Outer Harbour Area (m)	Direction from the Project Area
125054	2004	480725	7865359	-	6 (end of bore)	Salt @ 4,864 ppm	±1.0	Bore ends in fine sand	6,360	south south-west
125349	2005	478817	7872258	21	38	Salt @ 93,000 ppm	-	Weathered granite	3,440	west
125446	2005	478902	7868006	3.6	7.3	Potable	0.5	Cobbles, sand and gravels	5,490	south-west
102414	2006	478495	7868066	-	5.8 (end of bore)	-	0.5	Clayey sand to coarse	5,700	south-west
102708	2006	478185	7867516	-	-	-	0.7	Clayey to coarse sand	6,320	south-west
96294	2004	479108	7866020	7.3	10.7	-	2.0	Sand	6,830	south-west
96295	2004	478180	7866939	4.2	6.0	-	± 2.0	Cobbles	6,770	south-west
102438	2006	477452	7867557	5.0	6.8 (end of bore)	-	1.0	Clayey fine sand	6,790	south-west
102824	2003	477619	7867363	5.0	9.0	-	-	Clayey sand	6,810	south-west

(DERM, 2012d)

PORT EXPANSION PROJECT
EIS

Borehole Locations

Figure B.2.4

Legend

- Borehole Location
- Railway Line
- Project Area
- Townsville State Development Area

N

Scale: 1:70,000 (when printed at A4)

0 0.5 1 2 3

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_105

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010

B.2.3.2.3 Existing Groundwater Quality

A number of groundwater monitoring wells have been installed and/or monitored during several investigations on port land.

Most existing groundwater monitoring wells in the vicinity of Project Area were installed by Maunsell between 2002 and 2005 as part of a groundwater monitoring programme undertaken on behalf of the former Townsville Port Authority (now POTL).

Nine wells (TPA1 to TPA9) were constructed at different stages of the programme and located mainly in the eastern reclamation area. A total of nine rounds of sampling were completed to comprehend groundwater levels and make quality assessments.

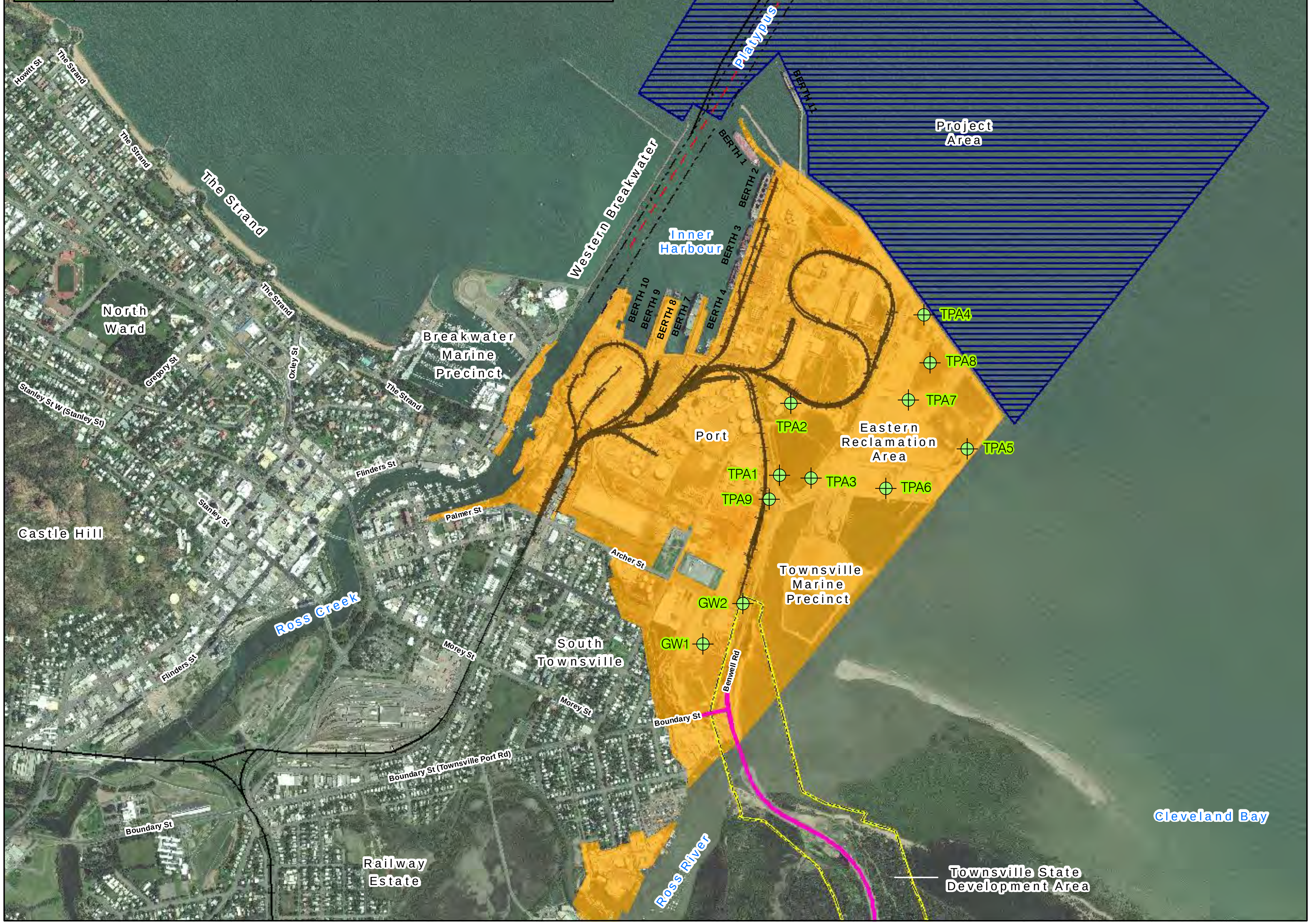
Wells TPA1 to TPA6 were established by the Townsville Port Authority at the start of the monitoring period. TPA7 and TPA8 were installed in December 2004 to monitor a newly constructed clay-lined pond. TPA9 was installed between April and October 2005 to monitor shallow background (up gradient) water quality conditions.

A groundwater monitoring program was completed by GHD (2008b) as part of the environmental studies for the Townsville Marine Precinct EIS (Lot 773EP2211), which included the construction of two new monitoring wells (GW1 and GW2) and the monitoring of two existing wells (TPA1 and TPA3).

The monitoring wells nearest to the Project Area are located approximately 25 m (TPA4) and 130 m (TPA8) to the west of the new reclamation area.

Details of the existing monitoring wells on port land are presented in Figure B.2.5.

Well ID	Year of Installation	Easting	Northing	Depth (m)	TOC Elevation (m AHD)	Distance to the Proposed Reclamation Boundary (m)
TPA1	2002	482892	7870629	n/a	3.909	980
TPA2	2002	482945	7870952	n/a	n/a	750
TPA3	2002	483032	7870616	n/a	3.663	880
TPA4	2002	483541	7871348	n/a	n/a	25
TPA5	2002	483736	7870747	n/a	n/a	230
TPA6	2002	483369	7870570	n/a	n/a	635
TPA7	2004	483472	7870968	n/a	n/a	300
TPA8	2004	483568	7871134	n/a	n/a	130
TPA9	2005	482847	7870522	6	n/a	1,070
GW1	2008	482549	7869871	6	3.387	1,730
GW2	2008	482728	7870053	6	3.909	1,480



PORT EXPANSION PROJECT EIS

Monitoring Well Details

Figure B.2.5

Legend

- Monitoring Well Locations
- Railway Line
- Townsville Port Access Road
- Channel Centre Line
- Existing Channel Limits
- Project Area
- Townsville State Development Area
- Existing Port Land

N

Scale: 1:25,000 (when printed at A4)

0 100 200 400 600 800 1,000

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_143

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011

B.2.3.2.4 Groundwater Levels and Inferred Flow Direction

Groundwater levels in three wells (GW1, GW2 and TPA3) monitored from 8 November 2008 to 14 February 2009 (GHD, 2008b) ranged between 0.9 and 2.5 m AHD and peaked in early February within one day of a significant rainfall event (241.6 mm on 3 February, 2009).

Groundwater levels at TPA1 were recorded up to 2.6 m AHD, around 1.5 m higher than GW1, GW2 and TPA3 and suggest the presence of a localised recharge mound in the vicinity of TPA1. GHD (2008b) suggested that this may be associated with placement of materials up gradient of TPA1; however, historic data were not available to confirm this.

Interpretation of groundwater levels monitored on 18 December 2008 by GHD (2008b) suggested groundwater flowing predominantly from west to east, towards Cleveland Bay, with a hydraulic gradient of around 6.7×10^{-4}.

Previous studies undertaken with respect to tidal influences on groundwater levels in the shallow aquifer at the existing port area indicate that:

- groundwater levels in the monitoring wells responded to tidal fluctuations, indicating that there was hydraulic connection between the marine environment and the deposits in which the wells were installed (Maunsell, 2005a)
- changes in groundwater levels due to ubiquitous tidal fluctuations can be much less significant than changes in groundwater levels as a result of rainfall recharge events (GHD, 2008b).

Permeability tests undertaken during previous investigations indicate that the hydraulic conductivity of the tested, shallow deposits ranged between 13 and 25 m/day (GHD, 2008b). Below-ground water will result in groundwater flow in the PEP reclamation and like the current port lands will be largely controlled by internal bund walls during the different stages of the development.

B.2.3.2.5 Groundwater Quality

Monitoring of groundwater quality in the shallow sediments has been undertaken during previous investigations, as presented in Table B.2.4.

Table B.2.4 References and main data sources of groundwater monitoring events

Reference	Periods of Sampling	Number of Sampling Rounds	Monitoring Wells Included
Maunsell (2005a)	December 2002 to October 2005	9	TPA1 to TPA9; wells were installed progressively
GHD (2008b)	November 2008 to January 2009	3	GW1,GW2,TPA1, TPA3

A summary of relevant previous groundwater quality monitoring results (Maunsell, 2005a; GHD, 2008b) is presented below.

- The shallow groundwater is saline and not suitable for any land-based beneficial use.
- Elemental concentrations were elevated in TPA7 and TPA8 (located at average distances of 300 m and 130 m from the PEP reclamation, respectively) during the December 2004 sampling event where groundwater conditions were slightly acidic (pH 6.24 and 5.08, respectively).
- The slightly more acidic conditions could be due to localised oxidation around individual wells during diurnal tide surges, creating acidic micro-environmental conditions in the sediments (Maunsell, 2005a).
- During development of GW1 and GW2 for Townsville Marine Precinct planning, waters in GW1 was observed to give off a strong ‘mangrove mud’ odour and GW2 a slight ‘rotten egg’ odour, which suggests the presence of hydrogen sulphide in groundwater. Given the environment and acid sulphate soil mapping for the area this tends to confirm the presence of potential acid sulphate soil material in the vicinity of GW1 and GW2.

Dissolution and leaching of minerals present in the existing reclaim sediments may account for the above conditions, as rainwater infiltrates the unsaturated zone and as groundwater levels fluctuate due to natural tidal fluctuations.

The *1:500,000 Groundwater Vulnerability Map for the Townsville area* (Stenson & DNRM, 2002) (Figure B.2.1) shows that the Port of Townsville precinct is located in an area with a groundwater vulnerability rating of moderate to high, which corresponds to the Holocene deposits of coastal tidal flats and fine to coarse-grained sands and gravels, respectively.

B.2.3.2.6 Groundwater Usage

The Study Area is located near the Townsville/Thuringowa groundwater management unit. No formal abstraction or allocation policy exists for the Townsville/Thuringowa groundwater management unit as the area does not fall in a declared sub-artesian or irrigation area. No sub-artesian bores in the Townsville/Thuringowa groundwater management unit are subject to licence. There are currently no water resource plans or resource operation plans for the catchments in the Study Area.

In 2009, ANRA (ANRA, 2009) estimated that that groundwater allocation in the groundwater management unit is:

- irrigation 83%
- rural 10%
- urban/industrial 7%

There are no registered groundwater abstraction bores within a 3.5 km radius of the Project Area.

B.2.3.2.7 Groundwater Environmental Values

The draft *Groundwater Water Quality Guidelines for the Townsville Region (Black and Ross River Basins)* (DEHP, 2012a) identifies that the Project Area is located in the Townsville groundwater chemistry zone, described as …'high salinity alluvial deposits, high sodium chloride, and high salinity'.

The guidelines differentiate different depth profiles, of which the shallow <15 m profile would be the most appropriate for the Project Area. Guidelines are derived relative to percentile values for each indicator. The guidelines also identify that the Project Area is in a 'data limited area'.

The draft groundwater values (90th percentile) for the Townsville Zone are presented in Table B.2.5.

Table B.2.5 Draft Groundwater Water Quality Objectives for Townsville Zone

Indicator	Value	Indicator	Value
Sodium	760 mgL	Hardness	457 mg/L
Calcium	96 mgL	pH	8.1
Magnesium	54 mgL	Alkalinity	447 mg/L
Bicarbonate	542 mgL	Silica	93.6 mg/L
Chloride	1,174 mgL	Fluoride	0.8 mg/L
Sulphate	100 mgL	Iron	0.15 mg/L
Nitrate	67 mgL	Manganese	0.23 mg/L
Electrical conductivity	4,238 µS/cm		

Based on the limited yield and the poor water quality of the groundwater, the beneficial use of the shallow groundwater in the vicinity of the Project Area as a potable source or for industrial purposes is considered highly unlikely. Furthermore, no groundwater abstraction bores are located within a 3.5 km radius of the Project Area. It is considered that there is limited beneficial use of the groundwater at, or in the immediate vicinity of, the Project Area.

B.2.4 Assessment of Potential Impacts

Potential impacts of the PEP on existing water resources have been assessed for the preconstruction, construction and operational phases. These impacts are discussed in the sections below.

The sections below only apply to fresh and estuarine water surface waters and groundwater. Potential impacts on marine water quality are described in Chapter B4 (Marine Water Quality) and the environmental values of those waters in Chapter B6 (Marine Ecology and Conservation).

B.2.4.1 Preconstruction and Construction

Potential impacts to surface water and groundwater identified during the preconstruction and construction phases of the Project are discussed in the following sections.

B.2.4.1.1 Surface Water Runoff

There were few potential impacts to existing surface water identified during the assessment process. The Townsville PEP is inherently marine in nature. Environmental effects which, in a terrestrial project may be experienced in surface water systems (for example, reduced water quality or changes to hydrology and hydrodynamics) are more likely to be experienced in the marine environment. These effects are presented in the relevant marine chapters (Chapter B3 Coastal Processes and Chapter B4 Marine Water Quality). Potential impacts to existing surface water resources during construction were identified as:

- reduced water quality in surrounding creeks and waterways due to construction traffic movement (spills and mud tracking to public road and subsequent runoff)
- handling and storage of chemicals, with spills and leaks of fuel/oil and other contaminants running off during stormwater runoff events
- generation of storm water runoff from developing lands that contains re-suspended sediments.

Pre-Construction and Construction Traffic

Construction traffic will access the Project Area for a range of reasons, including delivery or removal of materials, equipment, plant and personnel. Additionally plant operating on reclaimed land will move on and off the reclaimed hardstand during construction. While accessing and egressing site, plant may experience unplanned discharges or spills of construction materials (for example, aggregates and fill) or vehicle discharges (for example, lubricants or hydrocarbons such as diesel). Additionally, during wet weather or while working with wet sediments, plant and vehicles leaving site may track mud onto impervious pavements. If sediment tracks and runoff are not managed, any spilled or tracked material may discharged into local waterways during rain events with resultant effects on water quality including elevated turbidity and hydrocarbons, depending on the nature of the discharge. Large discharges from vehicle movements are considered unlikely. Small, infrequent discharges from vehicles are likely during construction. The consequences of discharges will be localised.

Small discharges will be managed through the use of vehicle spill kits. Mud and sediment tracking from the PEP is likely to be concentrated in the port areas where vehicles move from the civil works area (reclaimed hardstand) to the existing paved area. It will be possible to manage vehicle sediment by controlling egress from the reclaimed area and employing appropriate vehicle washdown facilities. The risk of reduced water quality in surrounding creeks and waterways due to construction traffic movements as an impact from the Project is considered low.

Stormwater Runoff from Reclaimed Land Surfaces

While not an existing water resource, runoff created on sealed reclaimed land is likely to be generated as the PEP is constructed. This runoff is likely to be of low quality on the reclaimed land due to the presence of construction materials and bare earth surfaces prior to sealing the surface. Runoff generated on the PEP reclaimed land could drain and outfall to the ocean, where flow is not routed to internal tailwater ponds. The predominant environmental effects will be marine water quality and are discussed in Chapter B4 (Marine Water Quality). For completeness, the potential generation of a new and low quality water resource on the pad are discussed below.

Rainfall collected on newly constructed PEP land will generate stormwater on the site where it previously was not created (as the PEP is situated over the seabed). Initially the permeability of reclaimed soils in the PEP is high (being sands associated with dredge reclaim and fill). It is likely that rainwater on the PEP will infiltrate the land particularly during low intensity events. During runoff producing events during construction, bunded reclaim areas will retain site waters, both dredge tailwater and stormwater. The majority of runoff and stormwater will be subject to treatment as part of the dredge and reclaim process. The suspended sediment and turbidity content in stormwater will be readily treated by the retention ponds used to manage dredge tailwaters.

For a small number of areas during construction, drainage outlets or direct runoff to the ocean may occur. Sediment loads are of primary concern. Such sites will be maintained clean and protected for erosion risks and managed for runoff quality. Storage and chemical use areas being constructed will be managed by strict procedures. Management measures are described in subsequent sections and are included as requirements of the Environmental Management Plan (Construction) (CEMP).

B.2.4.1.2 Groundwater

Effectively, groundwater at the site will not exist during the initial land development phase. As material is placed in the reclamation area, a shallow water table will develop in the sediments. This water table will be in limited contact with the water table in the adjacent sediments. Potential impacts associated with the creation of groundwaters through the placement of reclaimed material include:

- shallow groundwater acidification, due to placement of Holocene potential acid sulphate soil material, into the base of the reclamation area is unlikely, as potential acid sulphate soil dredge material would largely be placed at DMPA and other limited amounts incidentally in fill would be subject to an Acid Sulphate Soil Management Plan.
- Mobilisation of metals from the dredged sediments due to dissolution of minerals in the dredge material, and lateral migration into surrounding environment. This risk of this impact is unlikely as known metal concentrations in sediments would be natural levels and direct connectivity with the surrounding marine environment is limited due to the presence of the engineered bunds. Any dredged marine sediments with enriched metal content will be treated and disposed to land off site.
- Increases in shallow groundwater levels in surrounding environment during placement of material. This impact is considered unlikely as connectivity with surrounding environment is limited due to the presence of the bunds, and as increases due to loading are minimal compared to natural groundwater level fluctuations due to rainfall infiltration and tidal fluctuations.
- Handling and storage of hazardous goods, with spills and leaks of fuel/oil and other contaminants leaching to shallow groundwater. While spills of hydrocarbons and other materials are possible during the construction phase, spill kits will be used on site to contain and stop the spread of spilt material. Once contained it will be possible to excavate contaminated material and remove for treatment.

Overall the risk of effects on created groundwater in the PEP are considered low.

B.2.4.2 Operation

Potential impacts to surface waters and groundwater identified during the operational phase of the Project are discussed in the following sections.

B.2.4.2.1 Surface Water

Potential impacts to surface water resources during operations were identified as:

- increased flooding potential in the Ross River Basin
- handling and storage of hazardous goods, with spills and leaks of fuel/oil and other contaminants entering the existing water ways
- generation of storm water runoff that is impacted by potential onsite contaminant sources (such as fuel storage facilities, vehicle washdown areas).

Increased Flooding in Ross River Catchment

There may be concern that flood waters moving through the Ross River Basin and outletting at Ross Creek and Ross River are constrained by the placement of Townsville PEP. These potential effects were investigated through the *Townsville Port Expansion: Flood Impacts Study* (Appendix G1). Potential flood impacts, if they occurred would potentially be most likely to occur during the operational phase when the reclaim is completed and potentially manifest as changes to surface water elevations, flow velocities and/or times of inundation. These potential impacts were assessed by comparisons to the existing baseline study, using the developed hydrological and hydraulic models. The models were evaluated for both mean high water springs and storm surge downstream water levels.

Comparison of the developed case model results with the baseline model results indicated no change to the flood levels, flood extents or times of inundation are expected as a result of the PEP for all of the scenarios investigated. The ultimate development does not cause any significant obstruction to conveyance of flood waters at the mouth of the Ross River or Ross Creek.

Groundwater

Because of surface sealing, and because it will in effect develop a new groundwater beneath the PEP, groundwater is likely to continue to establish a signature reaching equilibrium with the surrounding marine waters resulting in a marine saline chemistry and quality. This groundwater will also naturally interact with surface drainage. Design of stormwater systems, such as piped underground or open channels, will be undertaken in the detailed design phase of the Project. Risk of impact to existing groundwater resources are considered negligible and risk of impact to new groundwater forming in the reclaimed area at the PEP are considered low.

Figure B.2.6 and Figure B.2.7 show the resultant flood extents and depth for mean high water springs and a static 100-year ARI storm surge coincident with the 100-year ARI flood event, respectively. Figure B.2.8 shows the difference between the developed case model results with the baseline model results for the 100-year ARI event with mean high water springs boundary conditions.

Given these modelling results, the risk of impact on flooding regimes in the Ross River Basin due to the Project was considered low.

Generation of Low Quality Runoff

The risk to existing marine water quality from low quality site runoff generated during operations will be low. With proper management, runoff from the PEP will be a treated to avoid potentially contaminated contributions. Potential effects in the marine environment where water would outfall are presented in the Chapters B4 and B5 on Marine Water Quality and Marine Ecology.

Capped, sealed and paved areas will be located on permeable ground surface and the newly created sealed surfaces will have a lower permeability than the land under construction and will generate more runoff compared with unsealed surfaces. Once the Project Area has been filled and sealed, infiltration from rainwater directly below the surface will be minimal. The presence of sealed surfaces and purpose-built drainage will convey surface waters generated at the PEP into a port-wide reticulated drainage system. Outflow of surface waters through drainage will be swift due to anticipated heavy tropical storms. Site management will be required by each future port tenant as management of stormwater contamination risk is best achieved at source.

DEHP licences are likely to impose conditions on quality requirements for runoff and stormwater outlet from tenants' facilities. Depending on the bulk materials stored and handled on the finished PEP lands, there is likely to be purpose-designed water and runoff site treatment system such as bunding and roofing, treatment systems (including diversions), proprietary products and/or retention ponds. Land management aspects of stormwater management will be consistent with *Queensland Urban Drainage Manual* (DNRW, 2007).

Integrated water cycle management principles will be adopted to account for the tropical setting and types of activities undertaken and products handled during the operations. This is described further in mitigation measures sections.

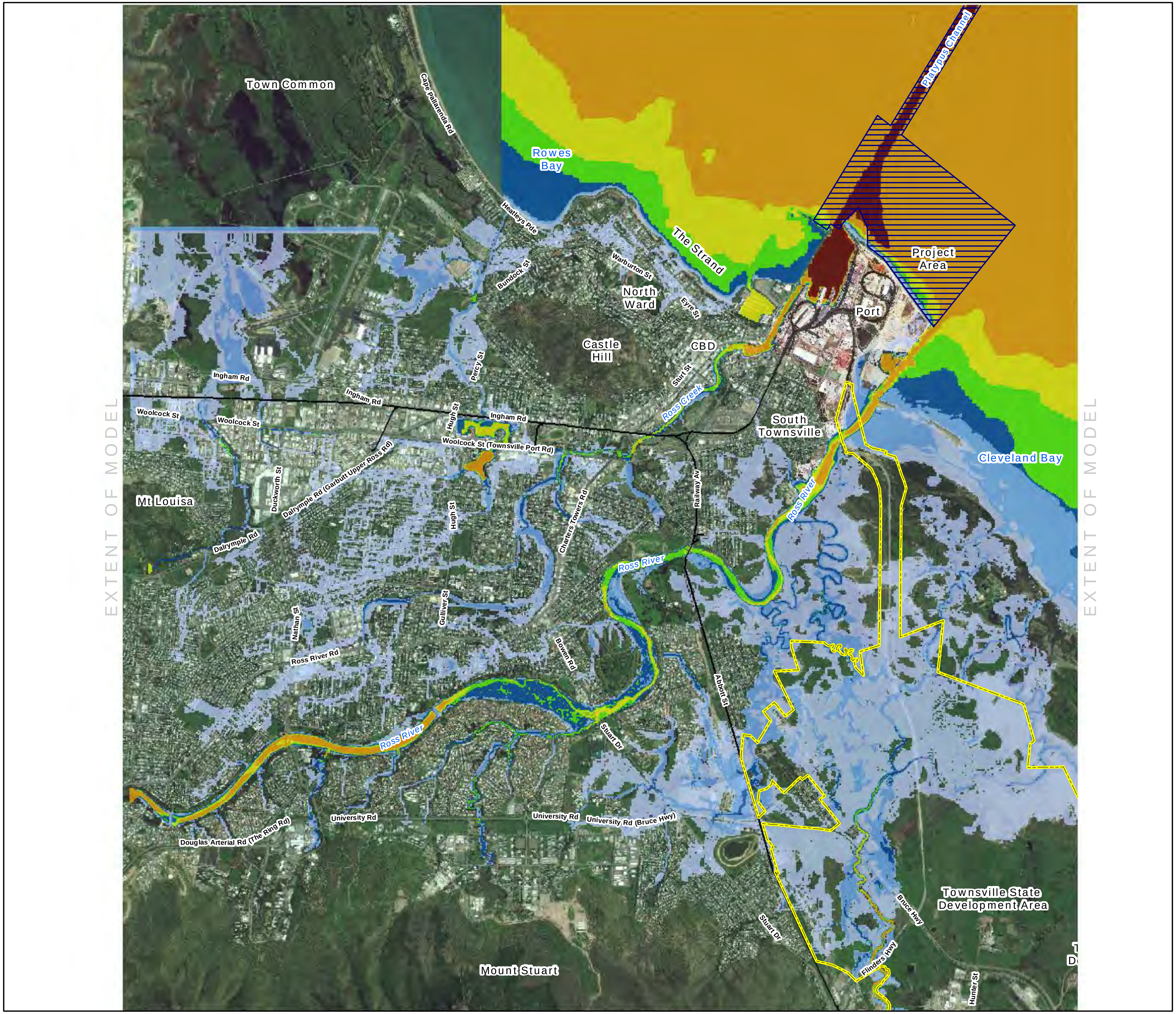
B.2.4.2.2 Groundwater

Because of surface sealing, and because it will in effect develop a new groundwater beneath the PEP, groundwater is likely to continue to establish a signature reaching equilibrium with the surrounding marine waters resulting in a marine-saline chemistry and quality. This groundwater will also naturally interact with surface drainage. Design of stormwater systems, such as piped underground or open channels, will be undertaken in the detailed design phase of the Project. Risk of impact to existing groundwater resources are considered negligible and risk of impact to new groundwater forming in the reclaimed area at the PEP are considered low.

PORT EXPANSION PROJECT EIS

Flood Extents and Depth for Mean High Water Springs

Figure B.2.6



Legend

- Railway Line
- Project Area
- Townsville State Development Area

Water Depth (m)

- 0 - 1m
- 1 - 2m
- 2 - 3m
- 3 - 4m
- 4 - 5m
- 5 - 10m
- > 10m

N

Scale: 1:70,000 (when printed at A4)

0 0.5 1 2 3

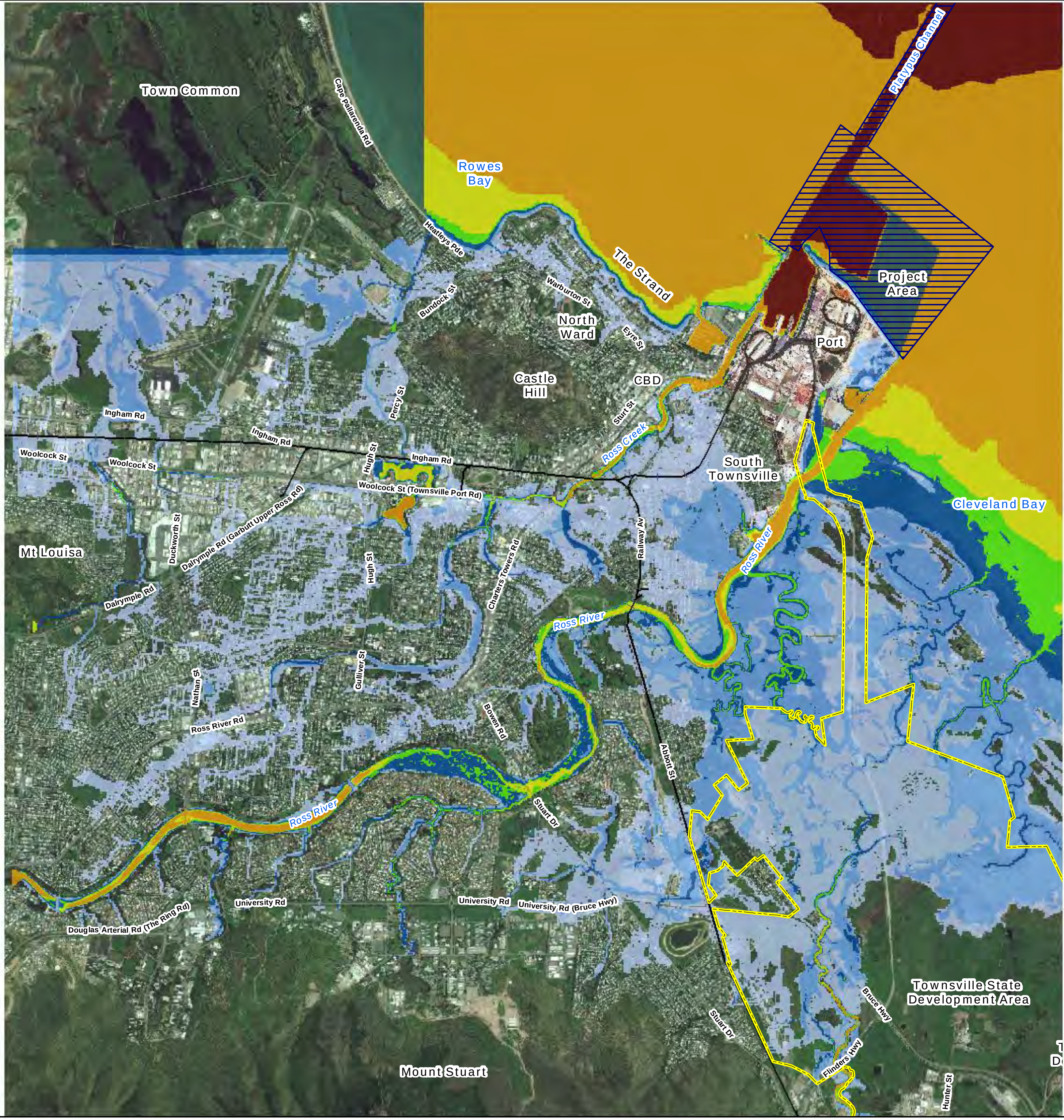
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_106

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010



PORT EXPANSION PROJECT EIS

Flood Extents and Depth for 100-year ARI Storm Surge and 100-year ARI Flood Event

Figure B.2.7

Legend

- Railway Line
- Project Area
- Townsville State Development Area

Water Depth (m)

- 0 - 1m
- 1 - 2m
- 2 - 3m
- 3 - 4m
- 4 - 5m
- 5 - 10m
- > 10m

N

Scale:1:70,000 (when printed at A4)

0 0.5 1 2 3

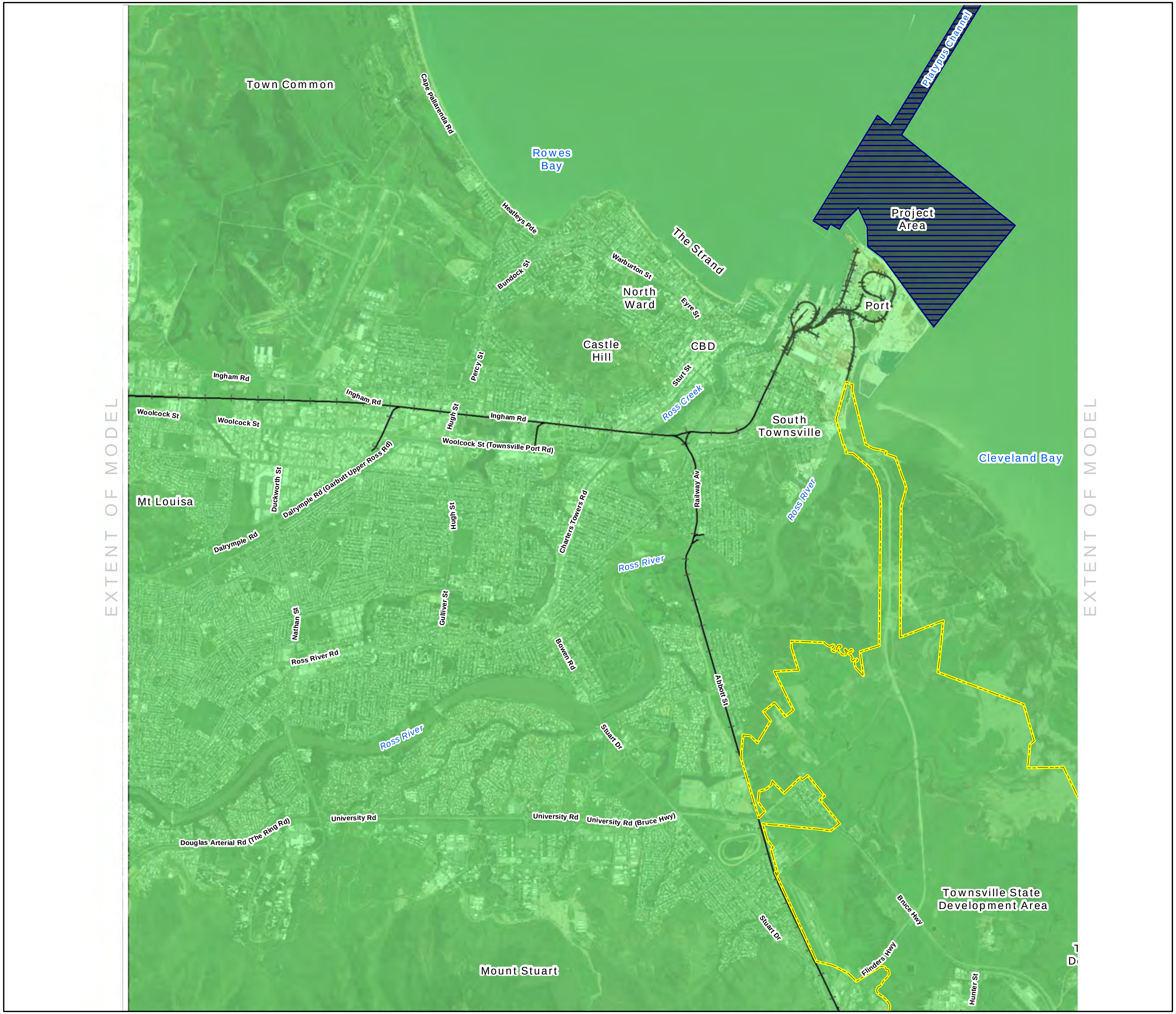
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_096

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010



PORT EXPANSION PROJECT EIS

Developed Case Model and Baseline Model Results

Figure B.2.8

Legend

- Railway Line
- Project Area
- No Change in Flood Levels Outside Project Area
- Townsville State Development Area

N

Scale: 1:70,000 (when printed at A4)

0 0.5 1 2 3

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_107

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010

B.2.5 Mitigation Measures and Residual Impacts

B.2.5.1 Pre-Construction and Construction Phase

Mitigation measures considered for surface water and groundwater during the pre-construction and construction phases of the PEP are described in the following sections.

B.2.5.1.1 Surface Water

The potential surface water impacts during the construction phase of the PEP will be managed through the CEMP. The mitigation measures that will be implemented in conjunction to the CEMP are listed in Table B.2.6.

Table B.2.6 Pre-Construction and Construction Phase Surface Water Mitigation Measures

Potential Impact	Mitigation Measure
Sedimentation and runoff	▪ Develop erosion sediment control measures as part of the CEMP detailing construction ideas, dimensions, materials, expected outcomes and implementation. ▪ Cover vehicles transporting material and provide shakedown facilities. ▪ Provide washdown bays in key locations to reduce transport of sediment off site. ▪ Design and construct to retain runoff internally within engineered bunds ▪ Integrate management actions for stormwater management in the CEMP.
Hydrocarbon and chemical spills	▪ Maintain an up-to-date hazardous materials register for materials on site. ▪ Locate safe and effective fuel, oil and chemical and washdown facilities away from watercourse and drainage channels. ▪ Store materials in clearly designated areas. ▪ Construct storage areas to consist of a compacted base and bunding to contain spillages, as per AS/NZS 3833:2007, AS1940:2004 (Standards Australia, 2004a), AS 3780:2008 (Standards Australia, 2008a), AS/NZS 4452:1997 (Standards Australia, 1997a) and AS/NZS 4681:2000 (or appropriate standard at the time) and roofed to prevent contamination and infiltration by stormwater. ▪ Apply CEMP that detail onsite management of above-ground construction activities and facilities. ▪ Include in the CEMP all identified sensitive receptors in the Project Area and include a suitable Emergency Spill Containment Plan. ▪ Provide spill control materials including booms and absorbent materials, to control the event of chemical spill. ▪ Educate relevant site personnel in appropriate chemical handling and response techniques. ▪ Install oil and grit separators for equipment maintenance areas on site.

Following implementation of the above mitigation measures the residual risk to surface water during construction from erosion and sedimentation and spills is considered low.

B.2.5.1.2 Groundwater

Potential groundwater impacts during the construction phase of the PEP will be managed through the CEMP. Mitigation measures that will be implemented in conjunction to the CEMP are listed in Table B.2.7.

Table B.2.7 Construction Phase Groundwater Mitigation Measures.

Potential Impact	Mitigation Measure
Hydrocarbon and chemical spills	▪ Maintain an up-to-date hazardous materials register for materials on site. ▪ Locate safe and effective fuel, oil and chemical and washdown facilities away from watercourse and drainage channels. Store materials in clearly designated areas. ▪ Construct storage areas to consist of a compacted base and bunding to contain spillages, as per AS/NZS 3833:2007, AS1940:2004 (Standards

Potential Impact	Mitigation Measure
	Australia, 2004a), AS 3780:2008 (Standards Australia, 2008a), AS/NZS 4452:1997 (Standards Australia, 1997a) and AS/NZS 4681:2000 (or appropriate standard at the time) and roofed to prevent contamination and infiltration by stormwater. ▪ Apply CEMP that detail onsite management of above-ground construction activities and facilities. ▪ Include in the CEMP identified sensitive receptors in the Project Area and include a suitable Emergency Spill Containment Plan. ▪ Provide spill control materials including booms and absorbent materials, to control the event of chemical spill. ▪ Educate relevant site personnel in appropriate chemical handling and response techniques.

Placement of dredge material in reclamation area	▪ Ongoing monitoring of groundwater levels and water quality, at perimeter bores. If potential effects are observed, corrective actions would include:
	  ▪ further investigation to qualify, quantity and delineate impacts
	  ▪ identify and implement appropriate management and/or remediation measures.
	▪ Implementation of an Acid Sulphate Soil Management Plan devised by the contractor.

Following implementation of the above mitigation measures the residual risk to groundwater during construction from spills and placement of dredge material in the reclamation area is considered low.

B.2.5.2 Operational Phase

Mitigation measures considered for surface water and groundwater during the operational phase of the Townsville PEP are described in the following sections.

B.2.5.2.1 Surface Water

The potential surface water impacts that will present throughout the operational phase will be managed through the implementation of appropriate mitigation measures presented in Tale B.2.8.

Table B.2.8 Operational Phase Surface Water Mitigation Measures

Potential Impact	Mitigation Measure
Sedimentation and runoff	▪ Develop and apply a site based stormwater management strategy to system requirements and engineering design. ▪ Design stormwater management measures to capture and filter runoff, without effecting overland flows. ▪ Erosion and sediment controls will be regularly inspected by tenants for maintenance and efficiency. ▪ Apply requirements of Queensland Urban Drainage Manual (DNRW, 2007) and the principles of water sensitive design. ▪ Tenants will prepare an operational Stormwater Management Plan that aligns to the *Model Urban Stormwater Quality Management Plans and Guidelines.*
Hydrocarbon and chemical spills	▪ Maintain an up-to-date hazardous materials register for materials on site. ▪ Locate safe and effective fuel, oil and chemical and washdown facilities away from watercourse and drainage channels. Store materials in clearly designated areas. ▪ Construct storage areas to consist of a compacted base and bunding to contain spillages, as per AS/NZS 3833:2007, AS1940:2004 (Standards Australia, 2004a), AS 3780:2008 (Standards Australia, 2008a), AS/NZS 4452:1997 (Standards Australia, 1997a) and AS/NZS 4681:2000 (or appropriate standard at the time) and roofed to prevent contamination and infiltration by stormwater. ▪ Apply operational environmental management plans (OEMP) that detail onsite management of above-ground construction activities and facilities.

Potential Impact	Mitigation Measure
	▪ Apply Emergency Spill Containment Plan. ▪ Provide spill control materials including booms and absorbent materials, to control the event of chemical spill. ▪ Educate relevant site personnel in appropriate chemical handling and response techniques. ▪ Install oil and grit separators for equipment maintenance areas on site.

Following implementation of the above mitigation measures the residual risk to surface water during operation from erosion and sedimentation and hydrocarbon and chemical spill is considered low.

B.2.5.2.2 Groundwater

Table B.2.9 identifies the mitigation measures to be implemented during the operational phase in order to reduce the level of risks to the groundwater.

Table B.2.9 Operational Phase Groundwater Mitigation Measures

Potential Impact	Mitigation Measures
Handling and storage of materials	▪ Maintain an up-to-date hazardous materials register for materials on site. ▪ Locate safe and effective fuel, oil and chemical and washdown facilities away from watercourse and drainage channels. Store materials in clearly designated areas. ▪ Construct storage areas to consist of a compacted base and bunding to contain spillages, as per AS/NZS 3833:2007, AS1940:2004 (Standards Australia, 2004a), AS 3780:2008 (Standards Australia, 2008a), AS/NZS 4452:1997 (Standards Australia, 1997a) and AS/NZS 4681:2000 (or appropriate standard at the time) and roofed to prevent contamination and infiltration by stormwater. ▪ Apply OEMP that detail onsite management of above-ground construction activities and facilities. ▪ Include in the OEMP all identified sensitive receptors in the Project Area and include a suitable Emergency Spill Containment Plan. ▪ Provide spill control materials including booms and absorbent materials, to control the event of chemical spill. ▪ Educate relevant site personnel in appropriate chemical handling and response techniques. ▪ Install oil and grit separators for equipment maintenance areas on site.

Placement of dredge material in reclamation area	▪ Ongoing monitoring of groundwater levels and water quality, as required. If poor quality are observed, corrective actions would include :
	  ▪ further investigation to qualify, quantity and delineate impacts
	  ▪ identify and implement appropriate management and/or remediation measures.

Following implementation of the above mitigation measures the residual risk to ground water during operations from chemical spill and placement of dredge material in the reclamation area is considered low.

B.2.6 Assessment Summary

The construction and operational phases of the PEP will have limited impacts on the surface water and groundwater environments. Flood impact modelling demonstrates that the PEP will not adversely change the flood levels in the Study Area and its surroundings.

The main potential risks of impact are associated with:

- the handling and storage of chemicals and materials, and the placement of dredge material that may risk small volumes of PASS into the reclamation area during construction
- the management of bulk loose cargoes and other trade products that may release low levels of contaminants onto PEP lands that may be released during rain events during operations.

The identified management measures for the construction and operational phases of the Project such as internal retention of stormwater drainage during construction and operational stormwater management practices and infrastructure will reduce the potential impacts on water resources.

Port Expansion Project EIS

Part B

Section B3 – Coastal Processes

AECOM BMT WBM

B.3 Coastal Processes

B.3.1 Relevance of the Project to Coastal Processes

This chapter addresses the physical hydrodynamic and sedimentation processes as set out in Section 5.4.1 of the *Townsville Port Expansion Project Terms of reference for an environmental impact statement, February 2012* (Terms of Reference) (Appendix A1), issued by the Queensland Coordinator-General, relating to the coastal environment. It also meets the requirements of the *Guideline for an Environmental Impact Statement for the Port of Townsville Port Expansion Project, Queensland* (EIS Guidelines), issued by the Australian Government Department of Sustainability, Environment, Water, Population and Communities and the Great Barrier Reef Marine Park Authority (Appendix A2). Consistent with this, the coastal processes as described herein include the hydrodynamic factors, particularly waves and currents, sediment transport forced by those factors and the resulting seabed and coastal morphology in the littoral and marine zone of Cleveland Bay at and adjacent to the Project Area.

Chemical properties of the marine sediments and water quality aspects are addressed in separate parts of this EIS.

As such, this chapter provides:

- A description of the key existing coastal processes in the broader Study Area that potentially may be affected directly or indirectly by the Port Expansion Project (PEP).
- An assessment of the impacts on these coastal processes likely to be result from PEP. Specifically taking into account the construction and operation of the new port and associated infrastructure, including breakwater construction and reclamation areas.
- The measures to manage and mitigate potential impacts to coastal processes.

B.3.2 Assessment Framework and Statutory Policies

B.3.2.1 Applicable Legislation and Policies

Prospective changes to coastal processes from the Project are a relevant consideration in the context of impacts on Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and also the *Great Barrier Reef Marine Park Act 1975* (GBRMPA Act), if such changes materially affect the declared marine park or its values.

From a Queensland Government perspective, the matters outlined in this chapter deal with aspects of the Project that require assessment under the provisions of the *Coastal Protection and Management Act 1995* (Coastal Act). Specifically the Project's consistency with the relevant policies of the *Queensland Coastal Plan*, including the *State Planning Policy 3/11: Coastal Protection* (Coastal Protection SPP)[1] and the *State Policy for Coastal Management* (Coastal Management Policy).

The Queensland Coastal Plan is the leading statutory instrument in the management of the Queensland coastline, replacing the former State and Regional Coastal Management Plans. It aims to provide a sustainable future for the Queensland coast, with a strong emphasis on planning for the impacts of climate change.

Responsibility for the implementation of the Queensland Coastal Plan predominantly lies with the Queensland Government and local governments. It is applied by government as both the land managers of coastal land and existing coastal developments, and decision-makers for approval of future coastal development.

---

[1] State Planning Policy 3/11 Coastal Protection was replaced by the Queensland Government on 8 October 2012 by the *Draft Coastal Protection State Planning Regulatory Provision: Protecting the Coastal Environment*. The Draft SPRP will operate for 12 months unless earlier repealed. Due to the release of the Draft SPRP at such a late juncture in the preparation of the PEP EIS, the various chapters and assessments contained within the EIS address SPP 3/11 as required by the approved Terms of Reference for the Project under the *State Development and Public Works Organisation Act 1971*. If required and still in place at the time of preparation, the EIS Supplement will address the Draft SPRP to the extent required by the Coordinator General.

Natural coastal processes are protected under the Coastal Management Policy. According to Policy Outcome 1, natural coastal processes including longshore transport of sand, are not to be interrupted or disrupted by structures or dredging. Policy 1.3 provides that such disruption may occur where it does not significantly impact on coastal management or can be compensated for by sand bypassing or the addition of new sediments to balance the loss.

Under the Coastal Protection SPP, relevant policies include:

- Section 2 – Coastal Hazards.
- Section 3 – Nature Conservation.
- Section 6 – Coastal Dependent Development.

In particular, policies 6.5 (Dredging and Disposal of Dredged Material) and 6.6 (Reclamation) are relevant to the proposal.

B.3.2.2 Assessment Framework and Methodology

B.3.2.2.1 Impact Assessment

The EIS guidelines have been followed in assessing the impacts on coastal processes by:

- determining the nature and behaviour of the existing conditions and processes occurring
- assessing the potential changes to processes affecting the existing conditions that may be caused by the PEP.

A review of available relevant literature and existing data was undertaken in order to:

- characterise existing coastal processes that affect the stability and integrity of the physical marine and coastal environment (coastal landforms) in and around the port
- identify potential issues that are of key relevance to the impact assessment process, particularly with respect to maintaining the integrity of The Strand.

Key sources utilised during the review of existing literature are set out in Appendix B2 of the EIS. Review of available existing information as published in reports and other source documents has been augmented by additional investigations undertaken as part of the EIS preparation.

Coastal processes have been considered in two broad categories, based on their morphological nature and the predominant sediment transport mechanisms, namely:

- Cleveland Bay marine hydrodynamic and sedimentation processes, including siltation in dredged areas and effects of dredged material placement.
- Beach system processes at the shoreline.

Each of these systems has been investigated and assessed somewhat independently using different modelling and/or analysis methods as described, although there are common factors affecting them, such as the prevailing incident waves and water level regime.

B.3.2.3 Data Sources

Data and information have been sourced for this EIS from existing publications and databases as referenced and from field measurements undertaken by the proponent specifically in support of the investigations undertaken listed below.

Hydrographic Survey

Hydrographic (bathymetric) data were sourced from the following:

- local hydrographic survey data
- bathymetric data of Cleveland Bay and the Great Barrier Reef Lagoon from external sources
- Navigation Charts
- Geoscience Australia Australian Waters Digital Elevation Model (250m grid).

Elevation data was converted to metres above Australian Height Datum (mAHD).

Wind Data

Wind data was sourced from regional Commonwealth Bureau of Meteorology and Australian Institute of Marine Science stations, and the local P14 station maintained by the Port of Townsville. A spatially variable wind field was constructed by interpolation between stations. The detailed list of the meteorological stations and the interpolation procedure is provided in Appendix H1 of the EIS.

Current and Wave Data

As part of the Preliminary Engineering and Environmental Study (PEES) for the port expansion which was undertaken in 2008/2009, a bottom-mounted Acoustic Doppler Current Profiler (ADCP) was deployed in the near-shore zone in the vicinity of Platypus Channel (BMT WBM, 2009). This coincided with the deployment of the sediment deposition/turbidity/light sensor units described below. The location was chosen to provide representative Cleveland Bay current and wave conditions in a water depth of approximately 5m. This deployment provided a range of tide, wind and wave conditions during typical (but different) spring and summer periods. A full description of the data is provided in the Oceanographic Data Collection Report (BMT WBM, 2009) prepared as part of PEES.

In addition, the model has been validated against ADCP data collected at two other locations between October 2010 and February 2011. This deployment focussed on collecting hydrodynamic data at the offshore Dredge Material Placement Area (DMPA) and on the eastern shoreline of Magnetic Island. The data retrieved has been processed and analysed to provide the appropriate water level current and wave parameters necessary for model calibration and validation purposes (Appendix H1).

Simultaneous regional data were also collated from other sources including offshore wave data from the Department of Environment and Heritage Protection (EHP) (formerly DERM) Waverider buoy. The buoy is located about 25 km east of the port, and does not provide a direct indication of the wave climate in Cleveland Bay or at the study site. In addition to collecting current data, the ADCPs deployed in this study also measured local wave conditions.

The ADCP deployment sites are shown in Figure B.3.1.

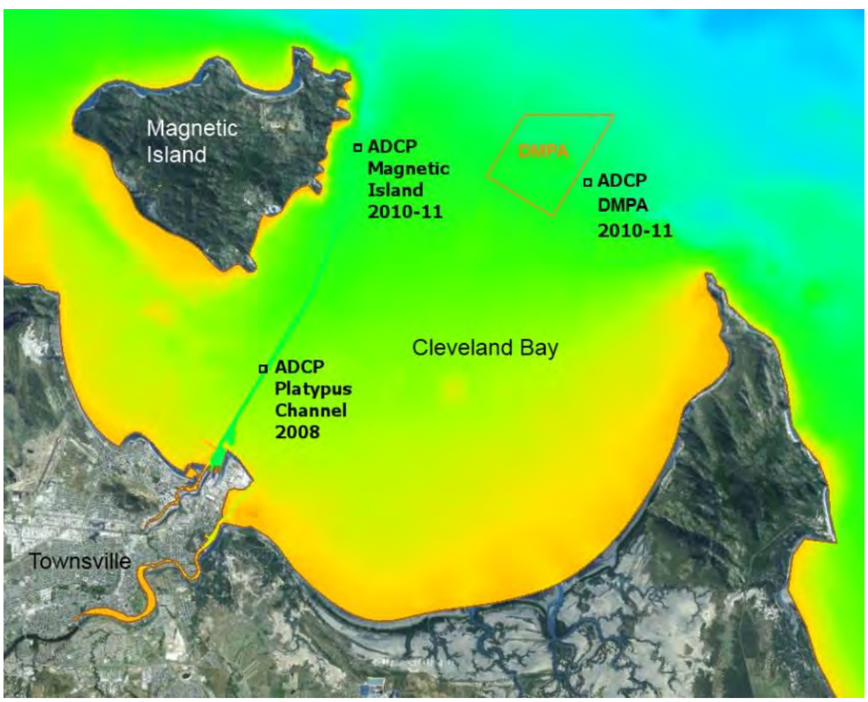


Figure B.3.1 Acoustic Doppler Current Profiler Measurement Sites (aerial image – Google Maps)

Tidal Data

Tide level data from regional tide gauges were obtained from Maritime Safety Queensland (MSQ).

The model extents are such that transverse tidal phasing is evident across the boundaries. As such, careful attention was paid to constructing these boundaries. A calibrated regional tide model developed by BMT WBM was used for this purpose (Appendix H1).

B.3.2.4 Modelling

The measured data describing the hydrodynamics of the marine environment in Cleveland Bay have been supported and enhanced using validated numerical models. These models facilitate description of complex interactions of processes, including those not able to be measured directly for practical and logistical reasons, and were used as the key method of assessment of impacts of the PEP. They have been shown in many previous studies to simulate the hydrodynamic processes reliably and accurately and are capable of reproducing the dominant wave-current driven sedimentation processes in a manner suitable for impact assessment purposes.

The methodology for evaluation of hydrodynamic (HD) and advection-dispersion (AD) processes in Cleveland Bay was based on coupled three-dimensional modelling. The modelling system TUFLOW-FV was used. This is a finite volume model that handles both HD and AD components in a flexible mesh computational grid format.

Spectral wave modelling based on the SWAN software system was used to describe the wave climate and wave propagation. SWAN is an industry standard modelling system and is linked to TUFLOW-FV to cater for interaction of wave, water level and current processes and their effects on sediment re-suspension, transport and deposition across Cleveland Bay.

These models have been applied and verified as reliable for the purpose of impact assessment by BMT WBM on several other major studies involving wave/current driven sedimentation processes including:

- Gladstone Western Basin Dredging and Disposal Project (coastal studies).
- Murray River Mouth, Coorong and Lower Lakes Environmental and Morphological Modelling.
- MetOcean and Sedimentation Study for LNG Import Terminal, Pipavav Port, India.

A key advantage of employing the flexible mesh model framework was its ability to adjust the spatial resolution of the computational network and, in particular, to increase resolution in areas of specific interest to the study. In the current study, these areas include the PEP works sites, and the existing infrastructure in the immediate vicinity, such as breakwaters and berths. The hydrodynamic model was constructed to resolve these structures, with resolution also being commensurately reduced in areas where it was not needed, such as outside Cleveland Bay. As such, simulation times and efficiencies were not constrained by the highest resolution required.

Previous hydrodynamic modelling studies conducted for Port of Townsville include Wolanski *et al.* (1991), which focussed on the fate of dredge material placed at the DMPA and Mason *et al.* (1992), which focussed on the flushing from Cleveland Bay. GHD (2004) provides an investigation of hydrodynamic processes in the outer harbour and outputs of the Delft 3D model used by GHD. It also provides an overview and summary of historical data and investigations of hydrodynamic behaviour in Cleveland Bay and in the outer harbour area, providing a basis for assumptions about sediment transport patterns and their relationship to wind and wave processes. This was used to inform the modelling undertaken for the present EIS.

Formal calibration of the TUFLOW-FV numerical model was undertaken as part of the EIS study, described in more detail in the Hydrodynamic and Advection-Dispersion Modelling Technical Report contained in Appendix H1 of the EIS. Data used for calibration included Acoustic Doppler Current Profiler (ADCP) velocity and water level measurements from the PEES investigations (BMT WBM, 2009) and two ADCP deployments in Cleveland Bay undertaken as part of the current EIS investigations.

For assessment of beach system impacts along The Strand, the SWAN wave modelling provided the basis of determination of effects of the PEP on the prevailing waves that cause both alongshore transport of sand and cross-shore transfer of sand during storm events. The existing Port infrastructure has previously interrupted regional longshore sand transport to The Strand.

Extensive works have been undertaken over the past twelve years to redevelop The Strand beach system, creating beach compartments separated by controlling headland structures such that a new regime of stable beach alignments compatible with the prevailing incident wave climate is being (or has been) established. Assessment of likely impacts on The Strand beach thus focussed on analysis of the effects on the local wave-induced sand transport rates relative to the existing condition as established by those redevelopment works.

B.3.3 Existing Values, Uses and Charateristics

B.3.3.1 Study Area

The Study Area extends to the region that may potentially be affected by the PEP either directly or indirectly as well as additional surrounding areas as appropriate to facilitate comprehensive modelling and analysis (Figure B.3.2). It includes the whole of Cleveland Bay and its shorelines extending beyond the footprint of the Project Area, as a thorough understanding of the hydrodynamic and coastal processes operating in the Bay is required to make an evaluation of the impact of the PEP. This spatial extent has been confirmed as sufficient on the basis of previous assessments (Wolanski, King, & Ridd, 1991; WBM, 1993; Kettle, Dalla Pozza, & Collins, 2001; GHD, 2009c) to optimise the port and channel design configuration from an operational and ongoing maintenance perspective as well as for assessments of potential impacts to the coastal environment and processes.

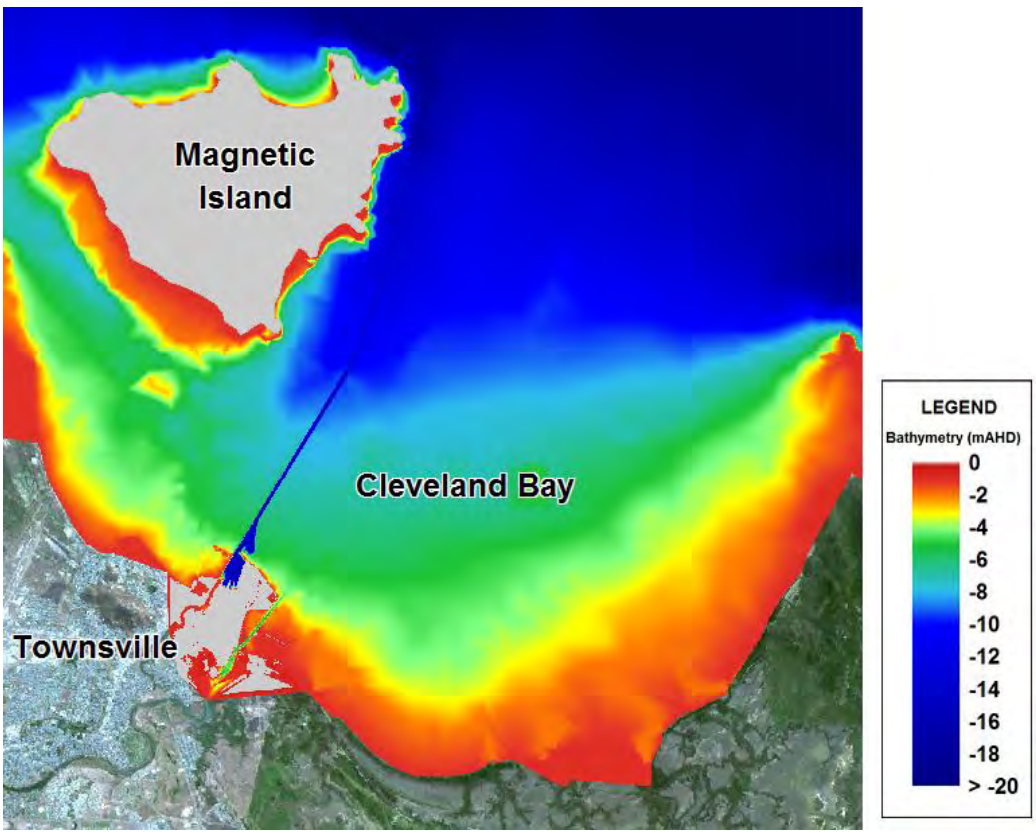


Figure B.3.2 Study Area and Cleveland Bay Bathymetry (aerial image – Google Maps)

B.3.3.2 Conceptual Description of Coastal Processes

Figure B.3.3 illustrates conceptually the broad coastal processes of Cleveland Bay, of relevance to this EIS. These processes and the marine and coastal landform morphology are described herein, together with assessment of potential impacts of the PEP. They include:

Hydrodynamics

Water levels relating to tides and storm surges.

- The wave climate, which comprises:
  - Ocean waves entering the Bay, which may be long period ‘swell’ or shorter period ‘sea’ and arrive from predominantly north to east-south-east direction sectors and propagate towards the port from the north to north-east direction.
  - Wind waves generated with Cleveland Bay.
- Currents in the Bay, generated predominantly by tidal and wind forcing.
- Freshwater inflows from the Burdekin River, Ross River and Ross Creek.
- Tidal flows at the Ross River and Ross Creek.
- Key influencing factors of cyclones and other severe weather events.

Marine Sedimentation Processes

- Fluvial sediment supply from the rivers and streams, which may be fine wash load that extends out into the Bay before settling to the seabed or coarser sand that deposits near the stream mouths and may be re-distributed along the coast by wave/currents action.
- Fine sediment supply to the Bay from the Burdekin River, carried in suspension by currents either directly or, predominantly, after nearshore deposition and subsequent re-suspension.
- Bay seabed sediment re-suspension, transport and deposition, potentially changing the seabed morphology or sediment composition and/or infilling dredged areas.

Shoreline Sedimentation Processes

- Alongshore sand transport at the beach shorelines, driven by wave breaking.
- Beach erosion and accretion along the adjacent beach system.
- Factors affecting and required for beach stability.

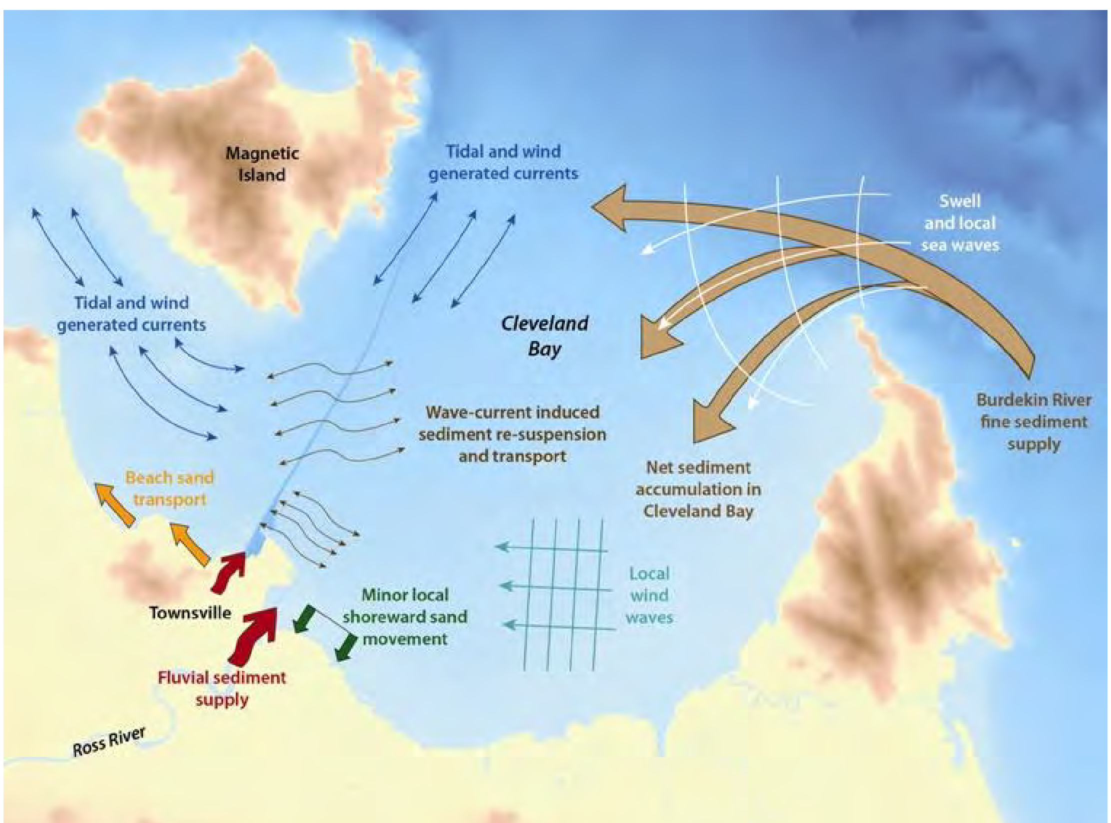


Figure B.3.3 Conceptual Coastal Processes in Cleveland Bay

Previous studies (Section B3.3.6.1) have confirmed that longshore sediment transport pathways have been disrupted by port infrastructure and that the PEP will impact only on local wind wave processes and local current patterns. Consequently, the Study Area for assessments relating to the beach system is, for practical purposes, constrained to the beaches immediately downdrift (west) of the PEP i.e. The Strand and Rowes Bay.

Across the GBR region, GBRMPA (2009) graded physical processes and summarised the changing nature in terms of impacting mechanisms such as cyclones, freshwater inflow, sedimentation, sea level and sea temperature (Figure B.3.4). The local processes described above must be contextualised within the setting and pressures of regional and global effects shown below.

Assessment component	Summary	Assessment Grade: Very good	Good	Poor	Very poor
Ocean currents	Ocean currents vary naturally and there is insufficient evidence to know if patterns are changing in the Great Barrier Reef.	?			
Cyclones and wind	There is no evidence of more frequent cyclones but there is evidence of increased intensity.		●		
Freshwater inflow	Freshwater flows may be affected by drainage patterns in the catchment.		●		
Sedimentation	Exposure of the Great Barrier Reef to terrestrial sediments has increased, especially in inshore areas.			○	
Sea level	Sea levels have risen in the Great Barrier Reef and are projected to rise further.		●		
Sea temperature	Average water temperature across the Great Barrier Reef is increasing.			○	
Light	Increased sedimentation may be altering light levels in inshore areas.		?		
Physical processes	The physical processes of the Great Barrier Reef are changing, in particular sedimentation and sea temperature. Further changes in factors such as sea temperature, sea level and sedimentation are expected because of climate change and catchment runoff.		◉		

GRADING STATEMENTS

- **Very good** - There is no evidence of significant changes in physical processes.
- **Good** - Some physical processes have changed in some areas, but not to the extent that the changes are significantly affecting ecosystem function.
- **Poor** - Physical processes have changed substantially in some areas to the extent that ecosystem function is significantly affected in some parts of the Region.
- **Very poor** - Physical processes have changed substantially and over a wide area. Ecosystem function is seriously affected in much of the Region.

Figure B.3.4 GBR region physical processes (after GBRMPA (2009) section 3.6.1)

B.3.3.3 Geological and Geomorphological Setting

The Townsville coastline is located along the southern boundary of Cleveland Bay, a U-shaped north facing embayment, 25km wide and 15km north to south, bounded to the east by Cape Cleveland and to the west by Cape Pallarenda. Magnetic Island is a dominant feature lying offshore partially in the north-west part of the bay.

Cleveland Bay is located about 50 km north of the Burdekin River, and is also about halfway between the Burdekin and Herbert Rivers which provide the dominant sediment supply to the central Great Barrier Reef coast (Belperio, 1983; Moss, Rayment, Reilly, & Best, 1993). At the coast, bedload sediment (sand) from these rivers, and from the much smaller Houghton and Ross Rivers, comes under the influence of wind and wave induced longshore drift, and is transported northwards along the shoreline. During summer floods, suspended load muds, and some finer sand, are discharged directly onto the inner shelf, where they either accumulate at depths out to 20 m, or are advected back into the tidal mangrove systems which fringe the coastal plain (Belperio, 1983; Larcombe & Ridd, 1995) (Larcombe & Ridd, 1995; Larcombe & Ridd, 1996; Bryce, Larcombe, & Ridd, 2003) and ;. During cyclones, coarse material at the coast may be formed into sandy beach ridges (for example, along Cape Pallarenda) or, in the southern and eastern protected areas of the bay, deposited as shelly chenier ridges (Miller, 1982; Larcombe, Kirsch, Harvey, & Carter, 1999).

It has been established (Carter, Johnson, & Hooper, 1993; Kettle, Dalla Pozza, & Collins, 2001) that the mainland coastline of Cleveland Bay formed from deposition of sandy sediments delivered into the north-north-westward littoral drift from the predecessor of the Haughton and Burdekin Rivers up to about 3000 years ago, by which time:

- Sea level was established at its present post-glacial high.
- Cape Cleveland had become attached to the mainland.
- The shoreline had prograded to attach Cape Pallarenda.
- The Burdekin River had shifted south to discharge into Upstart Bay.
- Ross River, formerly a tributary of the Houghton River, became the residual dominant stream discharging into Cleveland Bay at its south-western section.

The Bay became highly sheltered from the predominant south-east waves by Cape Cleveland, creating a relatively low energy environment. Cleveland Bay has accumulated sediments to become relatively shallow, deepening to only 10 to 11 metres (chart datum) along its northern entrance. The predominant source of this ongoing supply of fine sediments and very fine sands is the Burdekin River. Kroon *et al* (2012) have estimated that the average yearly export of suspended sediment from the Burdekin is presently 4×10^6 tonnes per year. These sediments, once deposited on the sea floor, are advected northward by longshore currents driven by the prevailing south-easterly winds and waves (Belperio, 1983). Orpin *et al* (1999) conclude that wave-induced bed stress is the most significant mechanism of sediment re-suspension with non-cyclonic suspended-sediment concentration events mostly limited to the inner shelf in water depths < 15 m.

Woolfe and Larcombe (1998) indicate that the three embayments north of the Burdekin River (Bowling Green, Cleveland and Halifax Bays) show successively decreasing rates of terrigenous infill. Orpin *et al* (2004) conclude that 80 to 90% of the Burdekin River sediments are captured in Bowling Green Bay. Orpin et al. (1999)estimate the longshore sediment export from Bowling Green Bay into Cleveland Bay to be $\sim 3 \times 10^8$ kg/year. Orpin *et al* (2004) find that Upstart and Cleveland Bays trap about the same amounts of sediment, about 5 to 10% of the total average Burdekin fluvial discharge, with accumulation rates < 1mm/yr. They note that the accumulation rate is a function of re-suspension and re-deposition as well as supply and that the Cleveland Bay tidal and sub-tidal zone is extensively reworked, re-suspended and re-deposited with relatively small net inputs during the last century. Further, they suggest an episodic rather than continuous pattern of deposition, as deduced from core data.

This combination of factors lead to a change in dominant seabed sediments in the Bay to poorly sorted slightly muddy sand in nearshore areas fining to mud further offshore (Kettle, Dalla Pozza, & Collins, 2001). The coastline was shaped by the prevailing waves and currents at a slow rate, determined by the generally low energy waves, punctuated by occasional higher energy cyclone wave occurrences that are able to penetrate across the bay to the shoreline. The Ross River continued to discharge sandy material to the coastline that spread only weakly away from its mouth, predominantly towards the west. This formed a sandy beach system in two compartments to Cape Pallarenda, separated by Kissing Point, as a result of the combined sand supply from the Ross River and sufficient wave energy there to transport the sand alongshore.

B.3.3.4 Hydrodynamics

B.3.3.4.1 Water Levels

Water level variations in Cleveland Bay result from the effects of:

- Tidal influences; and
- Storm surges associated with cyclones and severe weather systems in the region.

The astronomical tide is predominantly semi-diurnal with the dominant tidal planes as specified in the Maritime Safety Queensland (MSQ) Tide Tables (2012) given in Table B.3.1. Typical variation in the tides throughout the year is illustrated in Figure B.3.5 for 2010, showing the neap-spring cycles. This shows that there is significant fortnightly variation in the spring tides and a slight variation in the 5-day mean levels during the year.

Table B.3.1 Tidal Planes at Townsville Port

Tidal Plane	Level to local chart datum (m)	Level to AHD (m)
HAT	4.11	2.25
MHWS	3.11	1.25
MHWN	2.26	0.40
MSL	1.94	0.08
MLWN	1.63	-0.17
MLWS	0.77	-1.09

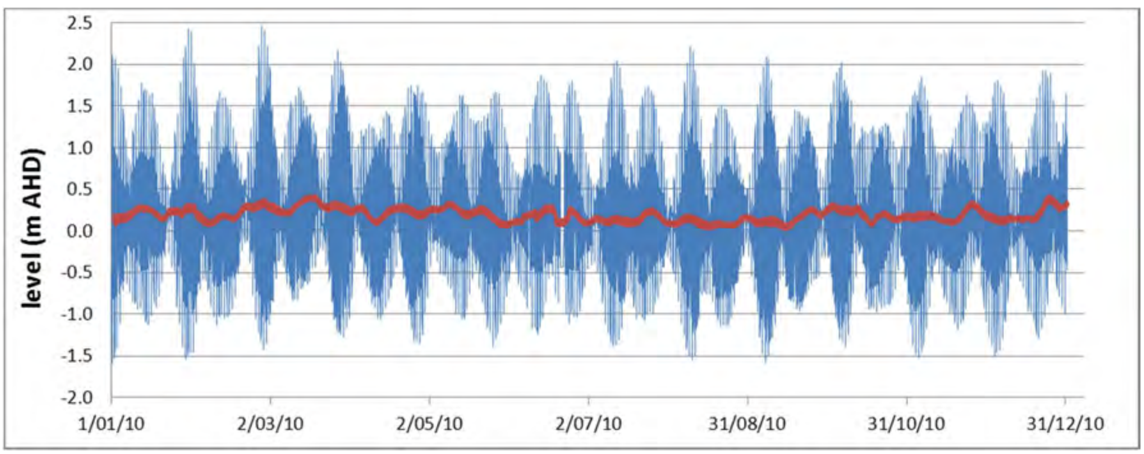


Figure B.3.5 Typical Tidal Variation at Townsville (Hourly – Blue; 5-day Average – Red): 2010

The tide propagates to Cleveland Bay from the east across the Great Barrier Reef (GBR) Lagoon. The modelling described in Section B3.3.4.4 shows the pattern of its propagation into the Bay past and around Magnetic Island.

The storm tide is the total water level resulting as the combination of tide and surge during a storm event. Storm surges and storm tide levels in Cleveland Bay have been investigated over many years, the most recent assessment undertaken by GHD (2007). This considers and updates previous work and is used herein as the most suitable source for consideration in this EIS. Design storm surge and storm tide levels are determined on a probabilistic basis utilising modelling, as the data record of historical storm tide levels is insufficient for that purpose. Table B.3.2 sets out the storm tide probabilities in terms of average return intervals (ARI).

Table B.3.2 Storm Tide Levels at Townsville

ARI (years)	Storm tide level to AHD (m)
50	2.28
100	2.46
200	2.52
500	3.11
1000	3.60

Several historical cyclone events have caused extreme elevated water levels that have been recorded at Townsville over the past century. Of these, cyclone Althea in 1971 is the most severe, passing close to the city with a surge of 2.9m and a resulting storm tide level of about 4.5m (chart datum corresponding to 2.65m (AHD). The recent cyclone Yasi in February 2011 remained 150km to the north, crossing the coast north of Cardwell, yet caused a peak storm surge of 2.36m that coincided with low tide and a peak storm tide level with the high tide 5 hours later at Townsville of 4.48m (chart datum) corresponding to 2.62m (AHD) (Figure B.3.6).

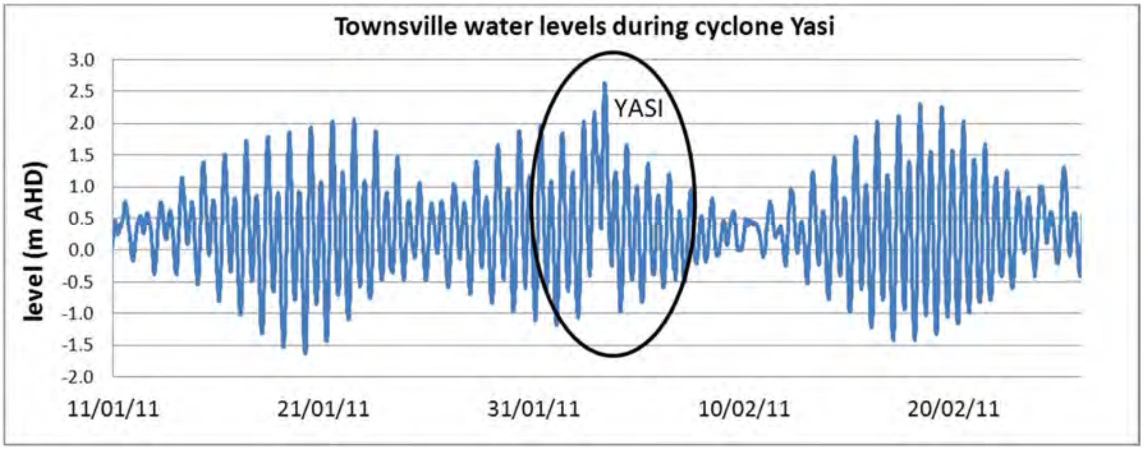


Figure B.3.6 Tide and Storm Tide Levels During Cyclone Yasi: February 2011

B.3.3.4.2 Salinity and Temperature

Salinity in Cleveland Bay is driven by the balance between evaporation and the wet season freshwater inflows from local catchments such as Ross River and Ross Creek and from the major regional source of the Burdekin River. Slightly hypersaline salinities are experienced during the winter dry season and lower salinities in the range 20 to 30psu have been measured in Cleveland Bay during certain summer wet seasons (Walker, Seasonal salinity variations in Cleveland Bay, northern Australia, 1981a). Bainbridge et al. (2012) described a vertically stratified Burdekin River plume affecting the Study Area during the 2010/11 wet season.

Water temperatures in Cleveland Bay typically range from a July minimum of around 20°c to a January maximum of around 30°c (Walker, 1981b). In general it is expected that the vertical structure would be generally well-mixed during the winter and weakly stratified due to vertical salinity and temperature gradients during the dry season. Some moderate vertical stratification effects due to the Burdekin River flood plume were captured in the hydrodynamic model for the 2010/11 wet season.

B.3.3.4.3 Wave Climate

Cleveland Bay and its southern shoreline are largely protected from the predominant prevailing east to south-east waves in the region by Cape Bowling Green and Cape Cleveland. On a regional scale, the Great Barrier Reef shelters the mainland from the deep ocean waves that occur further out to sea. As such, the prevailing waves are predominantly ‘sea’ generated by the local winds. Swell from distant sources is generally not significant in Cleveland Bay, but may be identified from time to time when they are particularly large at their source and the local wind waves are small.

Cape Cleveland Waves

Wave data recording has been undertaken off Cape Cleveland by the Department of Environment and Heritage Protection (EHP) (formerly by the Beach Protection Authority and DERM) since 1975, initially without direction data but over recent years including full spectral directional information. Those data shows that significant wave heights (H_s) up to about 2m occur most years and the highest H_s recorded there was just under 3 m until higher waves (to 5.5 m) from cyclone Yasi were recorded in February 2011. Spectral peak periods generally range up to about 6 to 7 seconds, consistent with the predominance of local ‘sea’, but occasionally may be 8 to 15 seconds when local winds are light and low swell up to about 0.3 to 0.5 m is the dominant wave train.

WBM Oceanics Australia (1993) presented an analysis of the breakdown of the recorded wave spectra into the component 'sea' and swell for the period April 1992 to March 1993. This confirmed the dominance of the shorter period 'sea' and showed for that period:

- There is a cut-off at about 6.5 to 7 seconds that separates sea from swell.
- Sea and swell commonly coexist.
- The swell is typically less than 0.3m in height but often reaches up to 0.5 to 0.6m, the highest swell being 0.7m in February 1993 when cyclone Oliver passed down the coast about 500km offshore.
- Swell periods are predominantly in the range 7 to 10 seconds.

The recorded directional data shows a dominance of easterly waves with substantially lower (Figure B.3.7) occurrences from east-north-east to north and only minor occurrences from other directions. The general lack of south-east waves despite the predominance of south-east winds is the result of the effect of Cape Bowling Green in blocking waves generated in the GBR Lagoon from south of about 100 degrees.

At times when a low underlying swell is dominant, in the absence of wind-generated 'sea', its direction is determined by its original source, with deep ocean swell approaching mainly from north-east at about 35-60 degrees whereas the more dominant swell generated along the GBR lagoon to the east and south-east approaches Cape Cleveland from the east (90-95 degrees) after passing Cape Bowling Green (Figure B.3.8).

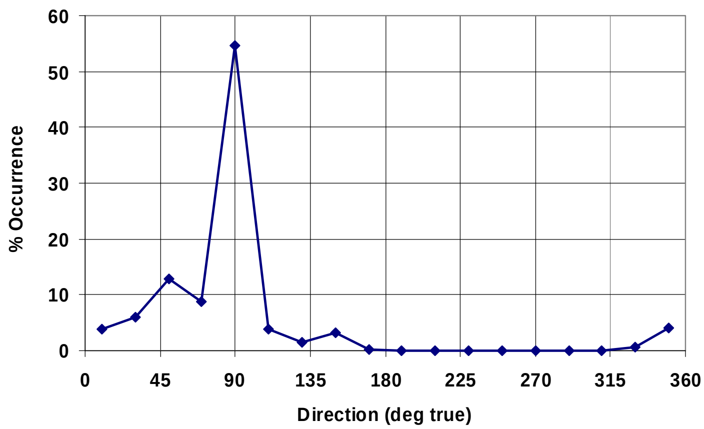


Figure B.3.7 Wave Direction Occurrence at Cape Cleveland

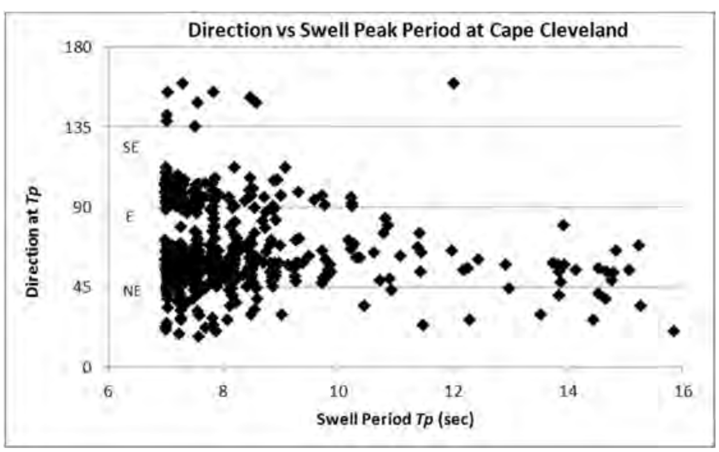


Figure B.3.8 Typical Swell Wave Directions at Cape Cleveland (Period > 7s)

Simple analytical wave hindcasting based on local winds in the immediate region has been used to assess the general nature and predominant source of the waves recorded at Cape Cleveland. Time series wind speed and direction from Flinders Reef has been used for that purpose, with approximate representation of fetch lengths and depths, taking account of the effect of Cape Bowling Green. Figure B.3.9 shows the hindcast wave heights thus derived, together with the recorded significant wave heights at Cape Cleveland for a 12 month period during 2003/04. The correlation is reasonably good, confirming that the dominant waves at that location are generated predominantly by the regionally representative wind and that simple hindcasting can provide a reasonable basis for estimating the incident wave conditions at Cape Cleveland.

Also shown in Figure B.3.9 are wave periods and directions. The periods correspond to wind generated 'sea' and have been found to correlate best with the recorded spectral peak periods using the relationship $T = 5\,H_s^{0.5}$. Ocean swell is not predicted in this method and can be seen in the recorded data with periods greater than about 7 seconds. Directions are limited by the effect of Cape Bowling Green and are predominantly from about 90 to 100 degrees with some north-east sector components, consistent with Figure B.3.7. On the occasions when the recorded directions are from the south-east (~130 to 160 degrees), the wave periods are low (2 to 3 seconds), indicating very locally generated small 'sea' conditions.

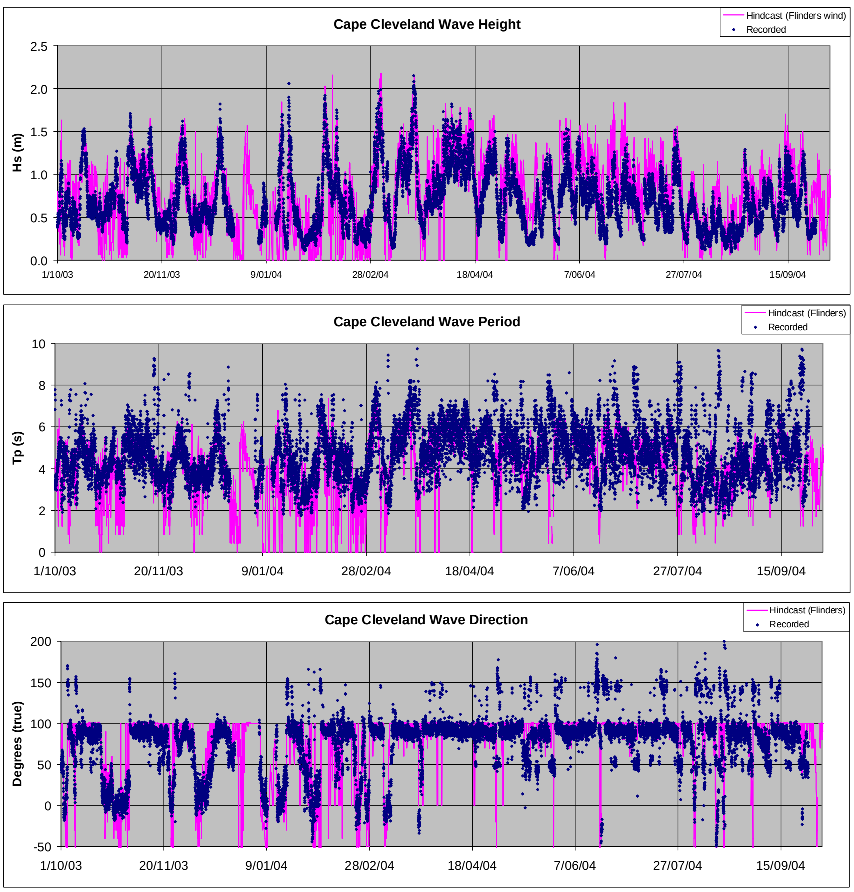


Figure B.3.9 Recorded and Simple Hindcast Waves at Cape Cleveland

SWAN Wave Models

Comprehensive spectral wave models covering the broader region surrounding and in Cleveland Bay were established to assess in more detail the wave climate and wave propagation in the context of the PEP, particularly for assessment of shoreline processes and for coupling with the hydrodynamic model.

The SWAN numerical model (Delft University of Technology, 2006) was used for this purpose. A detailed description of the model and its validation is presented in Appendix H1 of the EIS. SWAN has been applied to simulate both propagation of ocean swell and the generation and propagation of waves generated by winds in the model domain, providing for dissipation by white-capping, depth-induced wave breaking, bottom friction and wave-wave interactions in both deep and shallow water. SWAN simulates wave propagation in two-dimensions, including shoaling and refraction due to spatial variations in bathymetry and currents.

A regional model covering a large section of the Great Barrier Reef lagoon and Coral Sea was established to identify and simulate both deep ocean waves and more locally generated wind waves (grid resolution approximately 1600m). Finer resolution simulation of wave propagation to Cape Cleveland and in Cleveland Bay has been achieved by establishing a nested grid (~330m resolution) sub-model in the larger regional domain. Those SWAN model domains are shown in Figure B.3.10. Additionally, a more local SWAN model of 100m grid resolution was established for the region immediately surrounding and in Cleveland Bay, with additional nested grids of 50m and 15m resolution at and near the shoreline and breakwater structures, for use in simulating wave propagation to specific nearshore locations, forced by the waves recorded at Cape Cleveland.

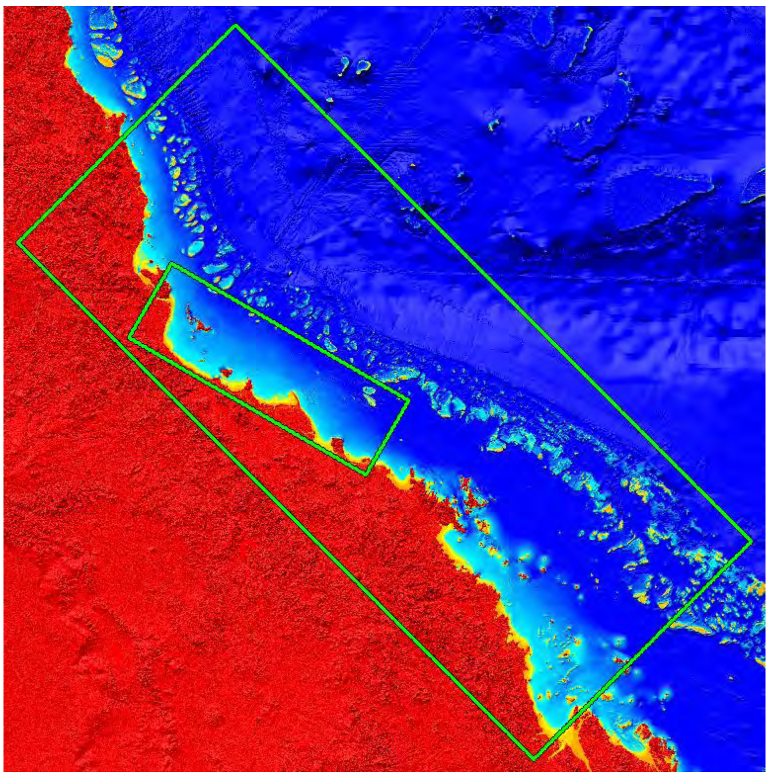


Figure B.3.10 Regional and Nested SWAN Model Domains

Wave generation and propagation in the deep ocean and the GBR Lagoon have been simulated with SWAN using wind boundary conditions were extracted from global NCEP model reanalysis. The EHP Waverider recorder at Cape Cleveland thus provides an internal point of regional wave prediction validation. Validation of the modelled wave propagation in Cleveland Bay has been undertaken by correlation with data recorded using bottom-mounted ADCP equipment at three separate locations shown in Figure B.3.11.

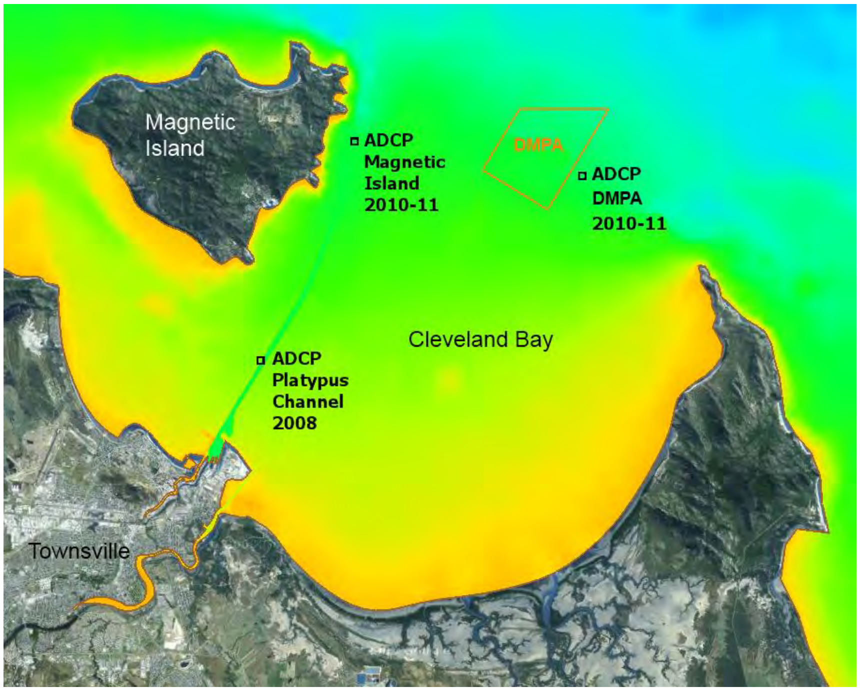
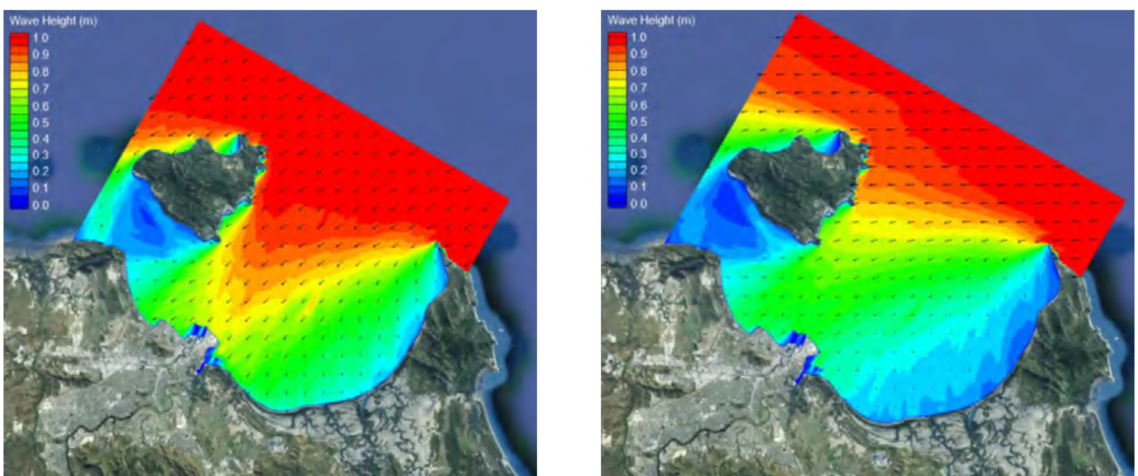


Figure B.3.11 **Locations of ADCP Recorders in Cleveland Bay** (aerial image – Google Maps)

Typical patterns of swell, sea and wind generated local wind-wave conditions based on the local 100m resolution SWAN model are illustrated in Figure B.3.12, Figure B.3.13 and Figure B.3.14 respectively, showing wave height (colour contours) and direction (vector arrows) variation across Cleveland Bay. These show the extent of variation of wave heights across the Bay and adjacent to the port area needed to be accounted for properly in determining wave-related sedimentation processes.



East North-easterly Swell

Easterly Swell

Figure B.3.12 **Typical Ocean Swell Wave Propagation into Cleveland Bay** (aerial image – Google Maps)

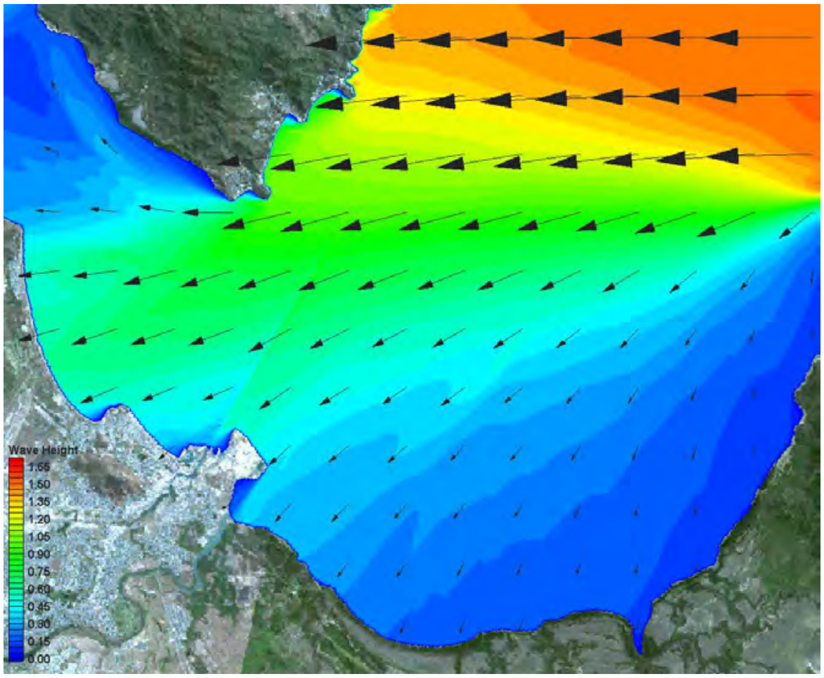


Figure B.3.13 Typical Sea Wave Propagation into Cleveland Bay: Hs = 1.5m; Tp = 6.5s (aerial image – Google Maps)

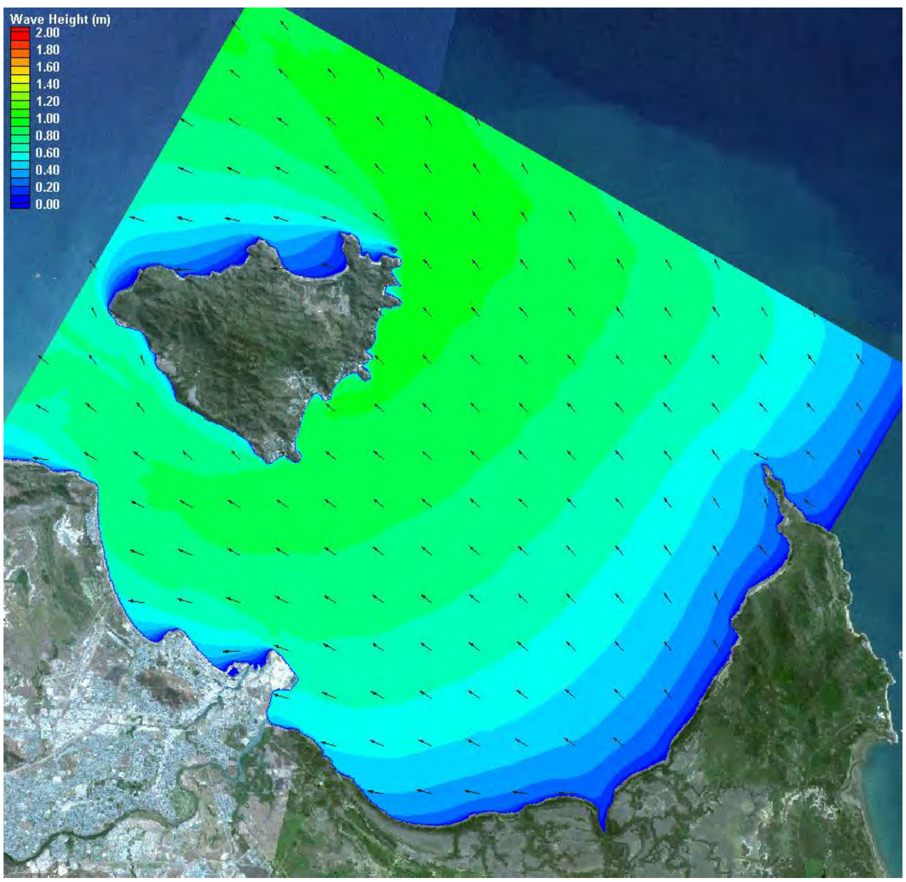


Figure B.3.14 Typical Local Wind Wave Generation in Cleveland Bay: ESE wind @ 25 knots (aerial image – Google Maps)

Measured wave data from the EHP Waverider Buoy and the two ADCPs deployed in 2010 (Figure B.3.11) were used to calibrate and validate the SWAN wave models. Figure B.3.15 shows the correlation between the modelled and recorded waves at Cape Cleveland, confirming good agreement in terms of regional wave generation. The results of the nested wave model calibration for Cleveland Bay are shown in Figure B.3.16 for the DMPA location and Figure B.13.17 for the Magnetic Island site. Agreement between the measured and modelled wave heights, directions and peak periods is very good in all cases, confirming the reliability and accuracy of the SWAN modelling.

An analysis of the prevailing waves for non-cyclone conditions for the Platypus Channel ADCP location (Figure B.13.11) has been undertaken in order to determine the typical spectral composition of the incident waves. This reveals the component wave trains in terms of long period swell, intermediate period sea and short locally generated wind waves, based on the ADCP data obtained for September 2008 to February 2009.

The wave spectra have been split into the three component wave groups (local wind-waves, sea and swell) using specified frequency limits for each component corresponding to <3.5s, 3.5 to 6.5s and >6.5s respectively. This is not intended to be a comprehensive description as there is overlap in the component wave train spectra across those limits. The wave height distributions derived for the component waves are shown in Table B.3.3. These are indicative only due to the limited length of the recording and the method used, but are presented to show the general comparative significance of each frequency component. Spectral energy in the three component groups co-exist much of the time, with equivalent significant wave heights predominantly in the range 0.2 to 0.6m. The local wind waves rarely exceed 1.0m in height. The underlying swell is less than 0.3m for 90% of the time. This method of distinction between 'sea' and 'swell' becomes increasingly unreliable for storm and cyclone events when larger 'sea' develops spectra with substantial energy at longer wave periods.

Table B.3.3 Occurrence (%) of Component Waves in Each Height Category at Beacon 9

H_s range (m)	'Swell' (T>6.5s)	'Sea' (T=3.5-6.5s)	Local wind waves (T<3.5s)	TOTAL
0.0 – 0.1	40.6	8.3	8.7	3.3
0.1 – 0.2	32.5	23.9	18.6	5.9
0.2 – 0.3	17.0	26.0	25.7	15.6
0.3 – 0.4	5.5	20.3	26.8	20.5
0.4 – 0.5	2.4	11.3	14.0	19.6
0.5 – 0.6	0.7	5.0	4.7	13.8
0.6 – 0.7	0.3	2.0	1.3	9.7
0.7 – 0.8	0.16	1.0	0.3	4.4
0.8 – 0.9	0.10	0.6	0.05	3.0
0.9 – 1.0	0.16	0.6		1.5
1.0 – 1.1	0.21	0.4		0.9
1.1 – 1.2	0.10	0.3		0.3
1.2 – 1.3	0.10	0.21		0.3
1.3 – 1.4	0.00	0.10		0.16
1.4 – 1.6	0.15	0.00		0.31
1.6 – 1.8	0.05			0.26
>1.8	0.05			0.42

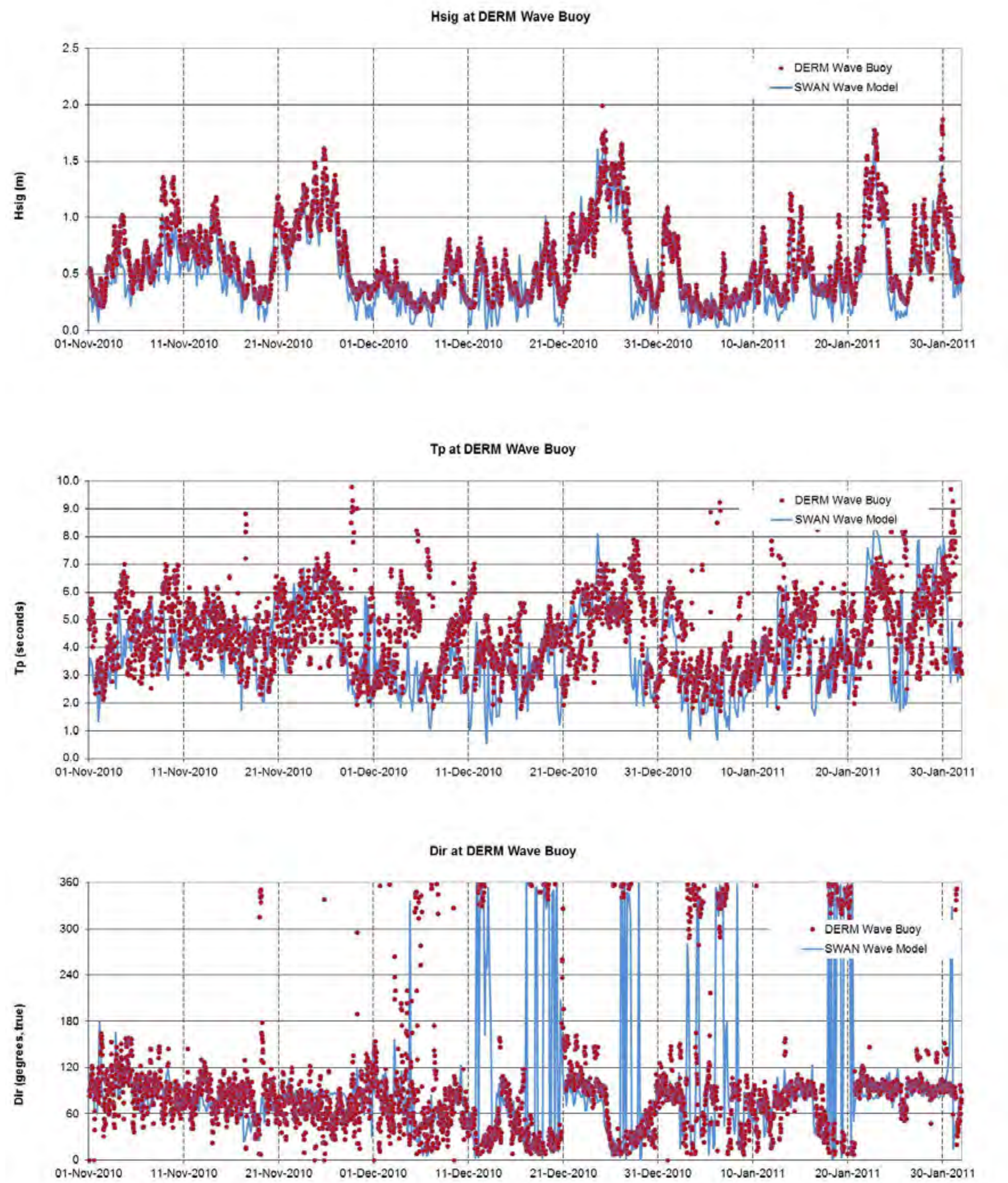


Figure B.3.15 Wave Model Calibration – at EHP Waverider Buoy

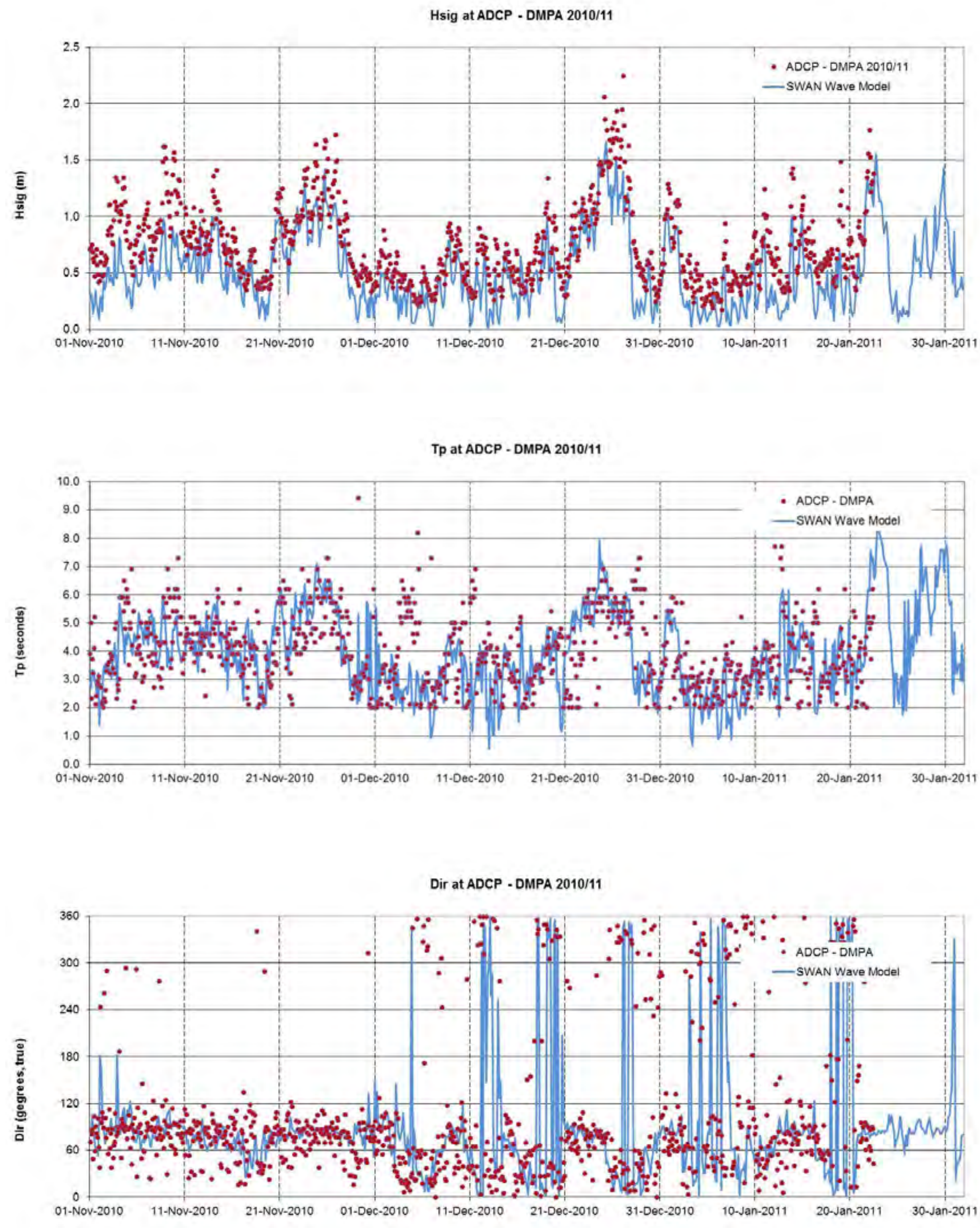
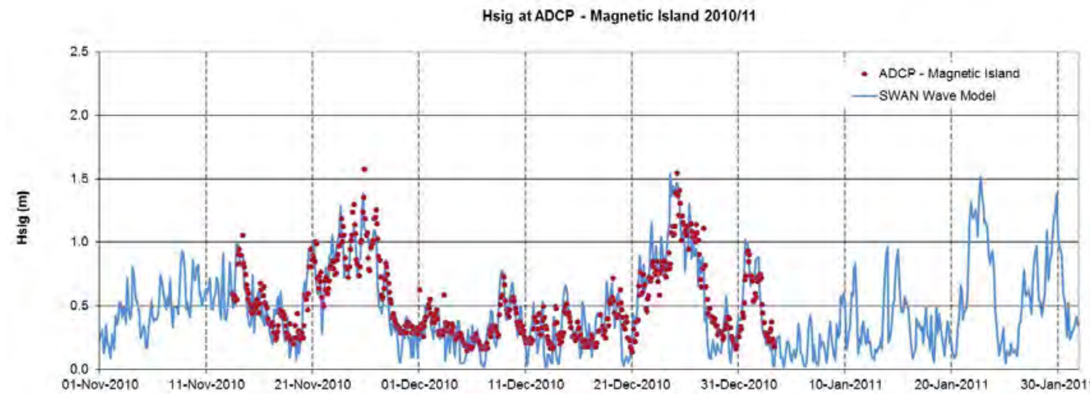
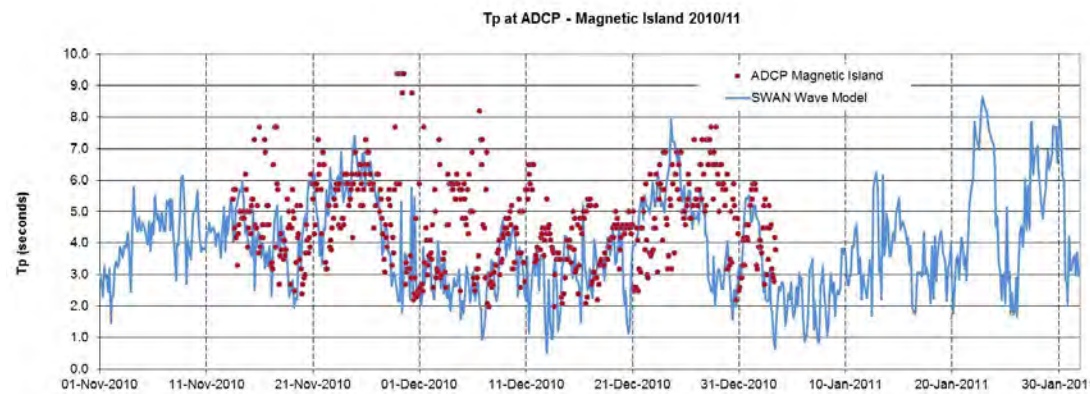


Figure B.3.16 Wave Model Calibration – DMPA ADCP





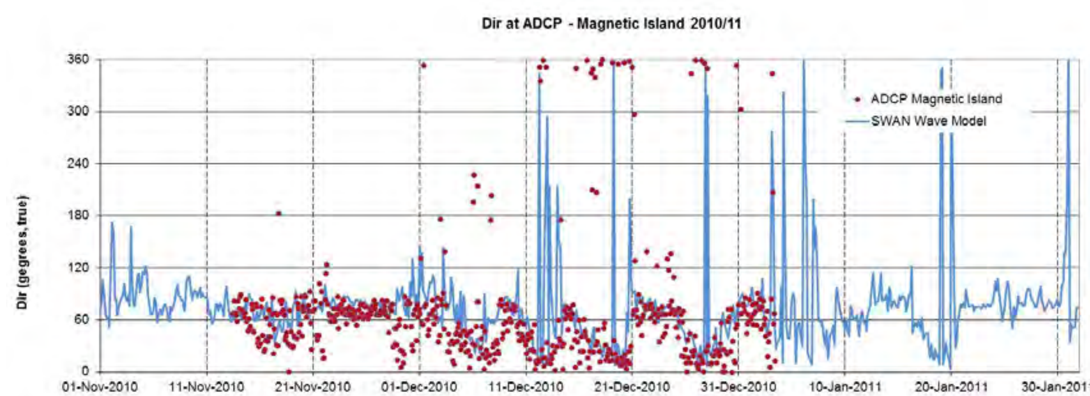
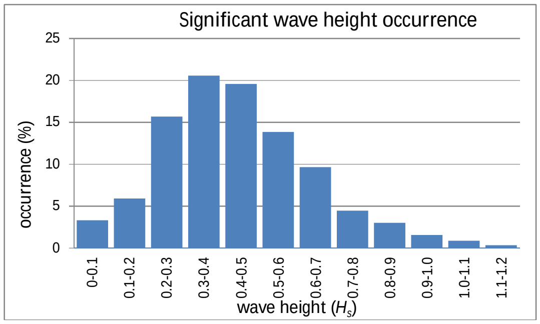


Figure B.3.17 Wave Model Calibration – Magnetic Island ADCP

In terms of the conventional parametric description of the wave conditions near Beacon 9, based on the total significant wave height (H_s) and the spectral peak period (T_p), Figure B.3.18 shows the occurrence probability distributions for the 2008/09 deployment set of recorded data.



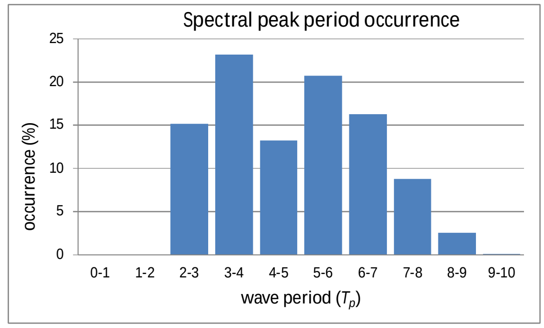


Figure B.3.18 Occurrences of Wave Height (left) and Period (right) at Beacon 9 from Recorded ADCP Data Sep 2008 to Feb 2009

Maximum Nearshore Wave Conditions

Wave conditions through Cleveland Bay to the Port and adjacent shorelines are less energetic than those at the wave recorder due to sheltering by Cape Cleveland, refraction and bed friction attenuation. Some recording of waves has been undertaken from time to time at various locations in the Bay. As well, analysis of data and hindcasting have also been undertaken to determine extreme cyclone conditions in the Bay (Riedel & Byrne, 1983; Lawson & Treloar, 1996). and and

Maximum cyclone wave heights predicted for the Port area are:

- 4.0 m as calculated for cyclone Althea (Lawson & Treloar, 1996) and ; and
- 3.3 m (50 year average recurrence interval) and 3.5 m (100 year average recurrence interval) (Riedel & Byrne, 1983). and

These results are compatible if cyclone Althea represents an event with an average recurrence interval of more than 100 years. In particular, the maximum likely wave condition at the Port and along the shoreline is influenced substantially by bed friction attenuation across Cleveland Bay. The degree of attenuation depends on the wave height, along with other factors including water depth and bed roughness, with larger waves being reduced relatively more than smaller waves. Thus, the above maximum wave heights near the port are unlikely to be exceeded even for rare high wave events outside Cleveland Bay.

Significant wave heights H_s of up to 5.5 m from north to north-east directions were recorded at the EHP Cape Cleveland Waverider buoy and at the DMPA ADCP during cyclone Yasi in February 2011 (Figure B.3.14). The spectral peak period was erratic leading up to the maximum wave conditions, however a typical relationship $T_p = 4H_s^{0.5}$ applies to much of the data (Figure B.3.15), corresponding to a maximum period of about 9.4s. A reliable recording or model analysis of the wave height at the Port is not available for that event. Nevertheless, on the basis that the incident direction led to little refractive wave height reduction and the water levels were elevated by storm surge, a wave height coefficient based only on bed friction in the range 0.4 to 0.5 is indicated, suggesting a maximum significant wave height near the port of about 2.5m during that event.

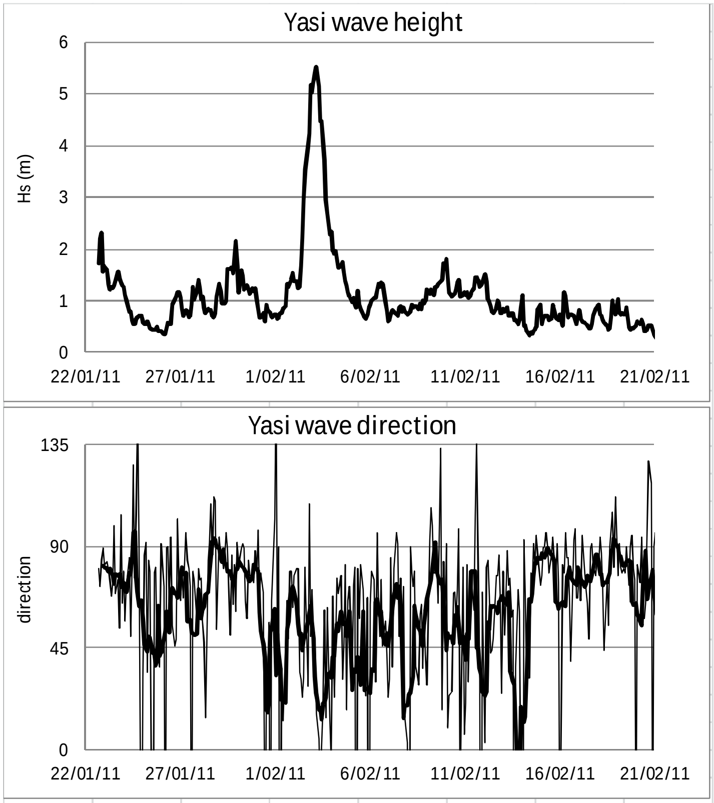


Figure B.3.19 **Cyclone Yasi Wave Height (top) and Direction (bottom)**

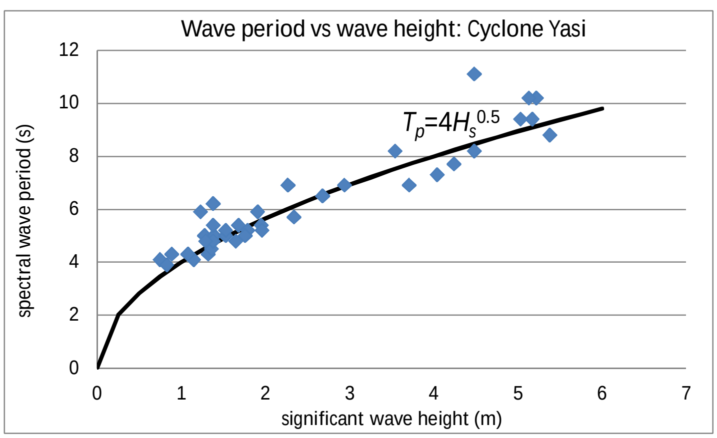


Figure B.3.20 **Wave Period Versus Wave Height: Cyclone Yasi**

B.3.3.4.4 Cleveland Bay Currents

Currents in the Bay are driven predominantly by tidal and wind forcing, influenced by coriolis effects and bed friction. Less significant current forcing can occur from spatial density gradients associated with salinity and/or temperature differences. As well, there may be vertical stratification of flow associated with fresh water inflows during flooding and seaward bottom return currents forced by wind setup of the water surface against the land during strong onshore wind events.

Currents have been measured extensively across the Bay over many years to define both the spatial (in plan) and vertical current profile distributions. These measurements have been used to calibrate and validate numerical models that facilitate comprehensive definition of spatial and temporal patterns of flow and responses to the various forcing mechanisms (Appendix H1)

Figure B.3.21 illustrates the spatial pattern of tidal flows into and from the Bay, in the absence of wind or other forcing. Figure B.3.22 illustrates the typical influence of the predominant east-south-east wind on the currents, forcing a net flow from east to west through the system towards Halifax Bay. Figure B.3.23 illustrates the typical residual current through the Bay resulting from the influence of the predominant prevailing winds.

Time series plots of current speed and direction for several locations across Cleveland Bay are shown in Figure B.23 to Figure B.3.26, covering a range of tidal and wind conditions, and includes both measured and modelled currents utilised as part of the model validation process (Appendix H1).

It can be seen that current speeds range up to about 0.3 to 0.6 m/s during spring tides and/or strong wind events. South-east to north-east winds can have a substantial effect on the currents, reinforcing the flood tide flow towards the west and reducing or reversing the eastward ebb tide flow.

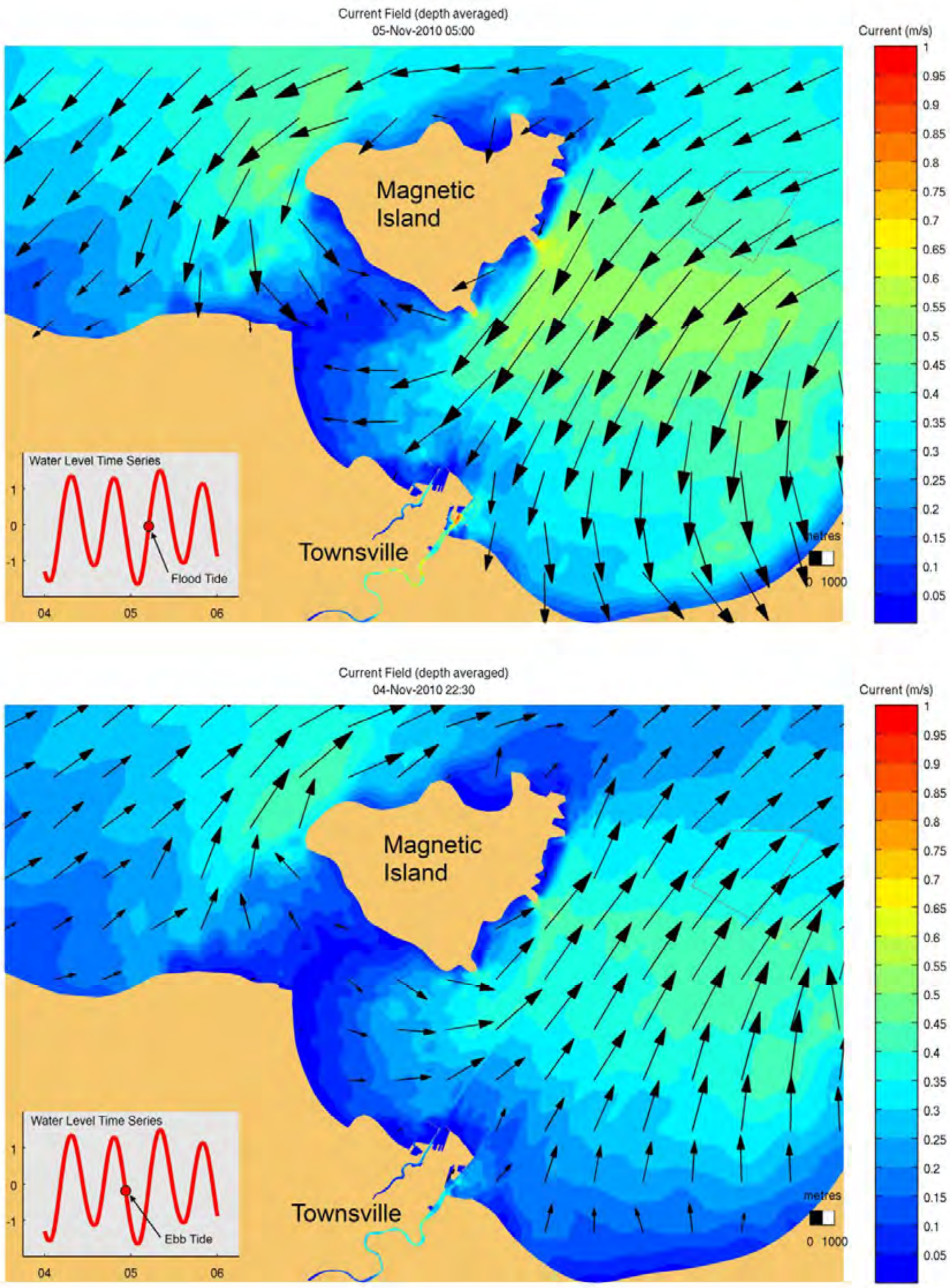
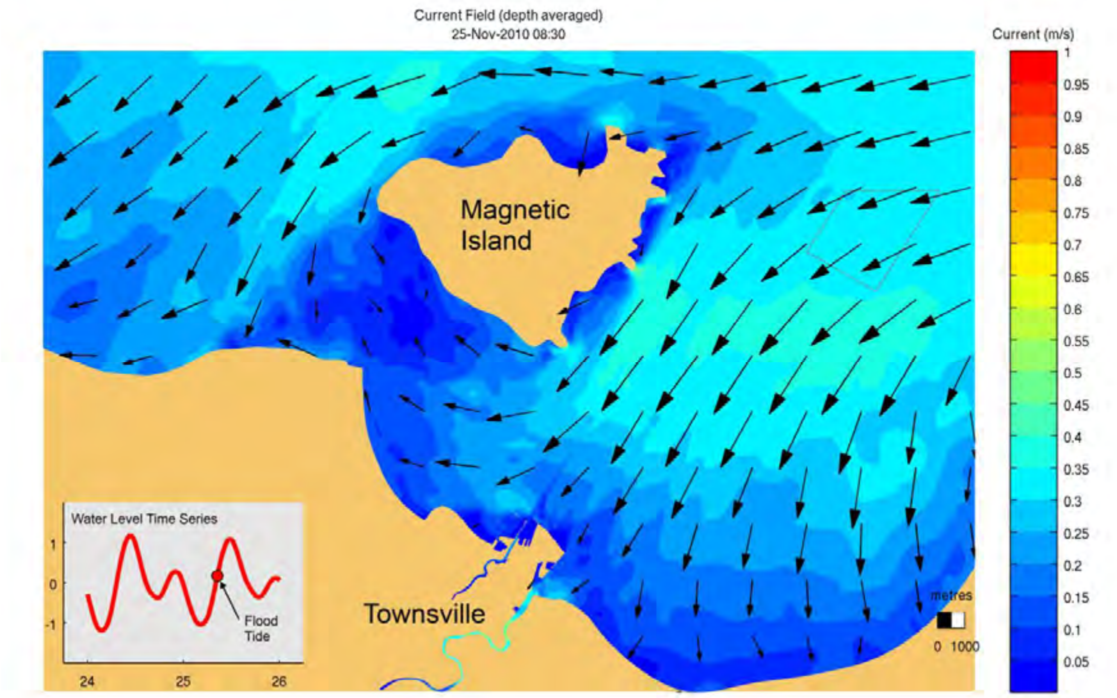


Figure B.3.21 Typical Tidal Current Flow Pattern in Cleveland Bay: Flood Tide (Top) and Ebb Tide (Bottom)



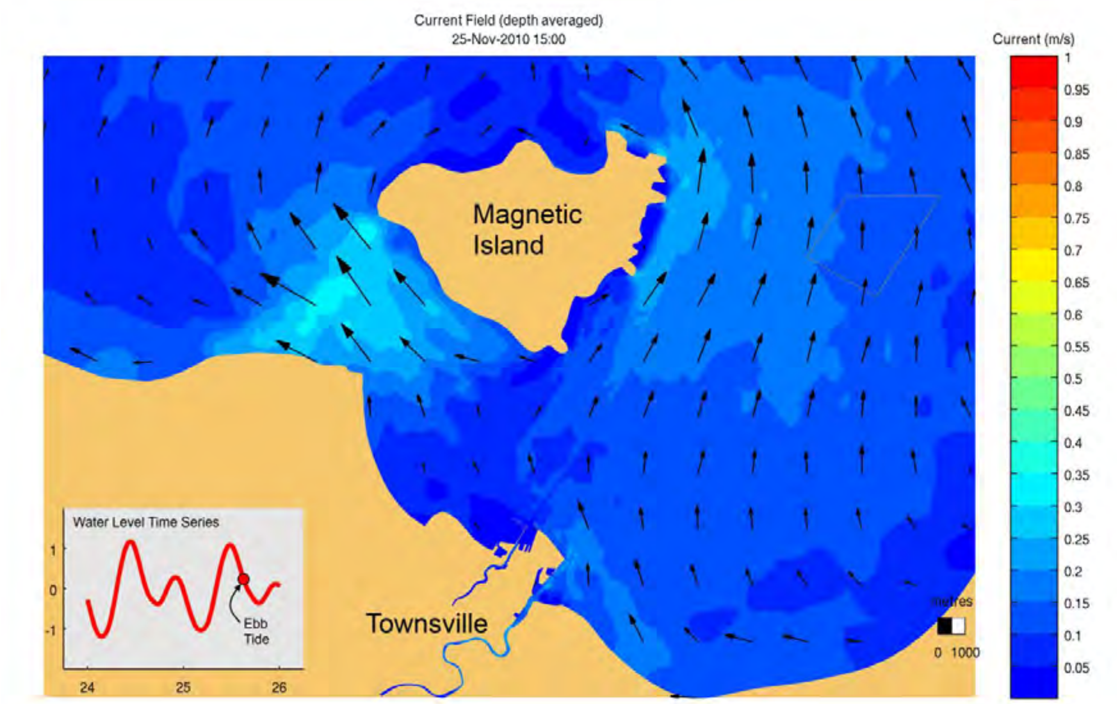


Figure B.3.22 Influence of Wind Forcing on Current Patterns: Flood Tide (Top) and Ebb Tide (Bottom)

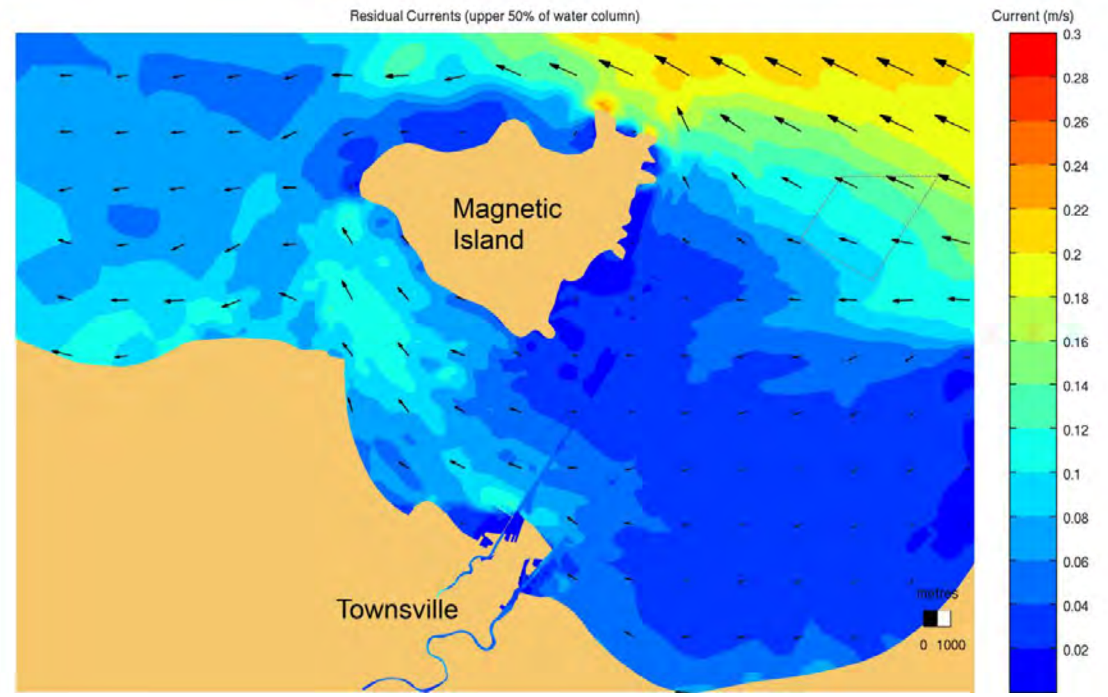


Figure B.3.23 Typical Residual Depth-Averaged Current Through Cleveland Bay due to Prevailing Winds from the South-east

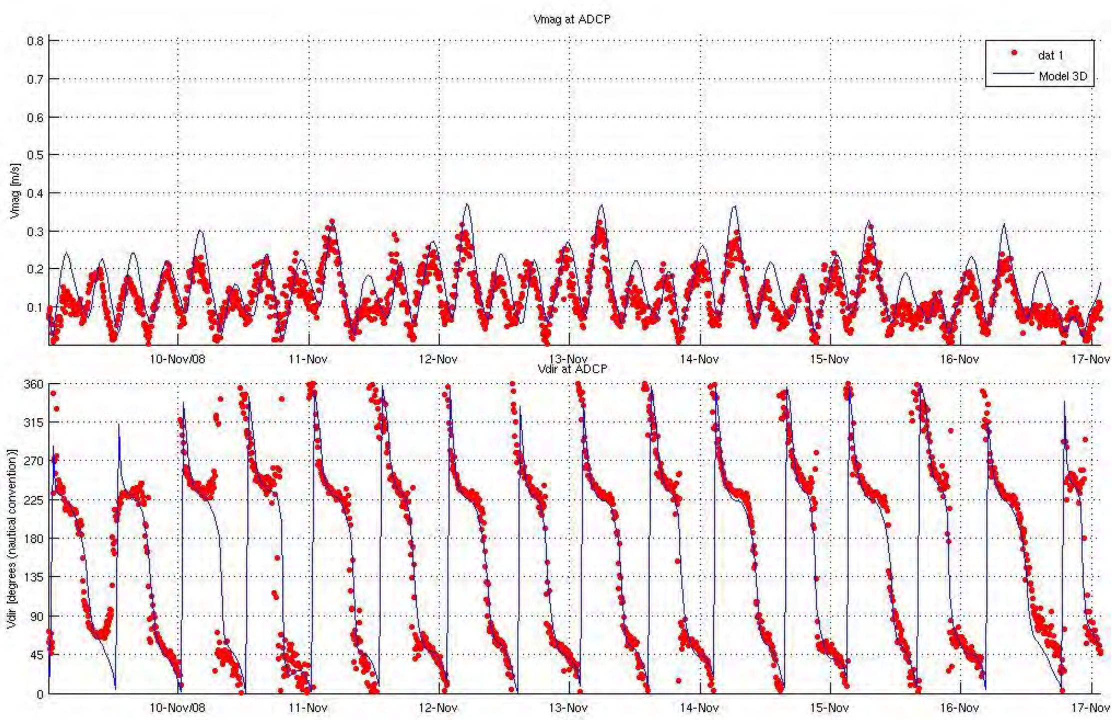


Figure B.3.24 Depth-Averaged Current Time Series at Platypus Channel, 2008

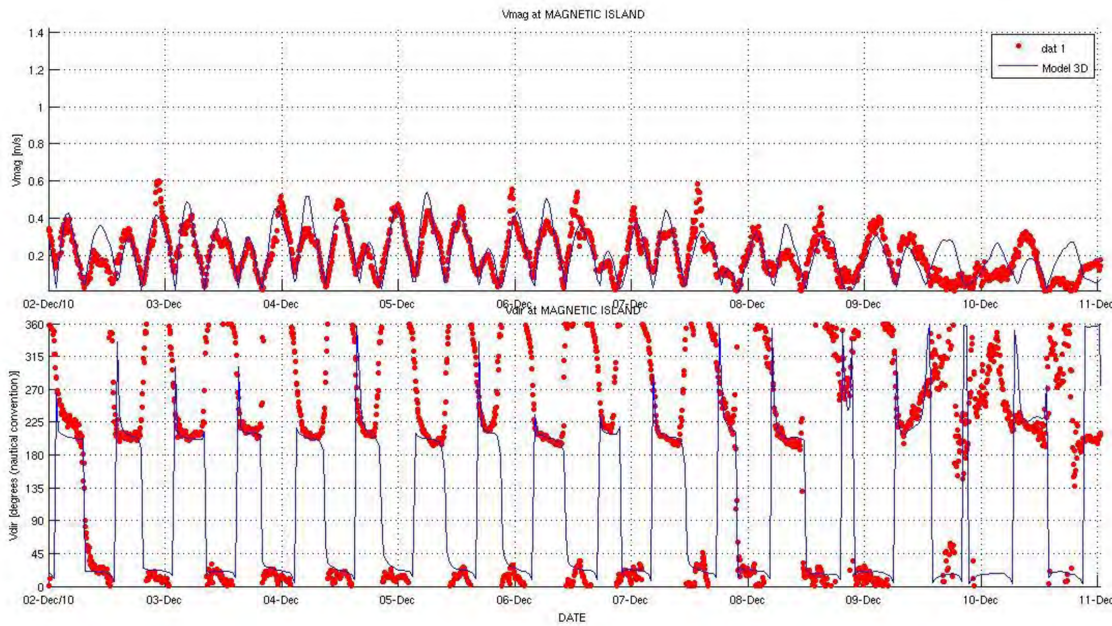


Figure B.3.25 Depth-Averaged Current Time Series at Magnetic Island, 2010

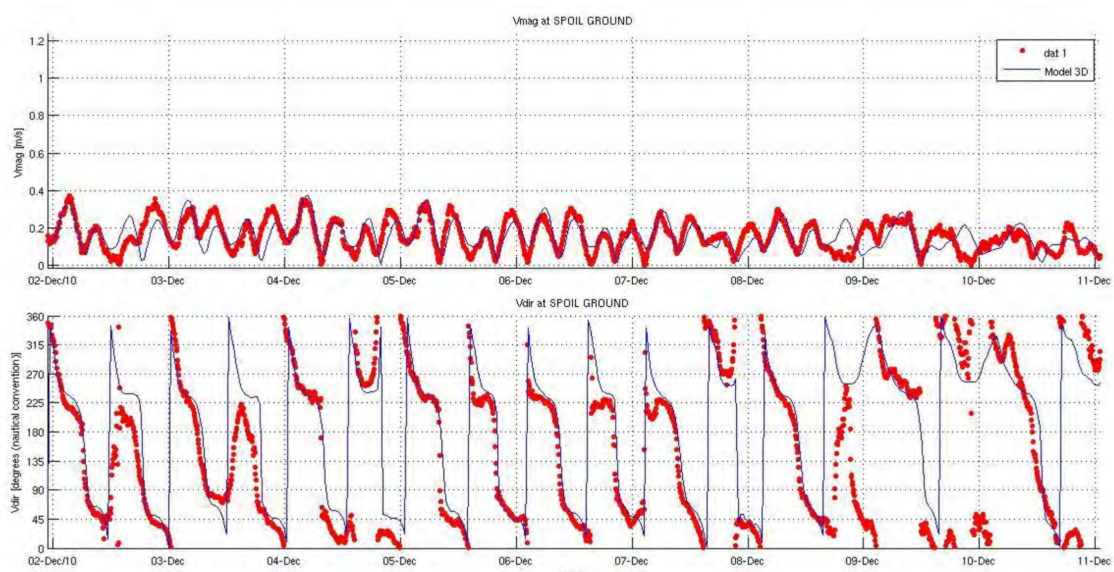


Figure B.3.26 Depth-Averaged Current Time Series at DMPA, 2010

B.3.3.5 Marine Sedimentation

B.3.3.5.1 Cleveland Bay Bathymetry

Cleveland Bay is deeply embayed with Cape Cleveland forming its eastern coastline, Cape Pallarenda at its western mainland boundary and Magnetic Island forming a dominant geographic feature partially in the north-west part of the Bay (Figure B.3.3). The bathymetry slopes gradually and evenly down towards the north, reaching a water depth of about 15m at the designated DMPA to the north-west of Cape Cleveland. The 10m (Chart Datum) contour runs slightly north of west and the 5m contour runs west-south-west across the Bay from Cape Cleveland. As such, the Bay is relatively shallow, requiring dredging of the shipping channel to meet navigational requirements along a length of about 13km to reach sufficient natural depths. Water depths in the West Channel between Magnetic Island and the mainland are shallower than 5 m except for a deeper outer section adjacent to the Island.

B.3.3.5.2 Overview of Sedimentation Processes

The geological and geomorphological setting of the Study Area is summarised in Section B3.3.3. Consistent with the evolutionary history of the Bay, the marine sediments consist generally of muddy sands and sandy muds, depending on location and exposure to wave action. Bed sediments in quiescent areas are almost entirely fine mud while shoals and shorelines in parts exposed to higher energy wave action are predominantly sand.

The nature and rates of sediment transport depend on the prevailing waves and currents and the nature of the sediments. The seabed sediments are re-suspended and transported by the combined action of waves and currents. Broadly, both waves and currents together cause bed shear stresses that mobilise the sediments while prevailing currents advect them, predominantly in suspension, in the direction of the current.

Erosion of sediment from the seabed and deposition of suspended material in the water column are both dependent on local bed shear stress. Cohesive sediments tend to erode when bed shear stress exceeds a critical threshold (for erosion). Deposition of cohesive sediments occurs when shear stress drops below a typically lower critical threshold (for deposition). Details of the formulae used, and parameters adopted in the TUFLOW-FV model are provided in Appendix H1 of the EIS.

Bed shear stress is calculated in the TUFLOW-FV model from the combined action of currents and waves using the procedure of Soulsby (1997). A Root-Mean-Square bed shear stress is used as the representative value in the sediment erosion and deposition calculations. As detailed in Jing and Ridd (1996), the longer period swell waves are found to be the dominant generator of bed shear stress, and hence sediment resuspension, in Cleveland Bay.

It is commonly considered that the behaviour of sand-mud mixtures with sand content >85 to 95% will be dominated by the sand processes, with the mud being released from or trapped in the sand interstices. Sediments with >5 to 15% mud content will tend to become cohesive with behaviour dominated by the finer fraction. Sand-mud mixtures typically attain a maximum shear resistance with a sand content in the range 30 to 50%.

A typical example of seabed sediment re-suspension leading to significant sediment transport is provided in Figure B.3.27, measured in 10 m water depth in 1993 (CoMarine, 1993; Orpin, Ridd, & Stewart, 1999). This is revealing in that, for the lead-up period in which 4 s 'sea' waves of about 1.2 to 1.5 m height co-existed with tidal currents up to 0.4 m/s, little re-suspension occurred. Only when 8 to 9 s swell of height >0.25 m was superimposed and the tidal current increased to 0.6 m/s did sediment re-suspension occur. The bed shear stress calculations in TUFLOW-FV indicate peak bed shear stresses in the lead-up period of about 0.15 N/m^2 due to the current alone, while the 'sea' wave period of 4 s is too short for the wave to be felt strongly at the bed. This increased to about 0.4 N/m^2 with the swell and higher current superimposed. This suggests a critical bed shear stress for significant sediment re-suspension of the fine Cleveland Bay sediments of about 0.2 N/m^2, significantly lower than the level of 1 N/m^3 suggested by Orpin *et al* (1999) for offshore areas.

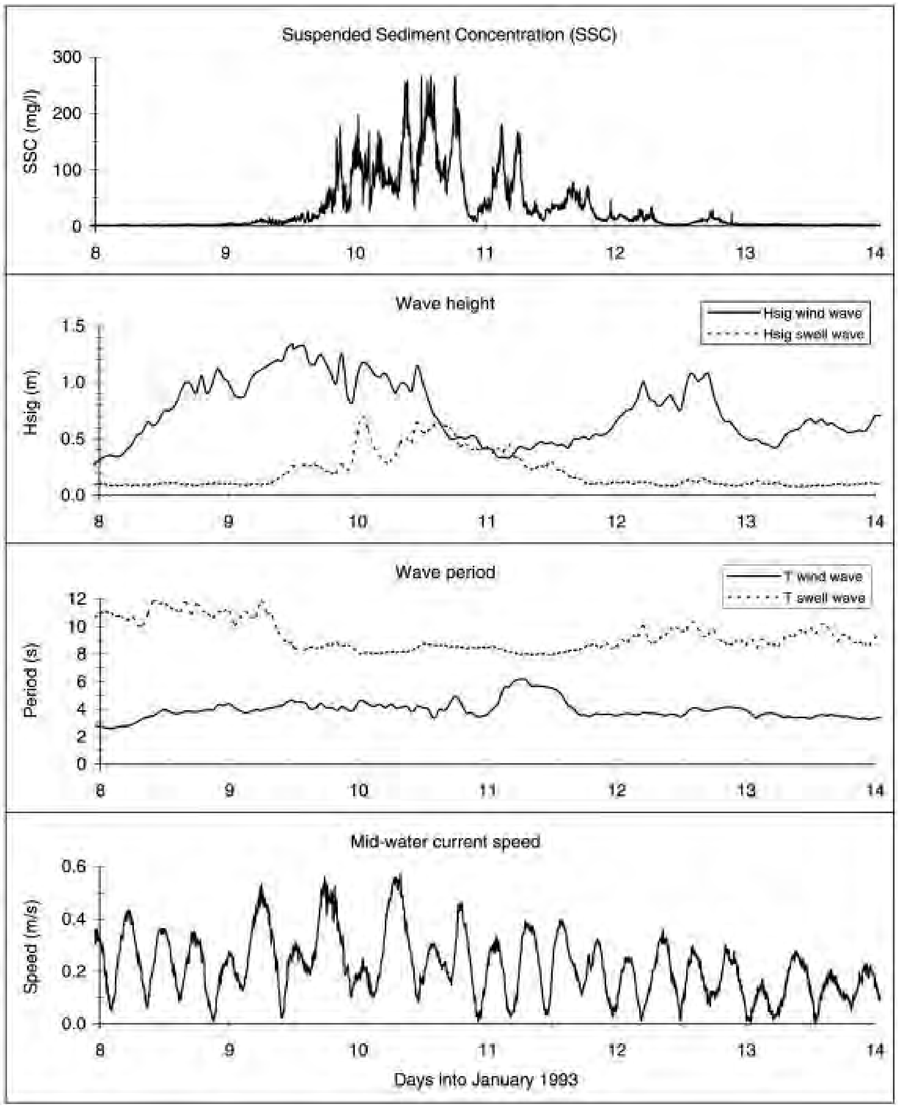


Figure B.3.27 Measured Sediment Suspension Event in 10m Water Depth, January 1993 (CoMarine, 1993; Orpin, Ridd, & Stewart, 1999)

B.3.3.5.3 Sediment Re-suspension Modelling

In the context of determining siltation rates in the harbour and shipping channels, the TUFLOW-FV model was used to simulate the re-suspension of fine material due to the action of waves and currents. Calibration and validation of the TUFLOW-FV model parameters for sediment re-suspension have been undertaken by correlation with a range of measured data as part of the present EIS investigations, as outlined in Appendix H1 of the EIS.

Measurements of turbidity caused by suspended sediments in the water column were made as part of the PEES study (BMT WBM, 2009). The turbidity measurements were converted into Total Suspended Solids (TSS) concentrations using an established relationship (Appendix H1). Calibration of sediment erosion and deposition parameters resulted in good overall agreement between modelled and measured TSS. The adopted critical shear stress for seabed sediment re-suspension was 0.2 N/m^2, consistent with that deduced for the CoMarine (1993) data (Figure B.3.27) as discussed above.

Figure B.3.28 illustrates a typical case of suspended sediment concentrations across Cleveland Bay associated with the combined action of tide and wind induced currents and wave action. This shows the predominant areas of sediment mobilisation and the pathway of sediment movement through the Bay towards the west. It can be seen that sediment is transported across the dredged channels and to nearshore areas at and adjacent to the Port. This leads to channel siltation and sediment deposition in more quiescent nearshore areas sheltered by the Port infrastructure, including adjacent to southern part of The Strand.

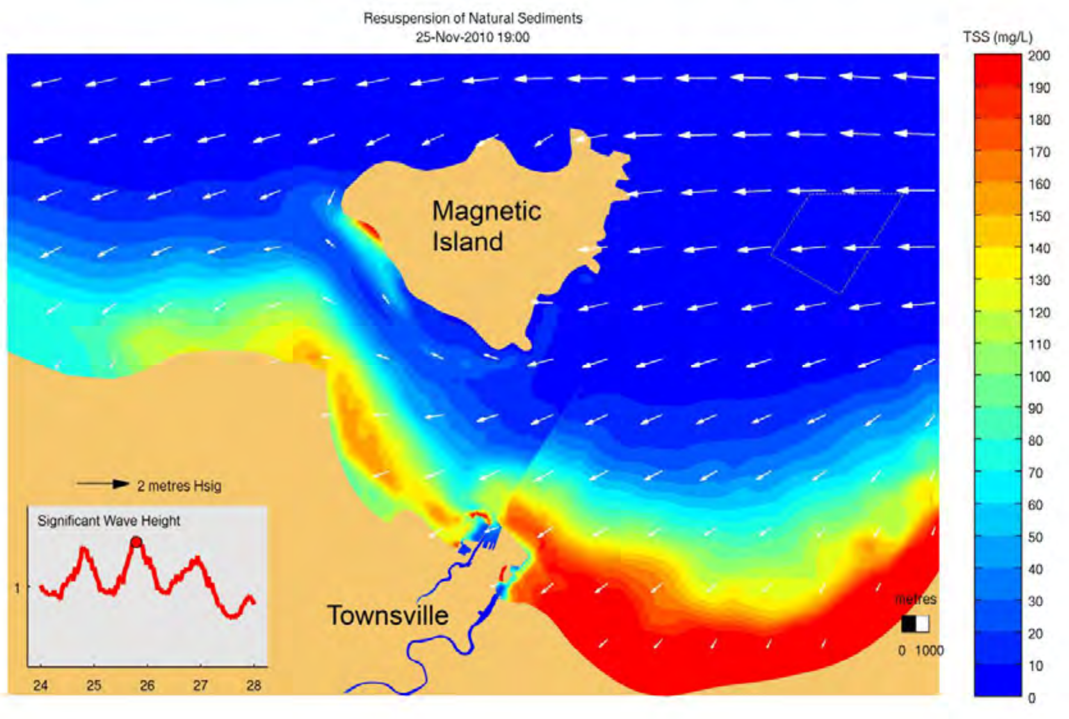


Figure B.3.28 Typical Spatial Distribution of Suspended Sediment Resulting from Wave-Current Induced Re-Suspension from the Seabed

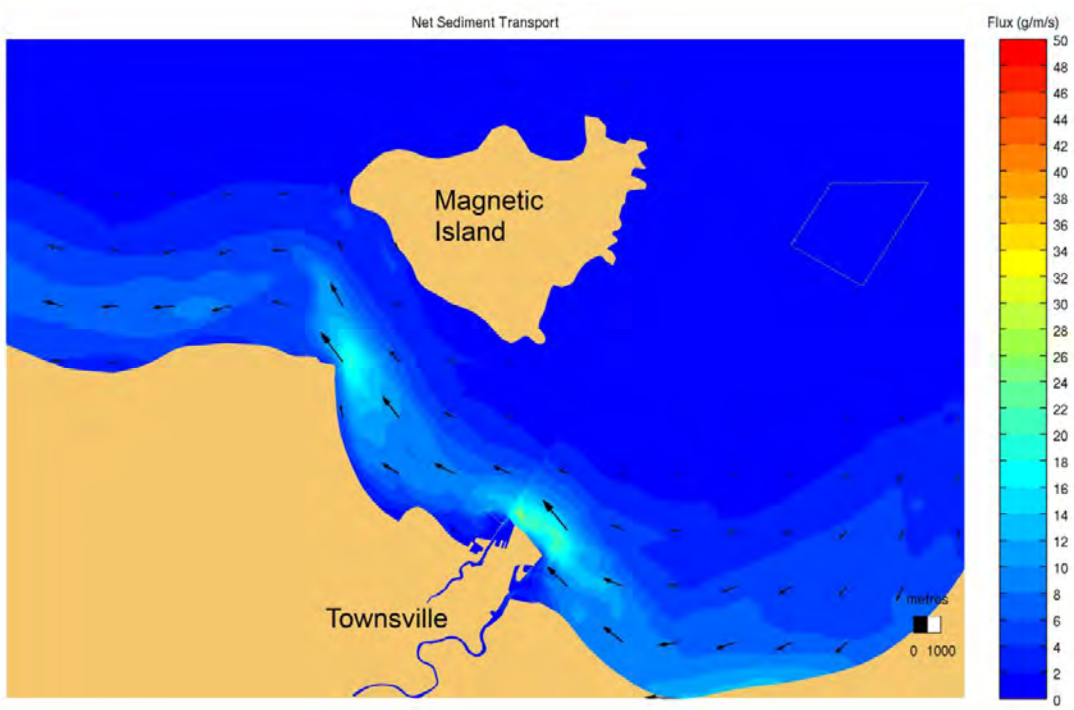


Figure B.3.29 Net (Residual) Suspended Sediment Flux

B.3.3.5.4 Siltation of Dredged Channels

Navigation access to the Port of Townsville is provided via the dredged Platypus Channel and Sea Channel. The harbour basin is also dredged to provide suitable navigation. Siltation and maintenance of the dredged areas are important considerations for ongoing operation of the Port.

The general processes involved in the siltation of dredged channels are, in broad terms, reasonably well understood. Prevailing waves and currents provide the principal mechanisms for sediment transport and net deposition of the suspended sediments to the seabed occurs when the hydrodynamic conditions reduce below those capable of maintaining the prevailing suspended load concentrations. That is, siltation in the dredged channels occurs when the actual concentrations exceed the equilibrium conditions for the wave-current regime. This occurs abruptly when the suspension transport moves from relatively shallow water into deeper dredged areas. Broadly, the rate of deposition is proportional to the excess of actual over equilibrium suspended sediment concentrations. The siltation thus depends on the 'trapping efficiency' of the channel, which is greater where the channel is excavated deeper and wider below the adjacent natural seabed level.

The key factors which are expected to contribute to siltation of the Platypus/Sea Channel are:

- The material which collects in the channel, as evidenced by the nature of sediments dredged, is predominantly fine silt with some sand. The transport of silt is predominantly in suspension while sand is transported as both bed load and in suspension.
- Channel siltation is directly related to wave action together with the prevailing currents. The waves and currents stir the silty sediments from the seabed of the Bay into suspension in the water column. The concentration of the suspended sediments in the water is a function of the bottom shear stress which in turn is a function of the combined prevailing waves and currents.
- The sediments stirred into suspension by the wave sand currents are carried with the prevailing currents to the channel. The tidal currents tend to run along the channel at its seaward end but are oriented more across the channel closer to the harbour. Cross-channel currents are increased by wind effects, particularly nearer the harbour.
- There is a tendency for the quantity of sediment in suspension to maintain equilibrium with the bottom shear stresses at any particular location. As the material is moved to an area of lower wave or current intensity, it will tend to settle out at a rate dependant on the effective settling velocity of the sediment in suspension.
- The deeper water in the dredged channel is an area of relatively lower bottom shear stresses where deposition tends to occur. The rate of deposition, or trapping efficiency, is determined by the difference in suspended transport capacity immediately outside and in the channel. Generally, areas where the channel is excavated deepest into the natural topography are area of greatest trapping efficiency and siltation. In principle, the trapping efficiency increases in the landward direction along the channel. Increasing channel width also leads to increased siltation.

B.3.3.5.5 Harbour Siltation Considerations

Siltation of the enclosed harbour area of the port involves a number of interactive processes. The sediment deposited in the harbour may come from Cleveland Bay or from Ross Creek.

Mechanisms which exist for the introduction of sediments from Cleveland Bay include:

- Inflow of suspended sediment with tidal waters, dependent on tidal prism and sediment concentrations in the water at the harbour entrance.
- Gravity induced flow of a dense layer of sediment-laden water near the seabed from shallower to deeper areas.

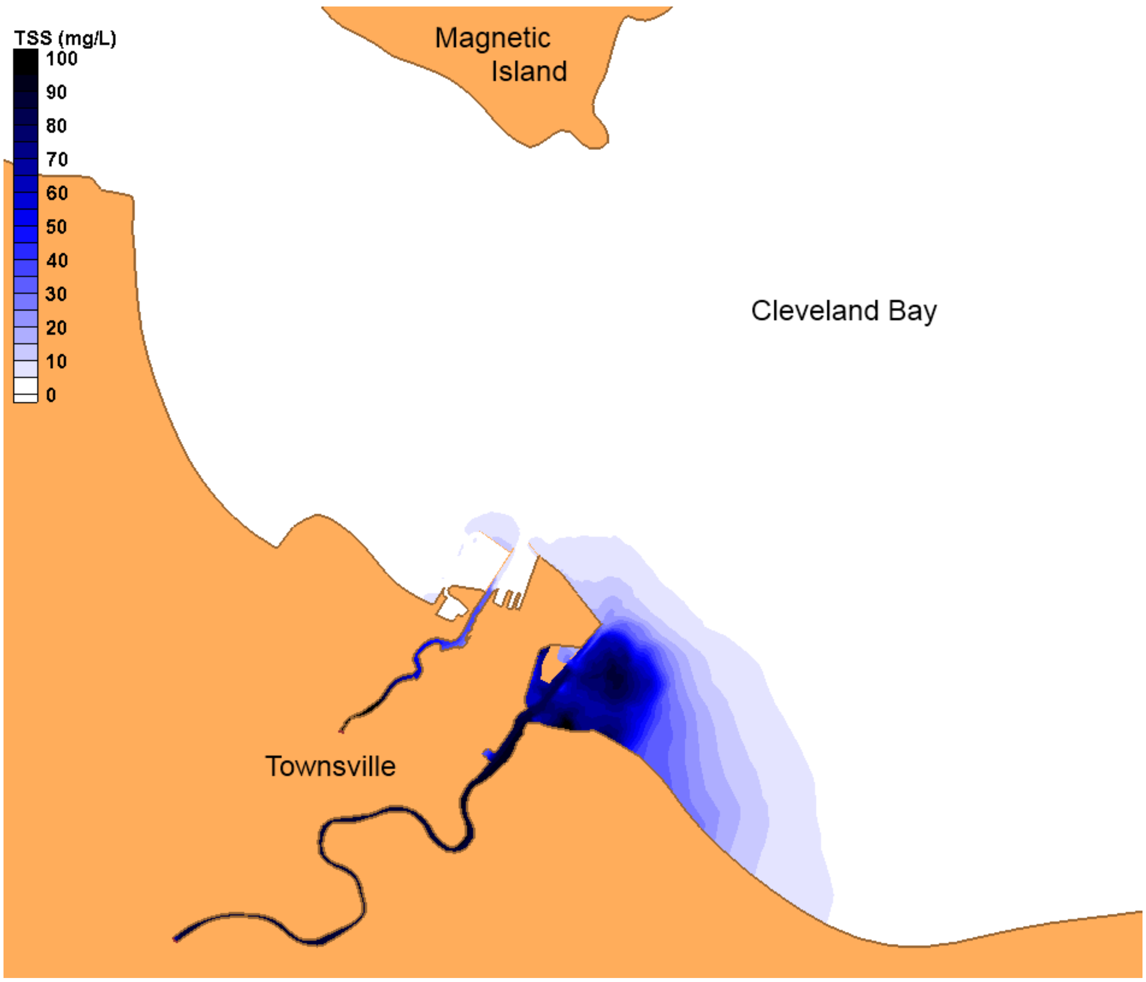
These mechanisms generally involve the transport of mainly fine silt rather than sand. Nevertheless, significant quantities of sand can be included with the inflowing sediments in close proximity to the harbour entrance, due to the stirring action of waves and/or vessels in conjunction with the currents in shallower water.

B.3.3.5.6 Suspended Sediment due to Ross River Discharge

Sinclair Knight Merz (1996)reports that upstream dredging as well as the construction of weirs and the Ross River dam have essentially eliminated the transport of coarse sediments (sand) to the coast as a result of direct retention of the sediment and altered flood flow conditions. Fine silts in suspension may be significant during floods, supplying additional sediment to the Bay (however, the dominant source of fine sediments in the Bay is the Burdekin River, as described in Section B3.3.3). Flocculation on contact with seawater could result in enhanced deposition in some areas.

The TUFLOW-FV model was used to investigate the fate of sediment discharged from the Ross River. Catchment modelling was undertaken as part of another BMT WBM study (BMT WBM, 2010) for a period of 30 years (1/4/1978 to 31/3/2008). A major inflow event representing the second greatest peak flow during the 30 year period was used for the sedimentation assessment.

The 1% exceedance suspended sediment concentrations due to the fine sediment fluvial discharge in the existing Port configuration are shown in Figure B.3.30. It is noted that the sediment concentrations shown in this figure have been depth averaged from the modelled three-dimensional concentrations fields, which explains the lower concentrations in the deeper inner harbour and channel.



FigureB.3.30 Depth-Averaged Total Suspended Solid Concentrations Exceeded for 1% of the Simulation Period due to Ross River and Ross Creek Sediment Discharge

B.3.3.6 Shoreline and Beach System

The shorelines adjacent to the Port area are illustrated in Figure B.3.31. The wave exposure and coastal processes of each of these shoreline areas are uniquely different, as reflected in their morphology and behaviour. They consist of:

- The embayed mangrove fringed low lying coastline to the east composed predominantly of fine sediments with some sandy ridges, truncated by minor tidal streams; and
- The coastline to the west that is sandy in nature forming two beach units of The Strand and Rowes Bay/Pallarenda separated by Kissing Point.

Figure B.3.31 Shorelines Adjacent to Townsville Port (aerial image – Google Maps)

The shoreline to the east is considerably sheltered from wave action by Cape Cleveland, being exposed only to relatively small locally generated wind waves from the north and highly attenuated waves entering Cleveland Bay from offshore. The minor sand ridges have developed by shoreward movement of coarser sediments during infrequent larger wave events, with only minor longshore distribution of these sediments. The coast is relatively low and flat. The Ross River mouth area is exposed to somewhat higher energy wave action which, together with sand supply from the river, has led to development of more prominent sand ridges (Figure B.3.32).

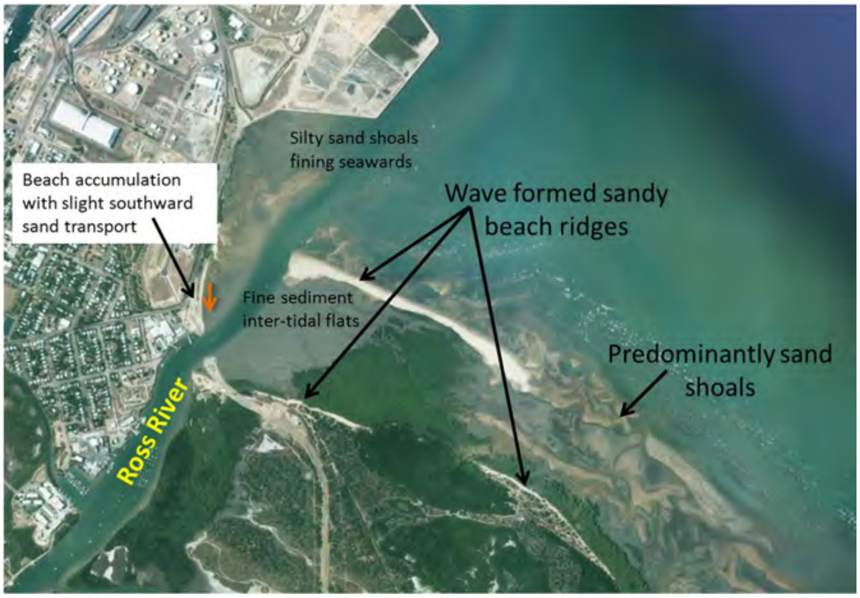


Figure B.3.32 Morphology of Ross River Mouth Area (aerial image – Google Maps)

The wave modelling shows that, apart from the local area at the mouth of Ross River, wave propagation to the shoreline east of the Ross River is not affected significantly by the existing Port works, although there is blocking of the small and relatively infrequent northerly local wind waves along a distance of about 500m. At the Ross River mouth, the eastward extension of the reclamation blocks and modifies waves from the north to north-north-east, particularly along the western side of the river channel. There, fine sediments appear to be accumulating gradually and a small beach has developed (Figure B.3.32).

West of the Port, the shoreline is consistently exposed to sufficient wave action to form clean sandy beaches with potential for both cross-shore and longshore movements of the beach sand. These beaches, particularly The Strand, are important coastal values for the community and are widely utilised for their recreational amenity (Figure B.3.33).

Figure B.3.33 Sand Beaches West of Townsville Port (aerial image – Google Maps)

B.3.3.6.1 Beach System Historical Context

It is generally accepted (CES, 2010; Mabin, 1996) that there was a natural westward supply of sand derived predominantly from Ross River along The Strand and past Kissing Point to Rowes Bay and beach systems further west. Mabin (1996) notes that The Strand Beach, once some 2.85km long with natural dunes, has been altered substantially over the past 130 years with growth of the Port and associated facilities. As development of the area progressed, the dunes were replaced by a rock seawall and parkland and the beach length was reduced by over 800m.

The natural supply of sand to the beach has been completely interrupted since 1874 through various Port development and river works. The presence of the Ross River Dam since 1973 has profoundly affected sediment delivery into Cleveland Bay, with the coarse fraction being trapped in the reservoir under most, if not all, conditions of flow (Pringle 1989; (CES, 2010). In addition, Sinclair Knight Merz (1996) report that the sand transport capacity of the river and sediment supply to the coast have been reduced through the excavation of river sand reserves and altered hydraulic flow conditions due to construction of the dam and other weirs. As a result, there has been an overall loss of sand to the beach system. Sinclair Knight Merz (1996) conclude that virtually all bed load transport of sediments to the coast has ceased and is unlikely to be reinstated while dredging of the accumulated sediments from behind the weirs continues in the Ross River.

Townsville Harbour from Castle Hill, 1897.
Left to right: Bucket dredge working at harbour entrance, Jetty or Railway Wharf, Magazine Island, Signal Station, entrance to Ross Creek.
DMS.

Entrance to Ross Creek, Townsville, from the Signal Station.
DMS.

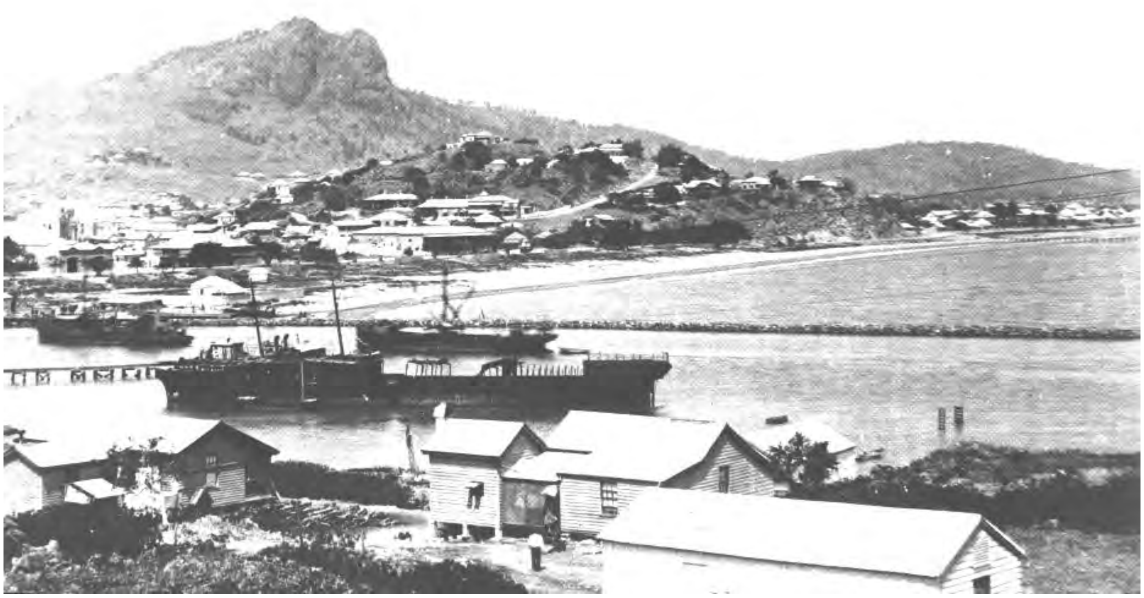


Figure B.3.34 The Strand Beach and Port Structures in 1897 (Source Unknown)

Beach erosion has been an ongoing problem for many years. Mabin (1996) concludes that the erosion problem was one of sand re-distribution by longshore drift processes in which sand removed from eroding areas was not permanently lost from the whole beach system. However, some permanent loss occurs in cyclone events with sand moved offshore and to the west.

Sand is transported along the beach by the action of waves and currents. Hardy (1991)and Mabin (1996) include discussion of the processes involved for the Strand beaches, highlighting the dominant importance of waves. There is also some cross-shore movement of sand associated with occurrences of storm events and subsequent beach recovery. Broadly, in the longer term, the coarser fraction of the nearshore sediments tends to move shoreward and the finer material moves seaward, allowing the beach to comprise relatively clean sand.

Mabin (1996) describes the process of longshore sand transport in terms of south-east movement by northerly sea waves and north-west movement by east to north-east sea and the incident swell. Historically, under the influence of the Port structures on incident waves, sand that moved southward from the central area was trapped there because that area is sheltered from the more easterly sea and swell, resulting in net erosion of the central area and net accretion near and east of Tobruk Pool (Figure B.3.35).

Figure B.3.35 Aerial Photo (1981) Showing Sand Build-Up East of Tobruk Pool

Kettle *et al*. (2001) describe the steps taken from the mid-1990s to overcome the beach erosion problems of the Strand and Rowes Bay / Pallarenda, as summarized briefly below:

- Formation of the Rowes Bay / Pallarenda Working Group to assess erosion issues;
- Formation by Townsville Port Authority of the Townsville Beach Management Technical Committee (TBMTC) to assess issues and develop strategies for managing a return to stable beaches;

- Commissioning of Coastal Engineering Solutions Pty Ltd (CES) to study wave and littoral processes affecting The Strand, forming the basis of design of remedial works;
- Sourcing by the TBMTC of stakeholder opinion on issues that needed to be resolved and approaches to their resolution; and
- Preparation by CES of a detailed report on coastal processes and beach management for The Strand and Rowes Bay areas (CES, 1998) leading to the plan for redevelopment of The Strand that commenced implementation in 1998.

The CES (1998) report confirmed the Mabin (1996) assessment of the general beach processes, including the dominant effects of waves on longshore sand movement and the impacts of Port development on shoreline changes along The Strand. The redevelopment plan for The Strand involved creation of five beach units separated by rock headlands to provide stability with respect to longshore sand movement (Figure B.3.36). General fill was imported and placed behind an upgraded seawall. About 250,000 cubic metres of coarse river sand was placed in front of the seawall to form a beach of about 20m width at high tide. A further 88,000 cubic metres were added in 2001. The redevelopment was designed not to require significant additional sand replenishment, although it was recognized that some may be needed from time to time.

Figure B.3.36 Satellite Image (2008) Showing The Strand Redevelopment in Relation to Existing Port Infrastructure (Google Maps)

B.3.3.6.2 Review of Sand Transport Rates

Muller *et al* (2006) interpreted the sediment distribution, profile changes and shoreline shape of the redeveloped beach system of The Strand and concluded that:

- Little of the imported sand moves more than a few metres offshore in the south-eastern part of the beach whereas substantial and long-ranging export (tens to hundreds of metres) occurs at the north-western area.
- The constructed headlands greatly reduce the sediment transport along this part of the coastline and provide enhanced stability. Each embayment tends to act as a separate beach unit, although there is some interchange of sand between them.
- While there are significant gains and losses of sand on a regular basis, most transects showed balanced gains and losses.
- The dominant currents induced by prevailing SE trade winds usually transport sand in a northward direction. The study inferred transport back to the south-east at the southern end, where finer sediment is trapped, and to the north-west at the northern end.
- Sand from The Strand is being transported around Kissing Point into Rowes Bay and future renourishment activities will be a necessity in order to keep the Strand in its current state.

Coastal Engineering Solutions (2010) calculated sand transport rates for the Rowes Bay beach system, indicating a northward transport there of typically 3,000 to 4,000 m^3/yr. CES notes that this transport would have been equivalent to the natural supply along The Strand and past Kissing Point but that this supply has diminished, leading to erosion at Rowes Bay beaches. CES found a 'null point' of zero net transport near Mundy Creek at the southern end of Rowes Bay. This has been interpreted as an artefact of the artificial relocation of Mundy Creek.

The implication of the findings for Rowes Bay are that the sand supply (if any) past Kissing Point prior to the 1999 Strand redevelopment would have been minor (less than 3,000 to 4,000 m^3/yr). Since essentially no sand supply from east to west past the Port exists, the average net transport past Kissing Point would have matched the average net erosion from The Strand.

The redevelopment works along The Strand provided stable beach compartments between the constructed artificial headlands, with an intention that any previous net sand movement along the northern end of the beach past Kissing Point would be halted as far as practicable and the new beach system stabilise with zero net longshore transport in each compartment. With the placement of imported sand to fill the beach compartments, there may be some initial over-supply that would spill over as a short term temporary net loss past Kissing Point until the 'equilibrium' shoreline alignment is reached, as noted by Muller *et al* (2006).

It would be expected that adjustment to equilibrium would have been achieved over the past decade, although the actual present status of shoreline evolution towards the stable alignment is uncertain. Furthermore, the effects of cyclone Yasi in February 2011 on this trend of evolution are unknown. It is likely that this major wave/water level event had a one-off impact that is large relative to the typical ambient behaviour. Sand was moved cross-shore and most probably alongshore, with some sand transported shoreward from the beach to the parkland area by wave over-wash. Nevertheless, recent inspections confirm that the beach system remains in good condition and that the design as constructed is robust and sustainable.

B.3.3.6.3 Calculation of Sand Transport Rates

Sand is moved in both directions along The Strand beaches by the prevailing waves, depending on wave direction and angle to the shoreline alignment at any time. The longer term average (net) transport is the relatively small difference between the larger component upcoast (north), downcoast (south) transport rates. The sand transport regime has been analysed in this study to provide an estimate of the transport rates and a basis for assessing potential effects that the PEP may have on the prevailing waves, sand transport and beach stability.

Sand transport has been calculated in time series form using conventional coastal engineering procedures based on the 'Queens' relationship (Kamphuis, 1991) and input time series waves. The 'Queens' relationship was preferred over other methods because it incorporates provisions for wave period and sand grain size that are required in this location. Shoreline alignments used were determined for the situation prior to cyclone Yasi as the most suitable indicator of the existing equilibrium condition.

Wave conditions and sand transport at the shoreline were determined at three sites along The Strand, being Site 1 (south), Site 2 (mid beach) and Site 3 (north) as shown in Figure B.3.37, on the basis of:

- Analysis of time series of prevailing local wind-waves based on recorded winds in Cleveland Bay;
- Transformation of the recorded incident 'sea' conditions at the EHP Cape Cleveland wave recorder to the three nearshore locations along The Strand;
- Determination of breaking wave conditions (height and angle) using conventional wave refraction and shoaling procedures; and
- Calculation of longshore sand transport separately for the wind-waves and recorded 'sea' waves in 3-hourly time series format for subsequent analysis of annual and seasonal patterns.

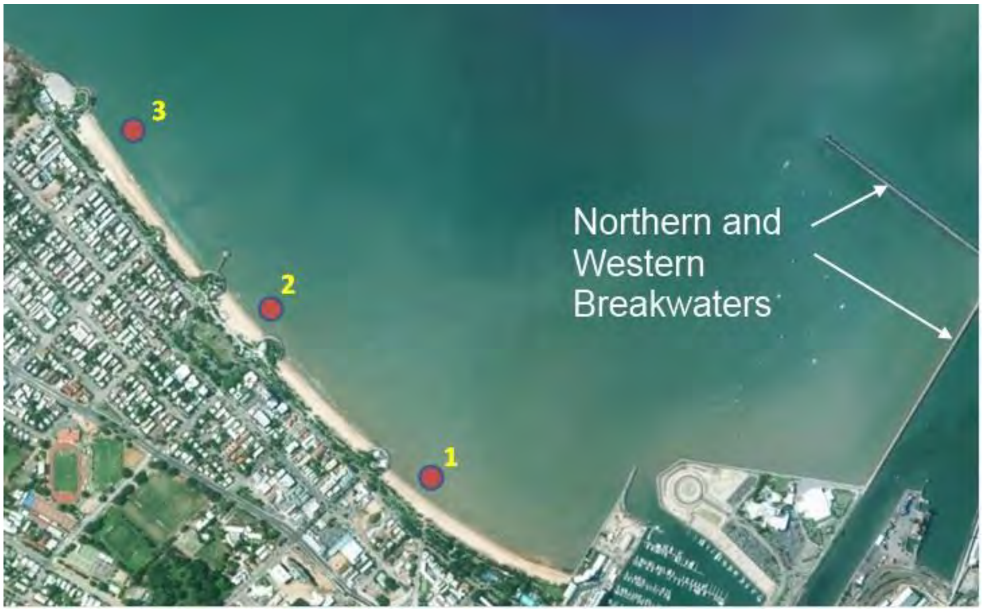


Figure B.3.37 Locations of Sand Transport Sites 1, 2 and 3 (aerial image – Google Maps)

Wave directions are of importance to sediment transport at the shoreline (Hardy, 1991). It has been shown in previous studies (Riedel & Byrne, 1983; Hardy, 1991) and that the mean wave direction at the shoreline along The Strand is slightly east of north-east. This is consistent with the incidence of swell coming into Cleveland Bay past Cape Cleveland together with predominance of local sea waves generated in Cleveland Bay itself from east to north-east.

The Port structures that are presently controlling wave propagation to The Strand are the northern and western breakwaters, shown in Figure B.3.37. These have varying effect on the waves depending on wave direction and location along the beach system, most markedly at Site 1 where they have effects on nearshore waves approaching from directions to the east and south of east-north-east. At Site 3, only those nearshore waves from south of east are affected.

It was indicated in the assessments undertaken that the low level background swell contributes very little to sand transport, as would be expected, since it refracts substantially to be essentially normal to the beach at The Strand. Accordingly, a separate analysis of any very minor contribution of underlying swell inherent in the recorded data was not considered.

Incident locally generated wind waves and those waves recorded at Cape Cleveland have been analysed for their effects in transporting sand along The Strand. Each of those components has been analysed separately and linearly added. While this is may not be entirely accurate due to non-linear aspects of interactions, it provides a useful assessment of the relative contributions of each component.

The sand transport rates derived at sites 1 to 3 (Figure B.3.37) are summarised in Table B.3.4, which shows the up-coast and down-coast components of transport along The Strand beaches, as well the resultant net transport. These show that the net movement of sand is typically the small difference between the two larger up and down coast components. The accuracy of these results must be regarded as relatively modest, with potentially significant error margin, particularly for the net rates. Nevertheless, the analysis is considered appropriate for the purpose of assessing the relative impacts of the PEP, as discussed below.

Table B.3.4 Calculated Longshore Sand Transport Rates Along The Strand Beaches - Existing

Wave Component	Annual Net Transport Rates (m^3/yr)								
	Site 1 (south)			Site 2 (mid)			Site 3 (north)		
	Up coast	Down coast	Net	Up coast	Down coast	Net	Up coast	Down coast	Net
Local wind-waves	350	-500	-150	805	-825	-20	1710	-805	905
'Sea' Waves	290	-605	-315	2320	-1335	985	2745	-1480	1265
Resultant Total Transport			-465			965			2170

Note: Up-coast is towards the north-west and down-coast is towards the south-east

The analysed sand transport results for the local wind-wave and incident medium period 'sea' waves indicate:

- Local wind-waves show a highly seasonal pattern of transport particularly at the southern end of the beach, being of very low rate, predominantly up-coast during winter and predominantly down-coast in summer at that location. The central and northern end of the beach are more exposed to the wind-waves, causing predominantly northward transport of about 1,000 to 1,500 m^3/yr. The wind-waves cause small but slightly southward net transport at the southern end of The Strand.
- The 'sea' waves incident from offshore cause only minor net transport along the beach, being less than about 600 m^3/yr, with little or no transport at the southern end and a tendency for net down-coast transport during summer in the central and northern parts.
- The combined result is a small transport rate towards the south-east at the southern end and (order of) 1,500 to 2,000 m^3/yr towards the north-west at the northern end of The Strand beach.

These assessed rates are consistent with the findings of Muller *et al* (2006). Other assessments (CES, 2010) suggest a net transport at Rowes Bay of less than 3,000-4,000 m^3/yr and the beach restoration works have been aimed at establishing a stable (zero net sand loss) situation.

The procedure adopted is consistent with state of art coastal engineering methods. It is considered that the analysis approach provides a suitable basis for relative impact assessment purposes, based on the effects that the PEP would have on the prevailing waves. It is recognised that the period of data analysed may not be representative of the long term and, in the absence of data to calibrate the various wave and transport parameters, it would not be expected to give results with absolute accuracy in the range ±20 to 50%. Nevertheless, the relative impacts of the PEP are likely to be identified with a higher level of accuracy than the absolute transport rates determined.

B.3.4 Assessment of Potential Impacts

B.3.4.1 Assessment Process

A risk-based approach has been adopted in this environmental impact assessment. This is based on the identification of potential impacting processes and characterisation of the likely level of impact to the existing environment. The risk assessment process is described in Part A of this EIS.

For the purposes of this chapter, impacts levels and risks were defined on the basis of the following:

- Magnitude of Impact – made up of assessment of the intensity, scale (geographic extent), duration of impacts and sensitivity of environmental receptors to the impact. Table B.3.5 is a summary of the categories used to define impact magnitude.
- Likelihood of Impact – which assesses the probability of the impact occurring. Table B.3.6 is a summary of the categories used to define impact likelihood.
- Risk Rating – which assesses the level of risk for key impacting processes. The risk rating was generated from the Magnitude and Likelihood scores, based on the matrix shown in Table B.3.7.

Table B.3.5 Categories Used to Define Magnitude of Impact

Magnitude	Description
Very High	The impact is considered critical to the decision-making process as it would represent a major change to the coastal processes of Cleveland Bay. This level of impact would be indicated by: Very large changes to the natural physical processes in Cleveland Bay, such as major shoreline erosion or major changes to tidal currents and/or sediment transport patterns
High	The impact is considered important to the decision-making process as it would a detectable change to the coastal processes of Cleveland Bay. This level of impact would be indicated by: Large changes to the natural physical processes in Cleveland Bay, such as shoreline erosion or large changes to tidal currents and sediment transport patterns
Moderate	While important at a state or regional or local scale, these impacts are not likely to be critical decision making issues. This would be indicated by: Moderate changes to the natural physical processes in Cleveland Bay, such as significant shoreline realignment or moderate changes to tidal currents and/or sediment transport patterns
Minor	Impacts are recognisable/detectable but acceptable. These impacts are unlikely to be of importance in the decision making process. Nevertheless, they are relevant in the consideration of standard mitigation measures. This would be indicated by: Minor changes to the natural physical processes in Cleveland Bay, such as subtle shoreline realignment or minor changes to tidal currents and/or sediment transport patterns
Negligible	Minimal change to the existing situation. This could include, for example, impacts that are below levels of detection, impacts that are in the normal bounds of variation or impacts that are in the margin of forecasting error.
Beneficial	Any beneficial impacts as a result of the Project such as for example, the creation/establishment of new habitat.

Table B.3.6 Categories Used to Define Likelihood of Impact

Likelihood Categories	
Highly Unlikely/Rare	Highly unlikely to occur but theoretically possible
Unlikely	May occur during construction/life of the Project but probability well <50%; unlikely but not negligible
Possible	Less likely than not but still appreciable; probability of about 50%
Likely	Likely to occur during construction or during a 12 month timeframe; probability >50%
Almost Certain	Very likely to occur as a result of the Project construction and/or operations; could occur multiple times during relevant impacting period

Table B.3.7 Risk Ratings

Likelihood	Magnitude (Consequence)				
	Negligible	Minor	Moderate	High	Very High
Highly Unlikely	Negligible	Negligible	Low	Medium	High
Unlikely	Negligible	Low	Low	Medium	High
Possible	Low	Low	Medium	Medium	High
Likely	Low	Medium	Medium	High	Critical
Almost Certain	Medium	Medium	High	Critical	Critical

The subsequent report sections present the impact assessment of the PEP for the key coastal processes issues identified in the baseline section which are:

- Hydrodynamics;
- Morphology and Sedimentation; and
- Shoreline and Beach System.

Key assumptions and limitations of the impact assessment are outlined and discussed where relevant.

B.3.4.2 Hydrodynamics

The Port Expansion Project including the reclaim areas and the dredged channels will induce changes to current magnitudes and directions in the immediate vicinity of the development. The numerical model described in Section B3.2.4 was used to assess the magnitude and significance of the impact.

Following setup, calibration and validation of the TUFLOW-FV model (Appendix H1), a series of hydrodynamic scenarios were executed and analysed. Seven scenarios were assessed to provide direct information on design conditions and potential hydrodynamic impacts.

B.3.4.2.1 Hydrodynamic Modelling Scenarios

The seven scenarios assessed included an Existing Case (using the current port bathymetry and solid structures), a Base Case (representative of conditions at the time of development of the port expansion), three Developed Cases, and two Ultimate Cases.

For the purposes of the impact assessment presented here, the Ultimate Case is compared to the Base Case. The geometric configuration of these scenarios was as follows:

- Base Case. This represented existing conditions together with dredging associated with the Berth 12 development and the reclamation and dredging associated with the Marine Precinct development.
- Ultimate Case. This included full dredging of the constructed harbour, widening of Platypus Channel between P12 and P14 and deepening of the approach channel to -14.5 mAHD.

A sensitivity analysis is also undertaken to assess the impact of the possible construction of a small additional Western Breakwater on the western side of the expanded harbour.

Model configurations for these scenarios are shown below in Figure B.3.38 andFigure B.3.39. For impact assessment purposes, the model was run from 01/11/2010 to 01/12/2011, a period which included strong SE winds that would have the effect of forcing residual currents across the Bay and generating waves that enhance sediment re-suspension from the seabed. The wind speed and direction measured at standard 10m height for the period in the vicinity of the Port is shown in Figure B.3.40. The wind rose for the 1 month simulation period is shown together with the long-term wind rose in Figure B.3.41.

It is noted that the simulation period included a wind field that broadly represents the long term average conditions at the Port. Winds from the SE were stronger than the long term average during the simulation period.

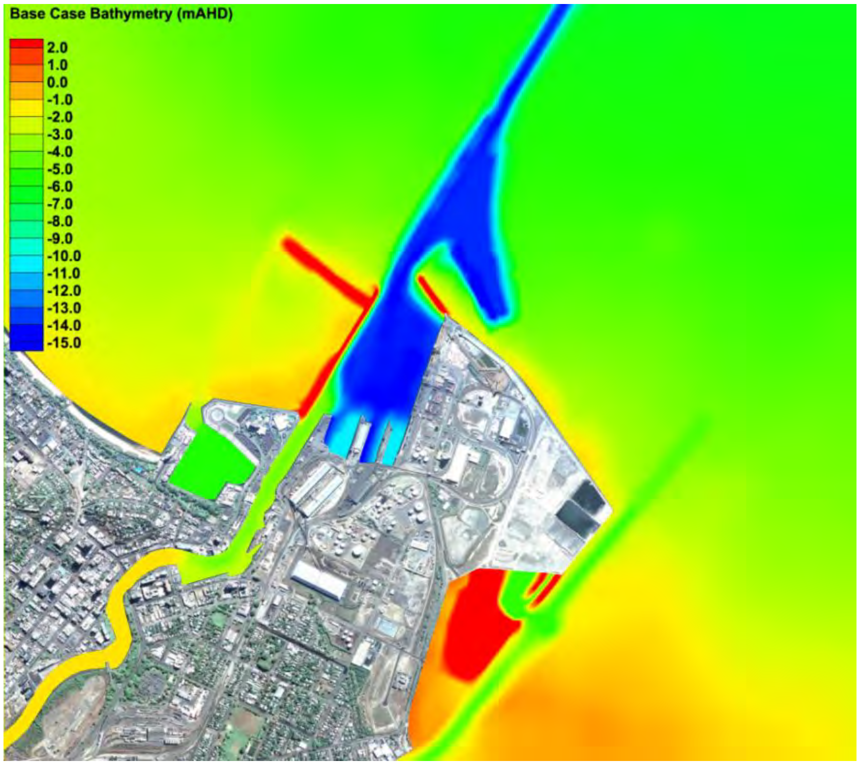


Figure B.3.38 Base Case Existing Model Bathymetry (aerial image – Google Maps)

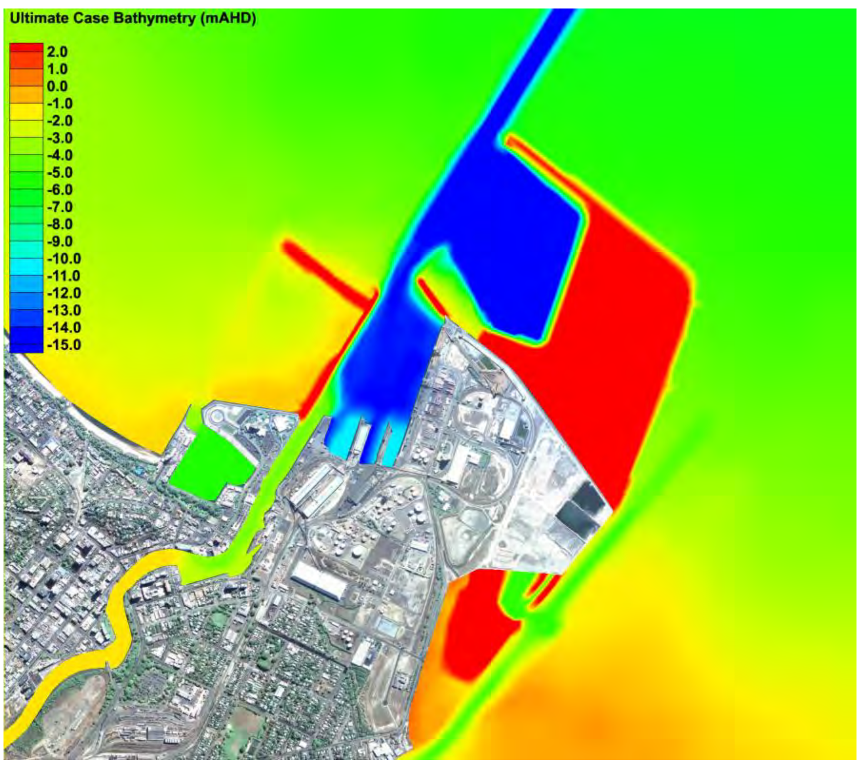


Figure B.3.39 Ultimate Case PEP Model Bathymetry (aerial image – Google Maps)

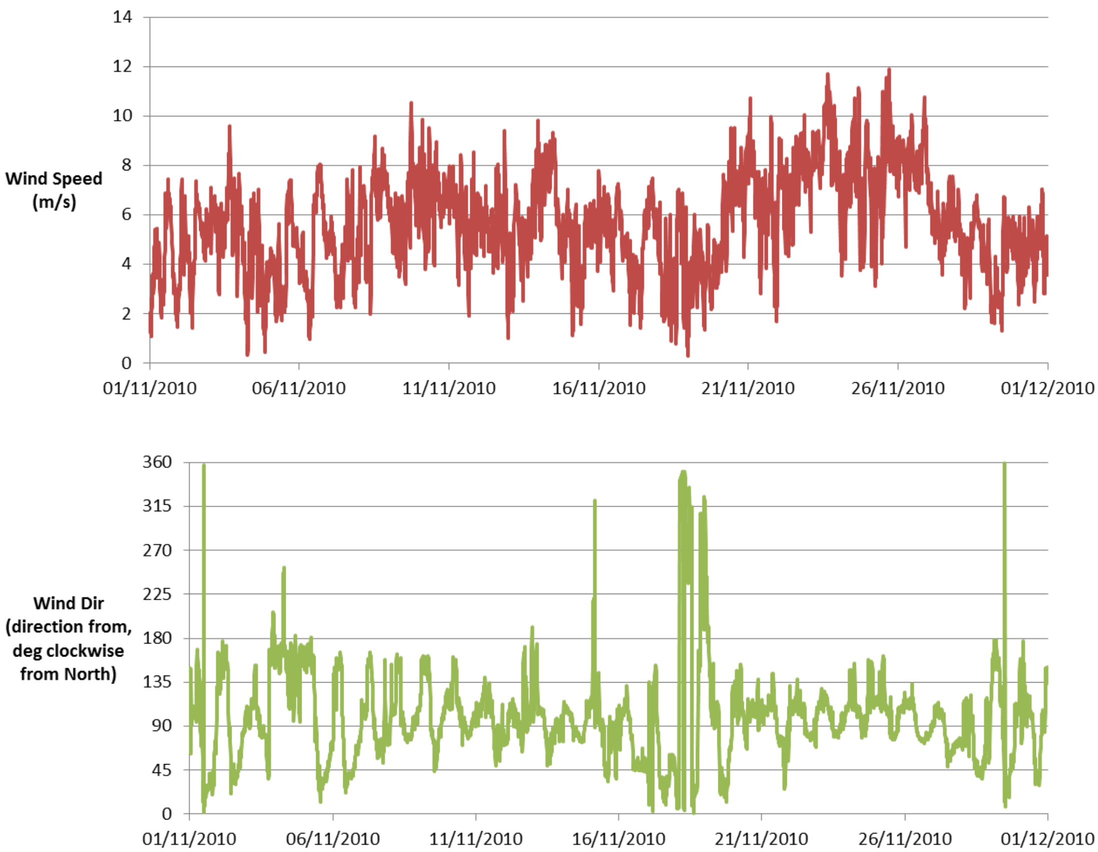


Figure B.3.40 Wind Speed and Direction at the Port of Townsville During the Modelling Period (10 Minute Averages Measured at 10 Metres Elevation)

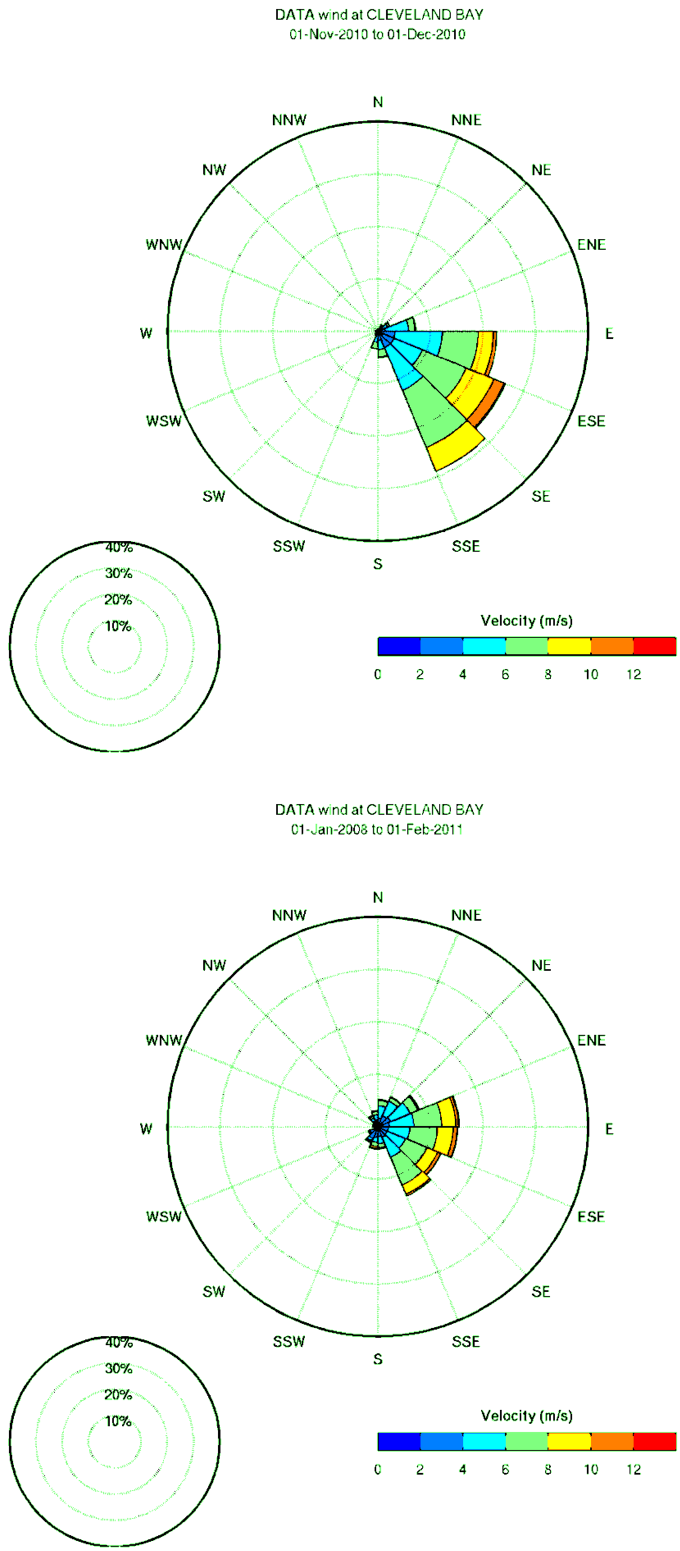


Figure B.3.41 Wind Rose for Simulation Period (Top) Compared to Long Term Wind Rose (Bottom)

B.3.4.2.2 Hydrodynamic Modelling Results and Discussion

Results are presented below in term of resultant impact at specific times between the Base Case and Ultimate configuration. Figure B.3.42 illlustrates the tide level near the port for the simulation and the times at which the typical current patterns and impacts have been extracted.

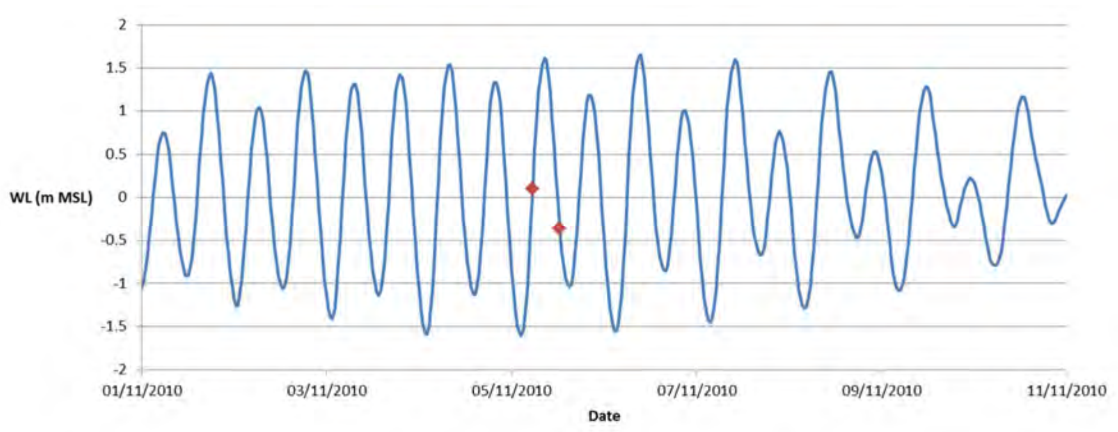


Figure B.3.42 Hydrodynamic Impact Assessment Tide Levels

Changes to current patterns in the vicinity of the Port were assessed for a flood tide and an ebb tide during a period of spring tides. Spatial plots of the changes in velocity magnitudes between the Base Case and Ultimate Case are shown in Figure B.3.43 and Figure B.3.44. Reductions in velocity magnitude are in blue, and increases in yellow / red.

Spatial water level impact plots are not shown due to the neglible magnitude of the changes.

The Hydrodynamic and Advection-Dispersion Modelling Technical Report (Appendix H1) provides a detailed discussion of the spatial impacts. In summary, the velocity impact plots show that the changes in velocity magnitudes associated with the Port Expansion Project are confined to the Project Area and the immediate surroundings. The magnitude changes are not large (up to 0.2m/s). The velocities in the expanded port and adjacent channels are generally reduced, while the velocities offshore from the new reclamation and breakwaters at Sites 2 and 4 are generally increased.

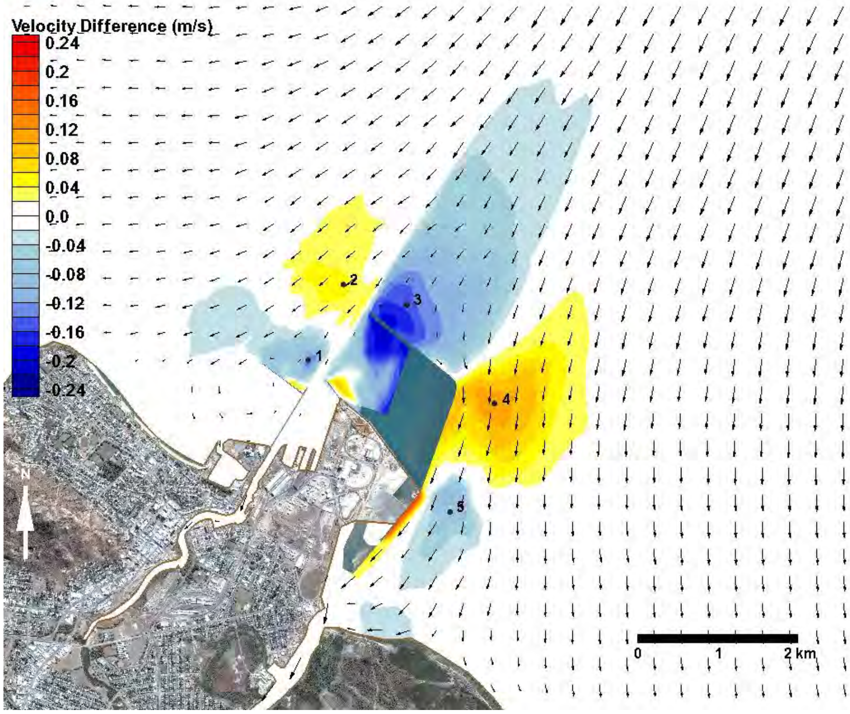


Figure B.3.43 Current Speed Difference Between Ultimate Case and Base Case During Flood Tide (aerial image – Google Maps)

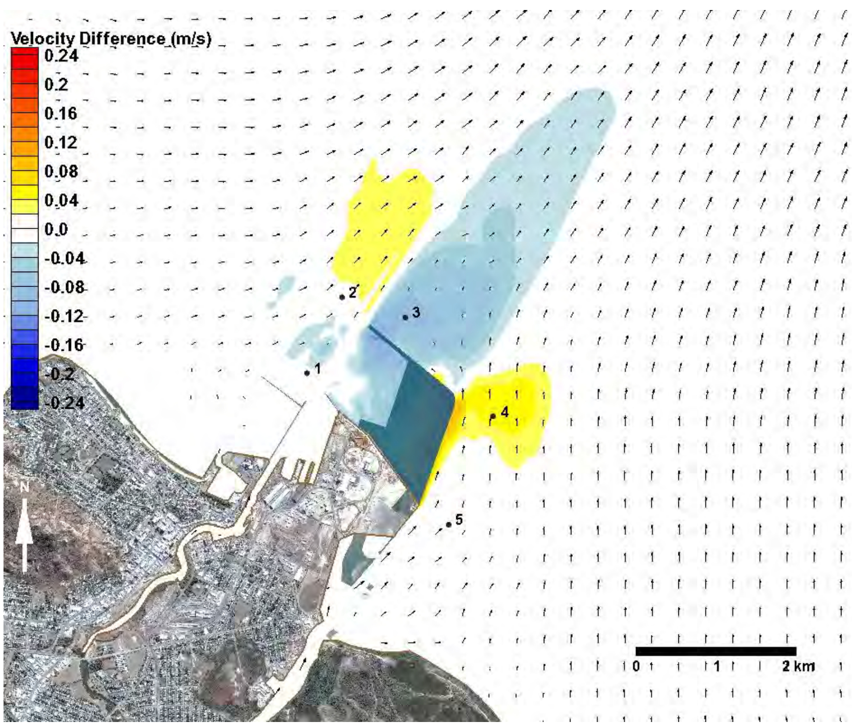


Figure B3.44 Current Speed Difference Between Ultimate Case and Base Case During Ebb Tide (aerial image – Google Maps)

Time series of water level and depth-averaged velocity were extracted at the four analysis sites shown in Figure B.3.43 and Figure B.3.44. Water level time series were identical for the Base Case and Ultimate

Case. The velocity magnitude time series for the Base Case, Ultimate Case and Ultimate Case With Western Breakwater are shown in Figure B.3.45 and Figure B.3.46.

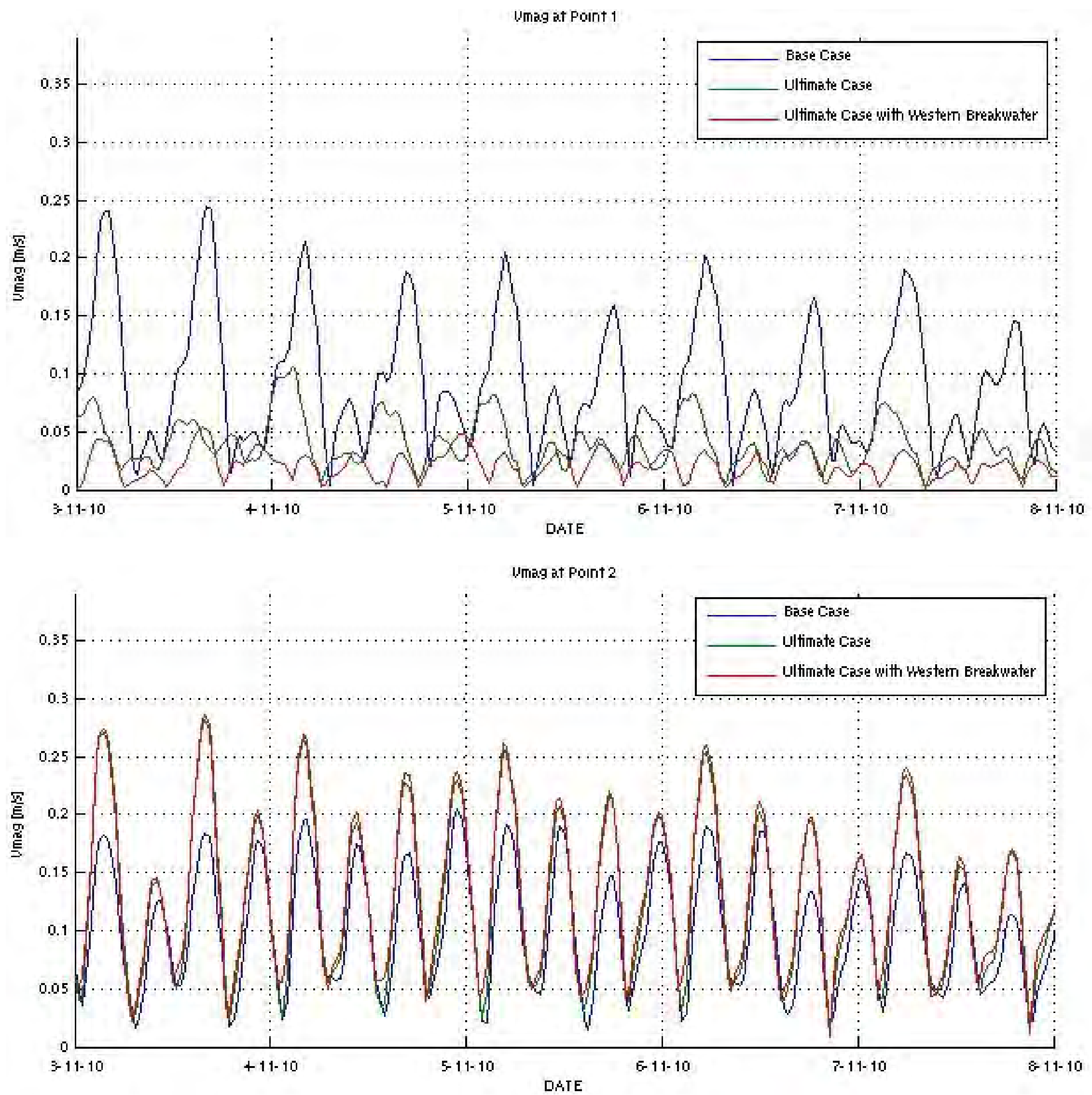


Figure B.3.45 Velocity Magnitude Time Series at Sites 1 and 2 for Base Case and Ultimate Cases

Figure B.3.45 illustrates the change in velocity magnitude at Sites 1 and 2 for the ultimate development cases (Ultimate Case and Ultimate Case with Western Breakwater). There is a general reduction in velocities at Site 1 for the ultimate development cases, and an increase at Site 2. The reductions at Site 1 are associated with the proximity of the new north-east breakwater and revetment, while the increase at Site 2 is due to the redistribution of tidal flows associated with the port expansion. None of the changes in velocity are significant in terms of an environmental or shipping impact due to their small magnitude relative to the velocities in the Base Case.

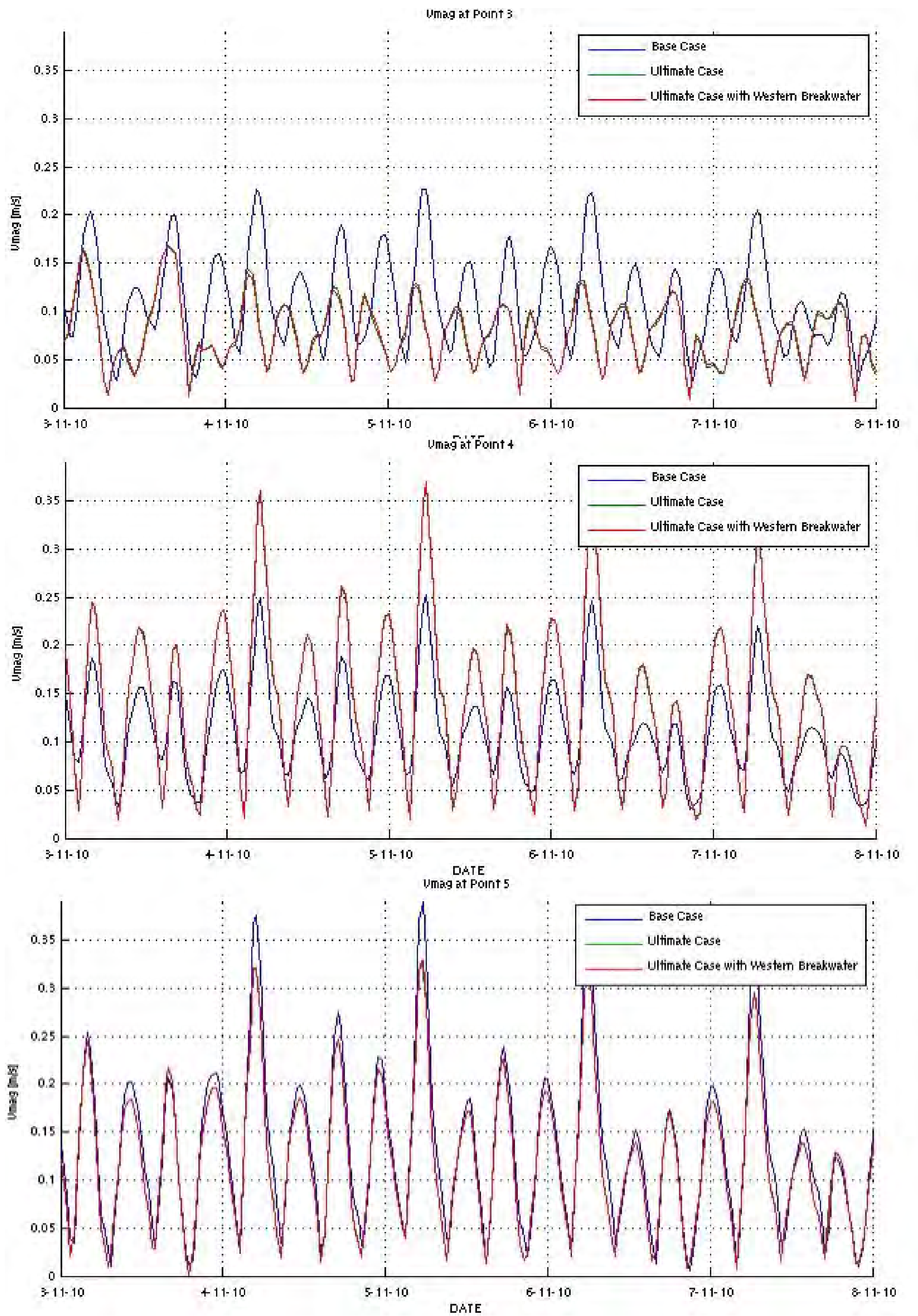


Figure B.3.46 Velocity Magnitude Time Series at Sites 3, 4 and 5 for Base Case and Ultimate Cases

Figure B.3.46 illustrates the change in velocity magnitude at Sites 3, 4 and 5 for the ultimate development cases (Ultimate Case and Ultimate Case with Western Breakwater). There is a general decrease in velocities at Site 3 for the developed cases, and an increase at Site 4. The decrease at Site 3 is associated with the additional sheltering afforded by the port expansion footprint while the increase at Site 4 is caused by tidal currents flowing around the new reclamation area. There is also a very small decrease in velocity magnitude at Site 5 during the flood tide. As with Sites 1 and 2, none of the changes in velocity are significant in terms of an environmental or shipping impact due to their small magnitude relative to the velocities in the Base Case.

B.3.4.2.3 Western Breakwater Sensitivity Analysis

The time series shown in Figure B.3.45 and Figure B.3.46 illustrate the very small effect that the small additional Western Breakwater would have on hydrodynamics in the Project Area, since the velocity magnitudes in the Ultimate Case are very similar to the velocities in the Ultimate Case with Western Breakwater. There is a slight reduction of tidal current velocities immediately inside the breakwater at all stages of the tide, which is the purpose of the design.

B.3.4.2.4 Summary of Hydrodynamics Results

The hydrodynamic impacts of the PEP are not large in magnitude or extent, being confined to changes in velocity magnitude in the immediate vicinity of the breakwaters and reclamation area. Water levels at locations in the vicinity of the PEP works will not change as a result of the Project.

Velocity magnitudes decrease by up to 0.2 m/s adjacent to the new breakwater structures and in the port expansion harbour area on both the flood and ebb tides in the Ultimate Case. There are increases in velocities of up to 0.1 m/s in the Ultimate Case in some areas as shown in Figure B.3.43 and Figure B.3.44.

No changes in tidal current velocities is predicted in the existing inner harbour.

B.3.4.3 Cleveland Bay Morphology and Sedimentation

B.3.4.3.1 General Effects

The PEP will alter the bathymetry and hydrodynamics of Cleveland Bay such that sedimentation processes will be significantly altered. Impacts on sedimentation processes and the marine seabed morphology relate predominantly to:

- Effects that the reclamation and breakwater structures will have on both waves and currents and associated sediment re-suspension, transport and deposition;
- Effects that deepening and widening the channels will have on sediment deposition in those dredged areas of the marine seabed; and
- Effects that alterations of the harbour basin configuration and depths have on hydrodynamics and deposition there.

This section considers impacts of the PEP on siltation processes associated with the harbour and channels, at adjoining nearshore seabed areas (e.g. adjacent to The Strand) and at the offshore Dredge Material Placement Area (DMPA).

B.3.4.3.2 Sediment Transport Patterns

In the context of determining impacts on sedimentation processes, including siltation rates in the harbour and shipping channels, the TUFLOW-FV model was used to simulate the re-suspension of fine material due to the action of waves and currents for the Base Case and Ultimate Case to determine the potential impact of the Project on bed morphology and siltation rates. The model was run for the period 01/11/2010 to 01/12/2010 with prevailing wind and tide conditions as described in Section B3.4.2.1.

The base case residual (net) sediment transport was shown earlier in Figure B.3.29 and illustrated the expected net transport in the north-west direction with highest transport rates in the shallower inshore parts Cleveland Bay.

The Ultimate Case residual sediment transport and corresponding impact (difference from base case) are shown in Figure B.3.47 and Figure B.3.48 respectively. It can be seen that outer harbour extension will redirect the residual suspended sediment drift around the reclamation. A small net reduction in fine sediment drift from east to west of the port may occur due to the combined interception effect of the outer harbour extension and the wider and deeper Platypus channel. This small reduction in fine cohesive sediment transport would not be expected to generate a perceptible morphological change either in the short or long term.

The bed morphology impact (difference in bed sedimentation/erosion between the ultimate and base case) is shown in Figure B.3.49. It can be seen that the outer harbour reclamation extension may cause a slight increase in sediment deposition rates in the area of Cleveland Bay immediately to the east of the harbour and port approach channel. A slight commensurate reduction in net deposition is predicted to the west of the approach channel and in front of The Strand. While the numerical model can predict a small change in the net sedimentation rate it is likely that this would not be perceptible against the background of natural variability.

Sediment deposition in the dredge channels is considered further in the following section.

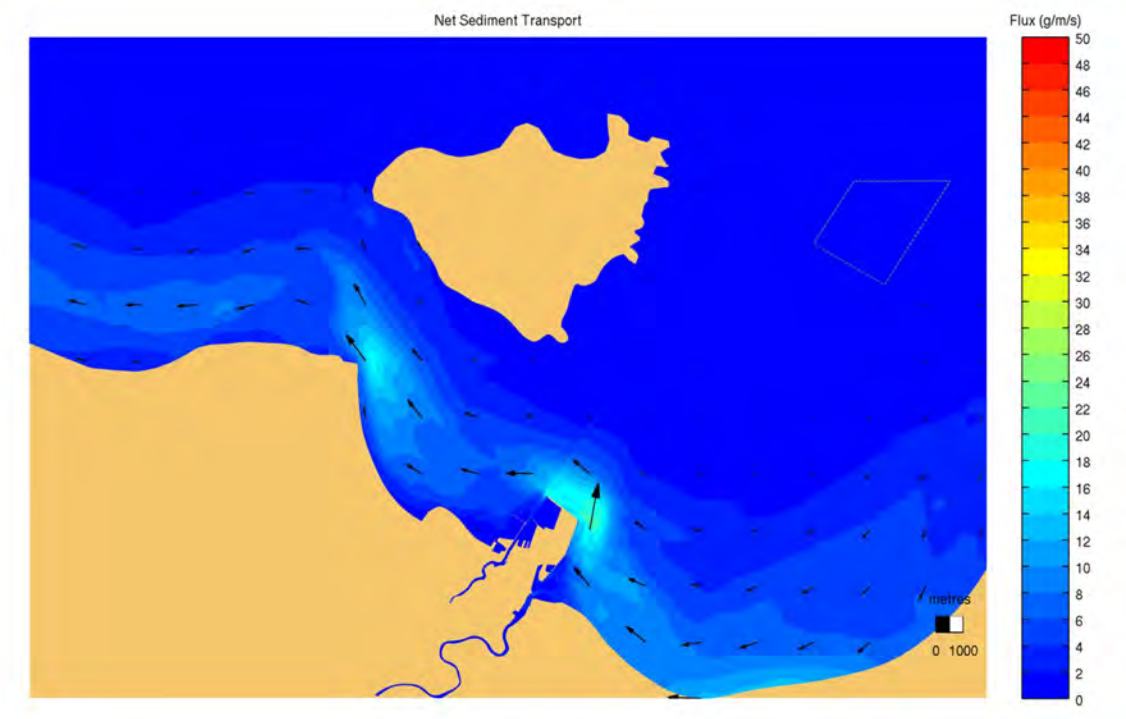


Figure B.3.47 Modelled Ultimate Case Residual Suspended Sediment Transport

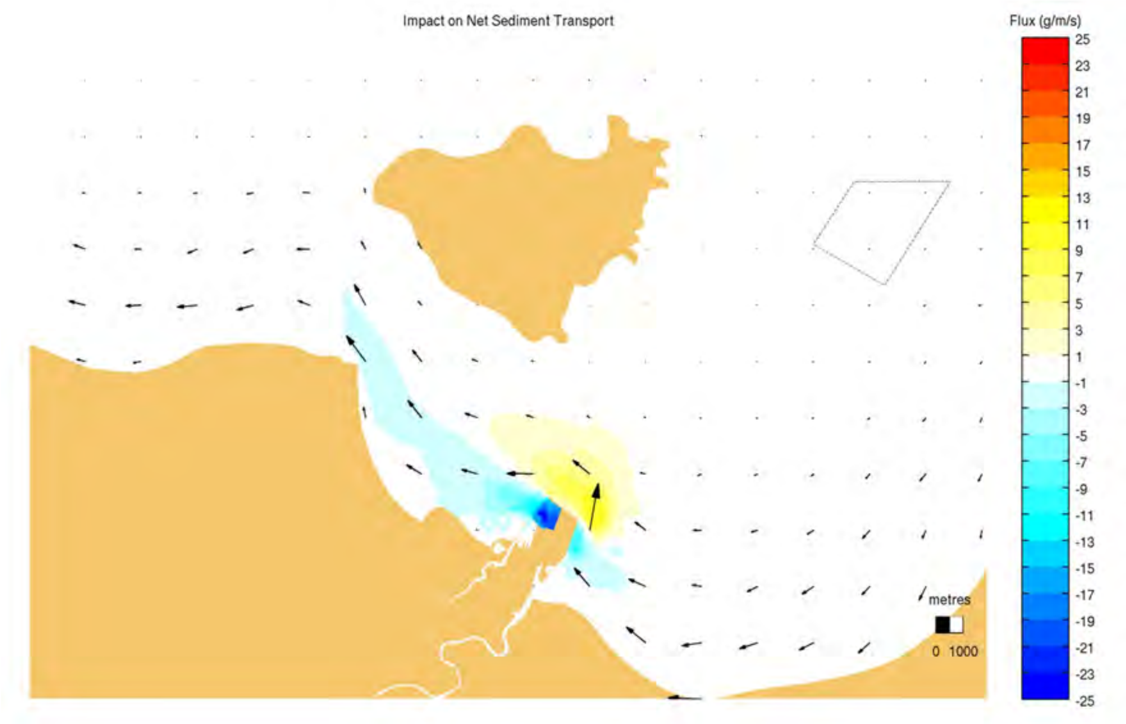


Figure B.3.48 Ultimate Case Residual Suspended Sediment Transport Impacts

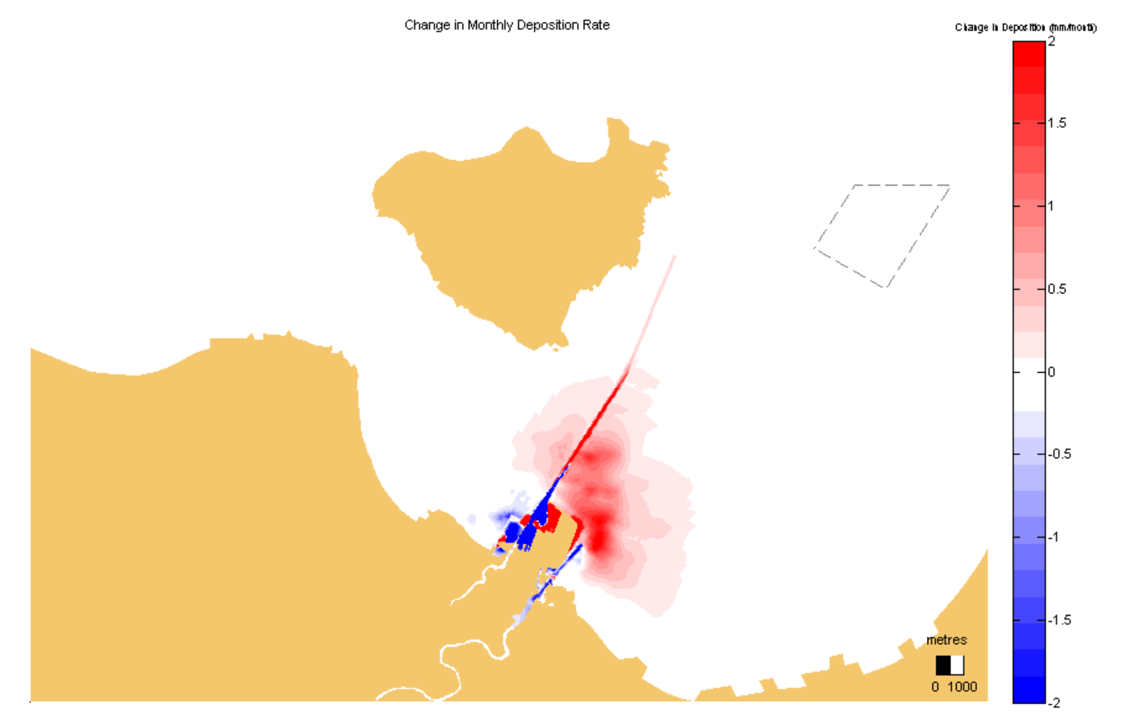


Figure B.3.49 Ultimate Case Change in Sediment Deposition Rate

B.3.4.3.3 Channel Siltation Assessment

The modelled Base Case channel siltation distribution is shown in Figure B.3.50 and the modelled annual siltation volumes are summarised in Table B.3.8 for the regions shown in Figure B.3.53. The modelled base case sedimentation rates were found to be in reasonable agreement with annual average historic dredging volumes for the existing dredged areas (GHD, 2008a).

The distribution of modelled Ultimate Case siltation depths is also shown in Figure B.3.51 and the modelled annual siltation volumes for the Ultimate Case are summarised in Table B.3.8. The change in siltation rates due to the port expansion are shown in Figure B.3.52. It is apparent that there is a reduction in siltation rates in the new enclosed outer harbour area and in the inner part of the Platypus Channel. There is a predicted increase in siltation in the outer part of the Platypus Channel, consistent with the broader pattern of siltation rate changes discussed in Section B3.4.3.2. There will be minimal change to siltation rates in the Sea Channel as a result of the Project.

Sedimentation volumes in the existing inner harbour are predicted to be reduced by around 45% and sedimentation volumes in the outer harbour are predicted to decrease by around 50% relative to the base case (which includes a dredged area for Berth 12). The Ultimate Case reclamation and breakwaters act to significantly reduce the efficiency of suspended sediment transport into the outer and inner harbour dredged areas. It is noted that the Ultimate Case assessments have been undertaken without the western breakwater in place. A modest decrease in predicted sedimentation would most likely occur with the addition of the western breakwater.

Associated with these reductions in the expanded harbour areas, the annual volume of sedimentation occurring in the Platypus Channel is predicted to increase by around 5%. This is partly due to the increased channel width as part of the ultimate development, as well as diversion of the sediment transport path to the shorter remaining section of that channel where infill depths of about 1m/yr may be expected.

Table B.3.8 Modelled Annual Sedimentation Volumes (m3)

Dredge Area	Base Case	Ultimate Case	Percentage Change
inner harbour	65,000	35,000	-46%
outer harbour	184,000	93,000	-49%
Platypus Channel	189,000	199,000	+5%
Total (modelled)	438,000	327,000	-25%

Overall, this modelling indicates that the total quantity of siltation in the inner harbour, outer harbour and Platypus Channel combined may be reduced by around 110,000m^3 per year (about 25% for that area) relative to the present situation. This is primarily due to the reduced suspended sediment net transport flux around the expanded port. The material depositing in the new enclosed outer harbour area will be entirely very fine silts without the minor component of coarser silt/sand that deposits in the existing dredged basin and berth areas exposed at the present time. The change to siltation rates in the Sea Channel due to the PEP project will be negligible (and there will be no change to maintenance dredging requirements in the Sea Channel).

Figure B.3.50 Modelled Base Case Channel Siltation Rate (mm/month)

Figure B.3.51 Modelled Ultimate Case Channel Siltation Rate (mm/month)

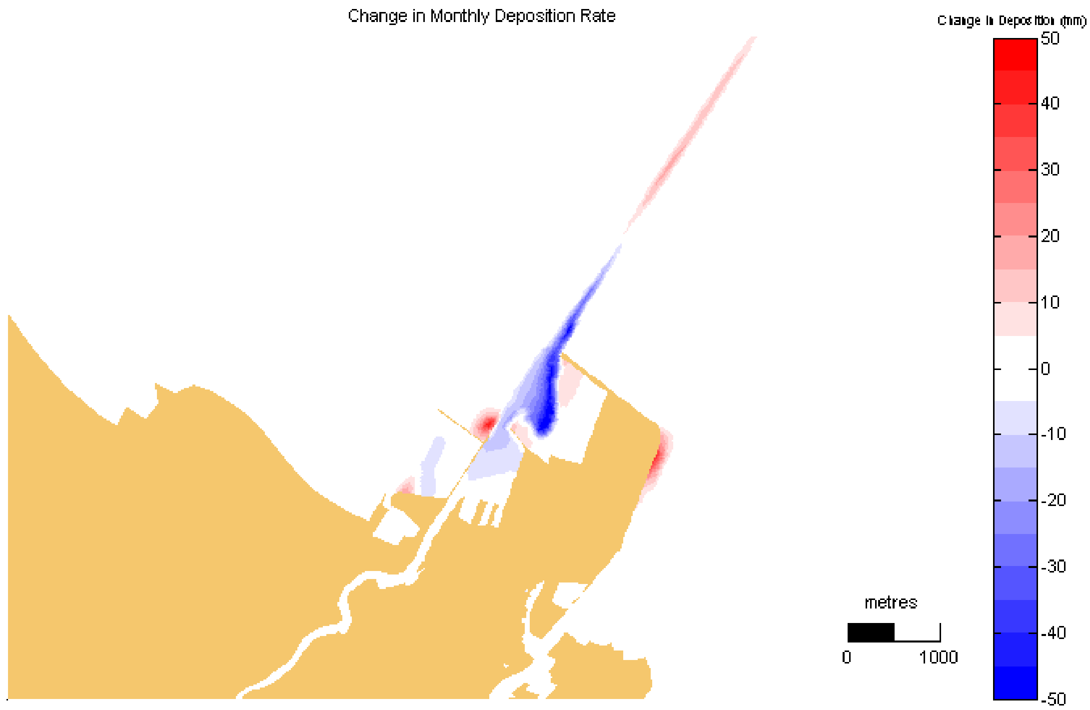


Figure B.3.52 Difference in Channel Siltation Rate Between the Ultimate Case and Base Case

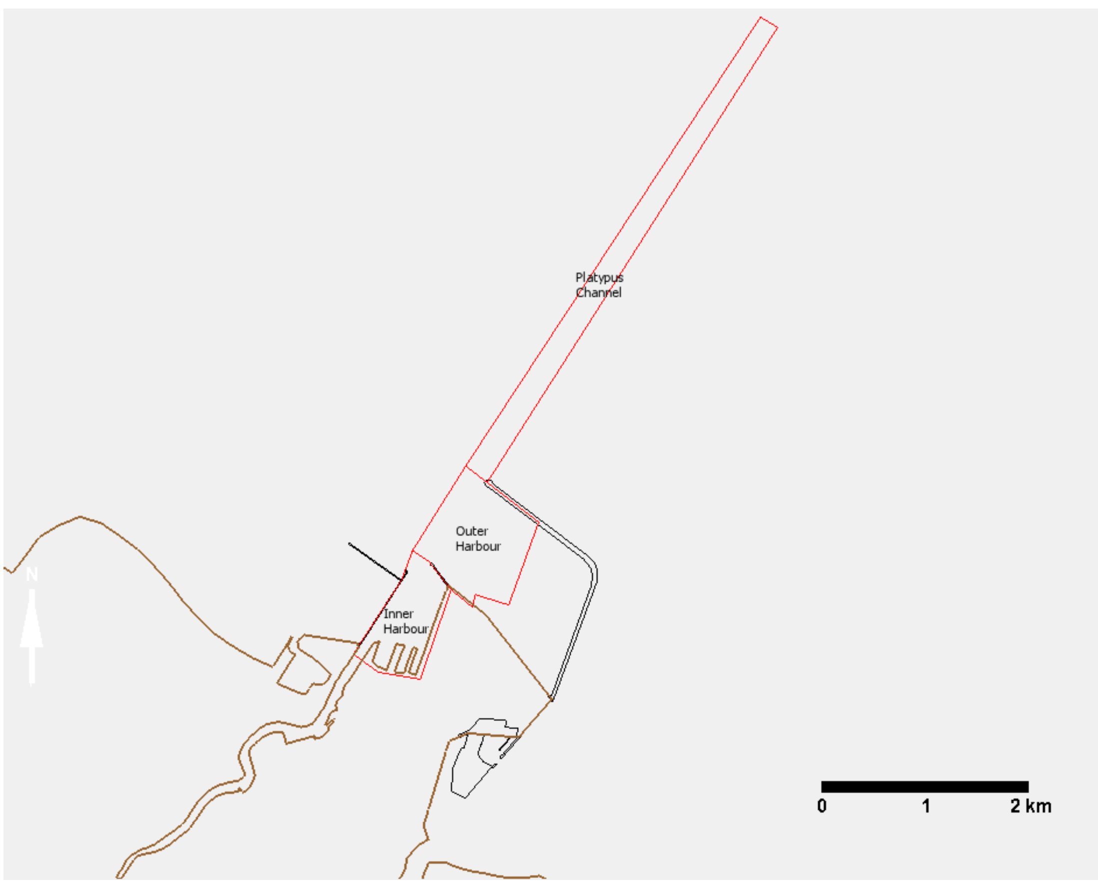


Figure B.3.53 TUFLOW-FV Sedimentation Model Regions

B.3.4.3.4 Dredge Material Placement Area Assessment

The PEP is expected to generate approximately 5.7 million cubic metres of surplus material that either has unsuitable engineering properties for reclamation purposes or is otherwise associated with channel deepening. This is in addition to the ongoing maintenance dredging requirements which have historically been about 0.2 to 0.5 million cubic metres per annum (GHD, 2008a). It is proposed to place this material in the existing designated Dredge Material Placement Area (DMPA). The existing DMPA is preferred over alternative DMPA sites as discussed in Part A of the EIS.

Ambient waves and currents have the potential to resuspend the dredge material and distribute the sediment more widely. The fate of resuspended sediment from the DMPA was previously studied using numerical models (Bode, Mason, & Hardy, 1994)) and tracer experiments (SKM, 1995). ETS Worldwide have recently undertaken another tracer experiment which included sources at the existing DMPA (ETS Worldwide, 2012).

The 3D modelling study undertaken by Bode *et al* (1994) showed that particles released from the DMPA tend to drift towards Magnetic Island under prevailing south-easterly and southerly winds. They also showed that particles released from the more landward (south-western) end of the DMPA have a greater tendency to drift towards the bays and beaches of Magnetic Island than particles released at the seaward (north-eastern) end of the DMPA. Three-dimensional effects were evident in the results due to the differing vertical structure of tide-driven and wind-driven currents.

The fluorescent tracer experiments conducted by Sinclair Knight Merz (1995) indicated that sediments at the DMPA are highly mobile; however the results were inconclusive due to the limited size of the field sampling area. The results did indicate that possibly 80 to 90% of silt-sized material was dispersed beyond the 1.5 km square sampling grid in the DMPA.

More recent (2012) fluorescent tracer experiments undertaken by ETS Worldwide confirmed that the existing DMPA is dispersive and found that tracer particles were transported and deposited in almost all directions. The results did indicate dominant trend for dispersion to the NE and SW (the dominant tidal current directions), and also indicated that material is transported from the DMPA to the NE coastline of Magnetic Island. The study findings were consistent with those of the SKM study.

The TUFLOW-FV numerical model was used to investigate the likely re-suspension and dispersion of material from the DMPA during the period 01/10/2008 to 01/11/2008. This period was chosen as it is reasonably representative of long term conditions, with predominantly east-south-east winds and a number of wave events with significant wave heights H_s above 1m as shown in Figure B.3.54.

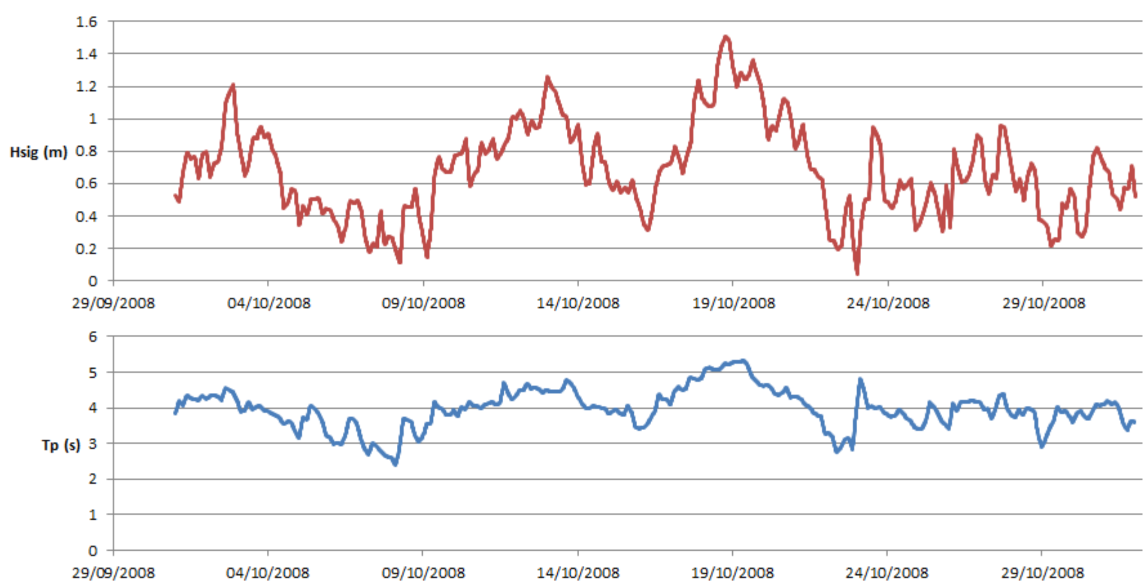


Figure B.3.54 Wave Conditions at the DMPA During the Simulation Period

The DMPA Preliminary Capacity Assessment (Part A of the EIS) has indicated that the height of the mound of sediment one month after placement may be an average of 0.7 metres above the existing bed elevation. Consequently, for the purposes of this assessment, the elevation of the DMPA was increased by 0.7m relative to the baseline surveyed level.

The relative erodability of the sediment to be placed at the DMPA compared to naturally occurring sediment is unknown. It would be expected that the softer material removed during the first stage of dredging in the outer harbour may be more easily resuspended than the stiffer clay material to be removed during the channel deepening works. In order to make a conservative estimate of the amount of resuspension, a critical bed shear stress for erosion of 0.12 N/m^2 was adopted for the silt and clay components of the dredged material.

The bed shear stress calculated at the DMPA based on the modelled current and wave magnitudes is shown in Figure B.3.55. Note the correlation between the bed shear stress magnitude and the wave height shown in Figure B.3.54 The critical shear stress for erosion (τ_{ce} = 0.12N/m^2) was exceeded during the most significant wave event, indicating that the sediment is likely to resuspend and disperse during moderate wave events (H_s > 1.2m) of sufficiently long period (T_p > 4s).

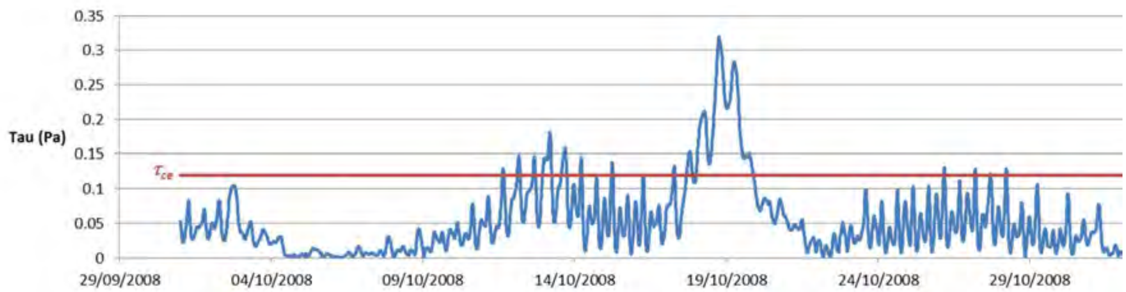


Figure B.3.55 Modelled Bed Shear Stress at the DMPA During the Simulation Period

The fate of sediment resuspended from the DMPA was also investigated. The sediment composition at the DMPA was assumed to be equivalent to the bulk average of the dredged sediment from the channel. The Total Suspended Solids concentration (TSS) exceeded for 1% of the simulation period due to sediment resuspended from the DMPA is shown in Figure B.3.56. The corresponding deposition of resuspended sediment is shown in Figure B.3.57. It is noted that the plume of resuspended sediment does tend to migrate around the north-east shoreline of Magnetic Island, in agreement with the results of Bode *et al.* (1994) and ETS Worldwide (2012), however the depth-average concentration due to the resuspended sediment at most times is negligible, and even during resuspension events is very low (always below 10mg/L in this simulation). There is a tendency for some of the sediment to deposit near the north-east coast of Magnetic Island (where the water depth increases) and in Horseshoe Bay. Nevertheless, this result must be put into context with existing conditions, since the load of sediment from the DMPA will be a small proportion of the total sediment in suspension in the bay. To illustrate this point, Figure B.3.58 shows the modelled Total Suspended Sediment concentration (TSS) in Horseshoe Bay, Magnetic Island, together with the modelled TSS that is due to sediments resuspended at the DMPA. Modelling indicates that, on average, the proportion of sediment in suspension at that location which originated at the DMPA is between 0 to 30% of the total during such transport events.

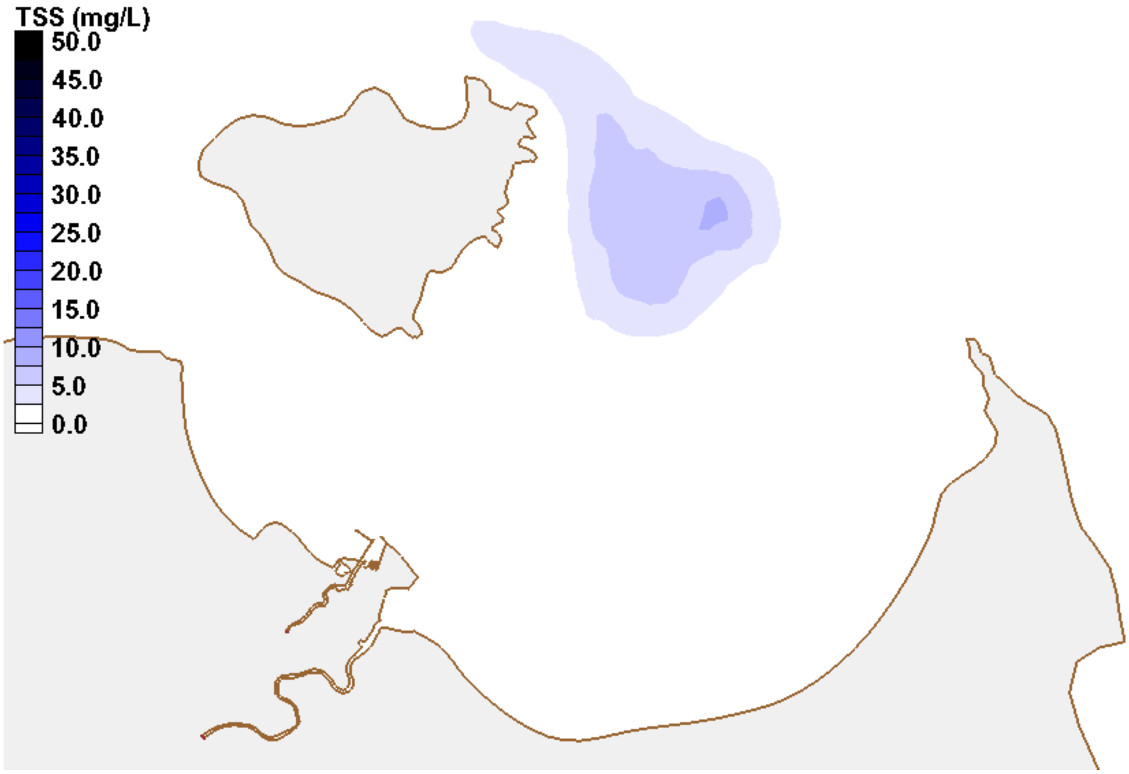


Figure B.3.56 Modelled Suspended Sediment Concentration Exceeded for 1% of the Simulation Period due to Re-Suspension from the DMPA

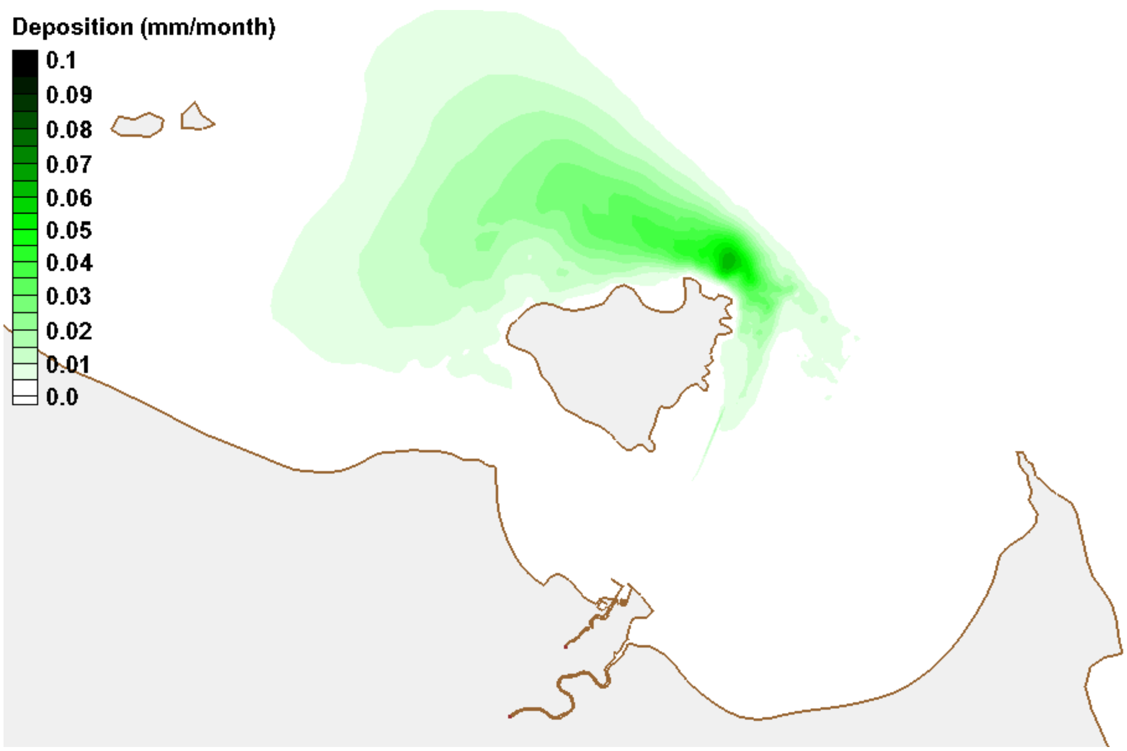


Figure B.3.57 Modelled Sediment Deposition due to Re-Suspension from the DMPA During the One Month Simulation Period

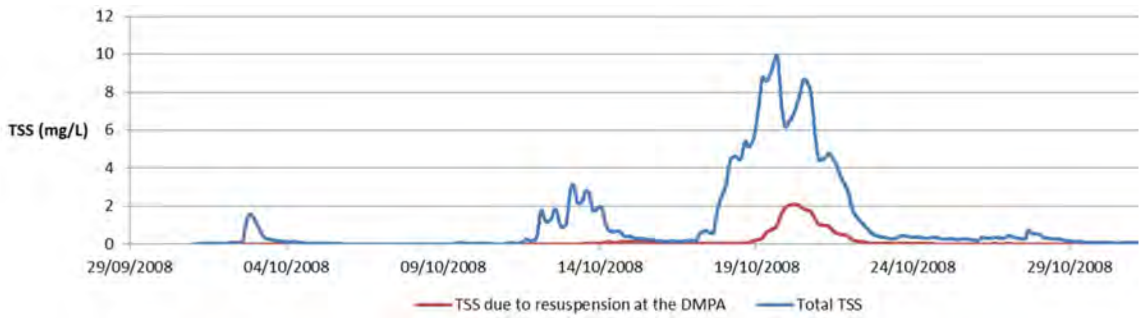


Figure B.3.58 Modelled Time Series of Suspended Sediment Concentration in Horseshoe Bay, Magnetic Island, (Blue – Total; Red – Amount Due to Sediment Re-Suspension from DMPA)

B.3.4.3.5 Fine Fluvial Sediments from Ross River

To assess the potential for changes to siltation patterns sue to fluvial supply from Ross River, the TUFLOW-FV model was used to investigate the fate of sediment discharged from the river in the Ultimate Case compared to the Base Case. Catchment modelling was undertaken as part of another BMT WBM study (BMT WBM, 2010) for a period of 30 years (1/4/1978 to 31/3/2008). A major inflow event representing the second greatest peak flow during the 30 year period was used for the impact assessment. The 1% exceedance level suspended sediment concentrations due to the fluvial discharge for the Ultimate Case configuration are shown in Figure B.3.59. These may be compared with those for the Base Case in Figure B.3.30. The difference between the Ultimate and Base cases is shown in Figure B.3.60.

The model results indicate that nearshore areas near The Strand are more sheltered from these suspended sediment discharges in this case and the PEP may help to reduce the amount of fine Ross River sediment that reaches and deposits in that area. There is a corresponding increase in the Ross River flood plume concentrations to the immediate east of the Port development.

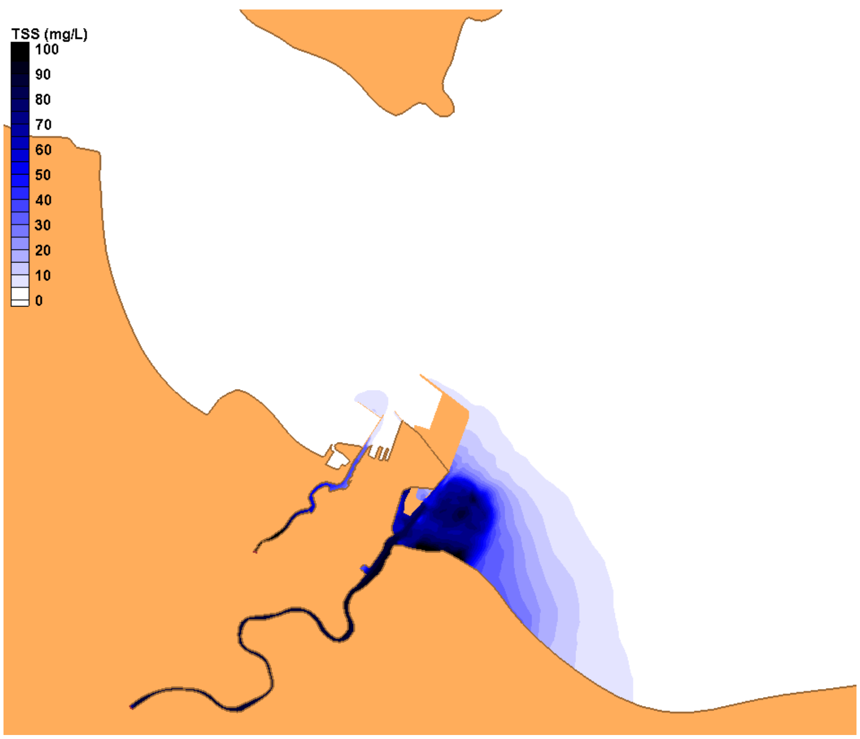


Figure B.3.59 Depth-Averaged TSS Exceeded for 1% of the Simulation Period due to Ross River and Ross Creek Sediment Discharge in the Ultimate Case

Figure B.3.60 Difference in Depth-Averaged TSS Exceeded for 1% of the Simulation Period due to Ross River and Ross Creek Sediment Discharge (Ultimate Case Minus Base Case)

B.3.4.4 Impacts on Shoreline and Beach System

B.3.4.4.1 General Effects

It has been shown by a range of investigations (Riedel & Byrne, 1983; Hardy, 1991; BPA, 1995; Mabin, 1996; CES, 1998) and the shoreline processes along The Strand beaches are determined predominantly by the incident waves. Discussion of the historical processes and existing conditions is presented in Section B3.3.6. The key factors to be considered are:

- Port development over the past 130 years and the construction of weirs, notably the Ross River Dam, have interrupted the natural sand supply to the beach system;
- Beach changes along The Strand to date have been the result of both removal of sand supply and changed wave incidence by the existing Port structures;
- The changes to wave incidence by the existing Port structures have involved partial sheltering of the southern and central parts of The Strand from waves entering Cleveland Bay past Cape Cleveland and more complete blocking at the southern end of locally generated wind waves from the south-east to north-east. This has caused sand moved southward by northerly waves to be ‘trapped’ at the southern end near Tobruk Pool; accreting the shoreline there and eroding the central parts of the beach; and
- The Strand redevelopment has created five separate beaches with controlling rock headlands to extend and realign the shoreline with the aim of providing stability with respect to longshore losses of sand.

The natural sand supply to The Strand beach system has already been completely intercepted as long ago as 1874. The redeveloped beach system has been designed to be stable with no sand supply and under the prevailing incident range of wave conditions that include the effects of the existing Port structures.

Based on these considerations, any potential impacts that the PEP works may have on the shoreline of The Strand would necessarily relate only to any potential impacts that there may be on the incident waves and the consequent effects on sand transport. As such, this impact assessment focuses on:

- The local wind-waves and propagated sea waves;
- The extent of any changes to wave incidence on the shoreline; and
- The implications of any such changes for sand transport rates and shoreline stability along The Strand.

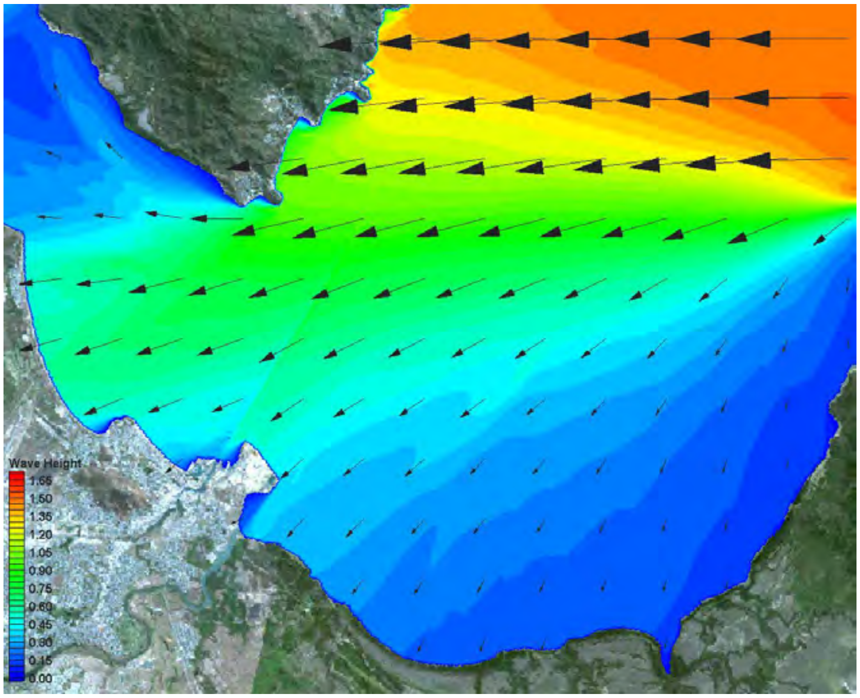
B.3.4.4.2 Impacts on Wave Propagation

Wave propagation analyses have been undertaken using the modelling software SWAN to determine the likely nature and extent of impacts that the Port expansion structures may have on waves that presently affect coastal processes along The Strand. The waves assessed include the locally generated wind-waves, moderate period (typically 4 to 7 seconds) 'sea' waves and longer period (> 7 seconds) swell waves of low height propagating across Cleveland Bay.

Wave impacts have been determined by testing in the model both the existing and developed cases, allowing impacts to be assessed as direct differences with respect to wave heights and directions and their effects on sand transport.

Incident waves entering Cleveland Bay past Cape Cleveland will be affected to varying degrees by the Port expansion, either directly or after some diffraction around the Port structures. For example, the impact on an easterly sea wave passing Cape Cleveland is illustrated in Figure B.3.61. It can be seen that there will be a decrease in wave energy propagation particularly along the southern and mid parts of The Strand. This will cause a decrease in both the potential for cross-shore erosion during storms and the component alongshore sand transport associated with these waves.

Locally generated wind-waves from the north are not affected by existing Port structures in reaching The Strand and that situation will not be altered by the proposed PEP. Locally generated east to south-east sea waves are presently largely blocked and have negligible height and no effect on sand transport at the southern end of The Strand. However, that effect will be extended further along The Strand by the PEP, thereby reducing the existing up-coast transport component and resulting net transport most markedly in the mid and northern parts of the beach system (Figure B.3.62).



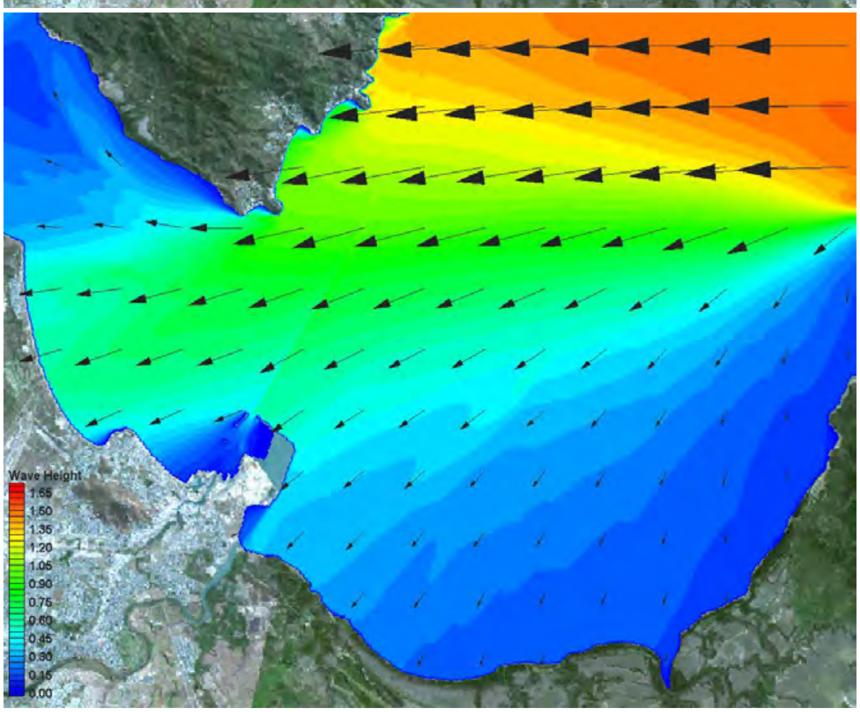
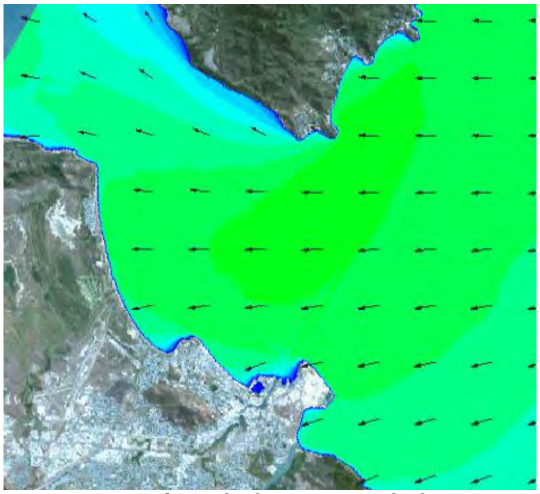
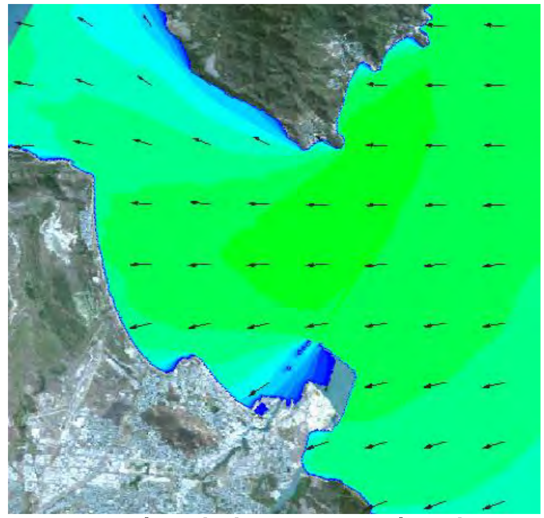


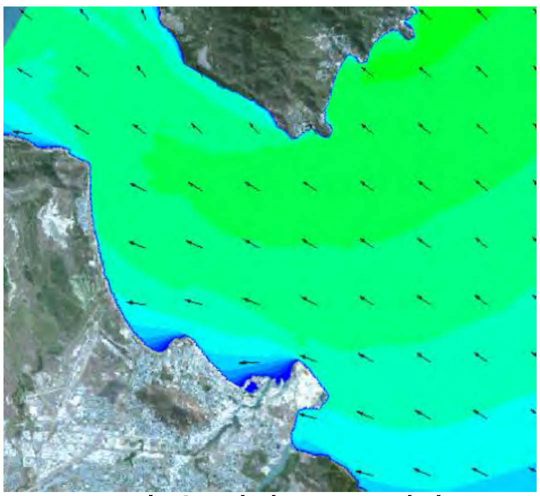
Figure B.3.61 Impact on 'Sea' Wave Propagation: Existing (Top) and With PEP (Bottom) (aerial image – Google Maps)



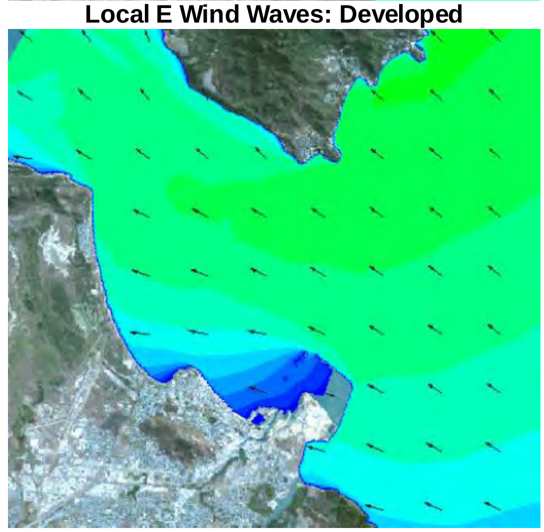
Local E Wind Waves: Existing



Local E Wind Waves: Developed



Local ESE Wind Waves: Existing



Local ESE Wind Waves: Developed

Figure B.3.62 Impacts on Local Wind Waves (aerial image – Google Maps)

B.3.4.4.3 Impacts on The Strand Sand Transport

There will be a reduction in the energy of some incident waves at The Strand due to the PEP. Waves generated locally in Cleveland Bay that presently are incident on The Strand beach from directions east-south-east to east-north-east will be reduced in height and altered in incident angle to varying degrees along the beach length. There will be a somewhat less effect on the longer period sea waves that propagate from offshore past Cape Cleveland. This will result in a reduction in the northward component of the longshore transport of sand to varying degrees along the beach length.

The wave propagation analysis shows that there will be no increase in wave heights at any location along the beach. Storm waves at the southern to mid parts of The Strand are likely to be reduced in height. The beaches there will thus be less subject to storm erosion or wave overtopping.

Analysis of longshore sand transport rates for the existing and PEP situations has been used to quantify the impacts on the net movement of sand along the beach system and any potential impacts on the beach alignment currently established. This has involved use of the wave modelling and sand transport analysis procedures outlined in previous sections in order to:

- Establish the existing and future directional incident wave conditions at several locations along The Strand beach;
- Calculate the component sand transport rates for the existing and developed situations; and

- Determine the changes to sand transport and associated change to beach alignment for stability.

As discussed previously, these sand transport calculations must be regarded as subject to significant error margins (order of ±25 to 50%) with respect to absolute transport rates, but may be compared in a relative sense with confidence.

Results of the sand transport analyses for the fully developed PEP case are presented in Table B.3.9. They may be compared directly with those in Table B.3.4.

Table B.3.9 Calculated Longshore Sand Transport Rates Along The Strand Beaches: PEP Case

Wave Component	Annual Net Transport Rates (m^3/yr)								
	Site 1 (south)			Site 2 (mid)			Site 3 (north)		
	Up coast	Down coast	Net	Up coast	Down coast	Net	Up coast	Down coast	Net
Local wind-waves	270	-500	-230	410	-895	-485	1180	-805	375
'Sea' Waves	110	-755	-645	1930	-1420	510	2620	-1490	1130
Resultant Total Transport			-875			25			1505

The resultant changes in longshore transport rates along The Strand are summarised in Table B.3.10, being the differences between the rates in Table B.3.4 and Table B.3.9. They indicate that, overall, there will be a potential reduction in the rate of loss of sand from The Strand beaches past Kissing Point by about 700 m^3/yr. The existing small southward net sand transport at the southern end will be increased by about 180 m^3/yr due mainly to decreases in the up-coast transport components. Similarly, the net transport in the central beach area will be reduced by about 1,000 m^3/yr.

Table B.3.10 Incremental Change in Longshore Sand Transport Due to the PEP

Wave Component	Change in Annual Net Transport Rates (m^3/yr)								
	Site 1 (south)			Site 2 (mid)			Site 3 (north)		
	Up coast	Down coast	Net	Up coast	Down coast	Net	Up coast	Down coast	Net
Local wind-waves	-80	0	-80	-395	-70	-465	-530	0	-530
'Sea' Waves	-180	-150	-330	-390	-85	-475	-125	-10	-135
Resultant Change in Total Transport			-180			-970			-665

These changes in the net longshore transport rates would be temporary in that they would lead to changes in the alignment of each beach compartment until, once again, the equilibrium condition equivalent to zero net transport is established. An analysis has been undertaken to determine the likely extent of such re-alignments needed to re-establish the existing net transport rates, on the assumption that the existing condition is the reference condition for relative impact assessment purposes. This is considered appropriate despite non-zero net transport rates being calculated because of the uncertainty involved in the calculated rates.

Figure B.3.63 illustrates the assessed relationship between the change in net transport and the shift shoreline alignment at each of the three sites along The Strand beaches. The target incremental re-alignments are indicated. It is evident that changes in the net transport rates are quite sensitive to shifts in shoreline alignment, being the small differences between the larger up-coast and down-coast components which are approximately linearly dependent on the breaking wave angle to the shoreline.

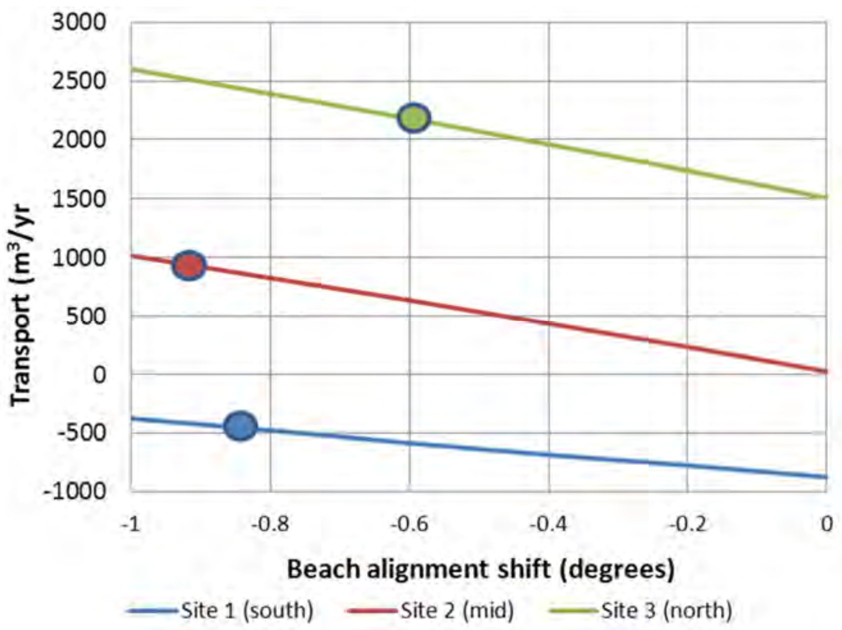


Figure B.3.63 Shoreline Alignment Shift to Restore the Existing Longshore Transport Regime Along The Strand Beaches

It can be seen that anti-clockwise shifts of about 0.6 to 0.8 degrees would be needed at the longer southern and northern compartments (sites 1 and 3) while about 0.9 degrees would be needed in the shorter central section (site 2). Based on the approximate net transport rates derived, these alignment shifts could result in:

- About 7m shoreline advance at the southern end of the southern beach compartment, predominantly of the base of the foreshore slope;
- Retreat about 3 to 5m of the northern ends of the mid-section compartments; and
- Retreat of the northern end of the northern beach compartment by about 5m.

Based on the sand volumes and transport rates involved, the timeframe for shoreline adjustment would be (order of) 5 years until the net transport rates are again in equilibrium

B.3.4.5 Impacts on Beach System Stability

Beach stability may be affected by changes in the longshore sand transport regime and/or changes in the capacity of the beach/dune system to accommodate cross-shore storm erosion. The assessment of longshore sand transport rates and likely alignment response indicates that there will be some minor re-alignments in restoring the existing condition of The Strand beaches. The fundamental stability of the beach system along The Strand will not be compromised by the PEP with respect to alongshore processes.

It has been identified that there may be some reduction in beach width and thus the buffer to accommodate storm erosion at the northern ends of the mid and northern beach compartments. This would in effect alter the plan shape of the northern beach compartment such as to make it more uniform in width along its length, while increasing the anti-clockwise shoreline rotation in the mid and southern compartments. The redevelopment works widened the beach system by approximately 20 m beyond its previous alignment, creating an additional erosion buffer. This has been modified as the beach system evolves to the equilibrium shape.

Coastal Engineering Solutions (2010) undertook a modelling assessment of typical storm erosion potential for the region at Rowes Bay, just north of Kissing Point. Their model results for a range of design storm events are shown in Figure B.3.64. These are particularly informative in that they show:

- Recession only above about RL+0.5 to 1.0m (AHD) with deposition of sand immediately nearshore;
- Recession of up to about 10m for events up to 200 year average return interval (ARI); and

- Onset of associated shoreward movement of sand from the beach for the more severe events (500 and 1,000 year ARI), pushing sand to a level of about RL+5m (AHD).

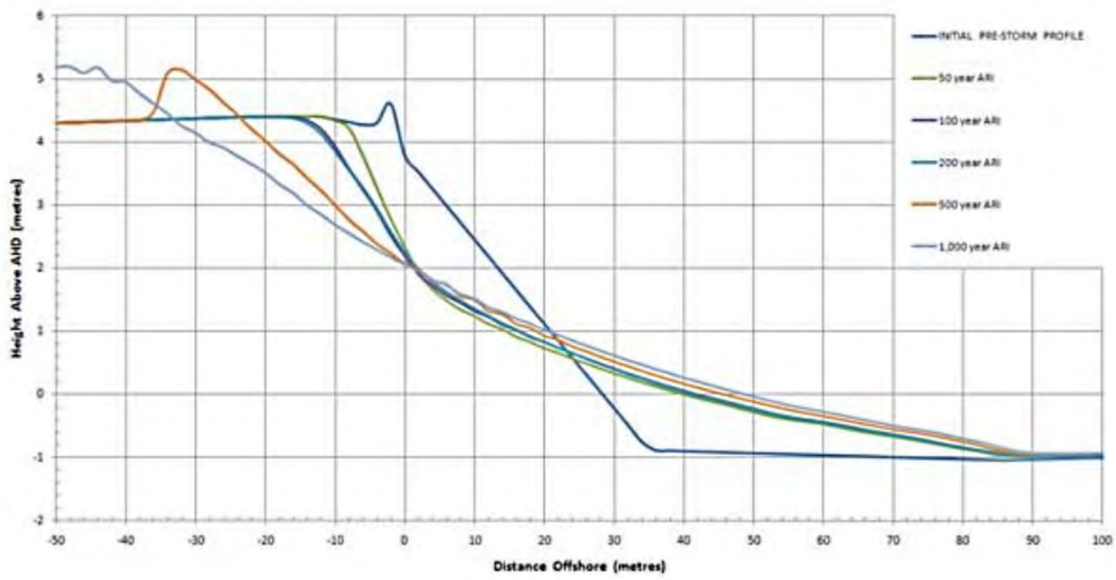


Figure B.3.64 Modelled Storm Erosion Potential (CES, 2010)

The sand taken offshore during the erosion event will be brought back to reform the beach by subsequent smaller waves, with no net loss of sand. Thus for planning purposes, a storm erosion recession of 10m is to be expected, with provision that more extreme events would erode further and over-wash to a level of +5m (AHD).

The beach surveys presented in Muller *et al* (2006) show the constructed beach level generally up to about RL+5m (AHD), except at the more sheltered southern end where it is lower (about RL+3.5m), with available beach widths generally about 30m. Satellite imagery shows that the width at the northern end of The Strand beach system is somewhat wider (30 to 40m) where it has accreted against the Kissing Point control structure (Figure B.3.65). It is narrower immediately adjacent to the control structures at the northern ends of the southern compartments (Figure B.3.66)).

Based on these considerations, it is likely that beach stability will not be compromised along the northern and southern parts of The Strand beach system. Nevertheless, there may be a slight increase in the vulnerability to storm erosion (reduced available buffer width) in the central area immediately south-east of the rock control structures (Figure B.3.66). These local areas may require reinforcement with additional nourishment from time to time, based on indications from ongoing monitoring. This would be achieved most effectively by strengthening the upper beach and dune area rather than adding to the beach width.

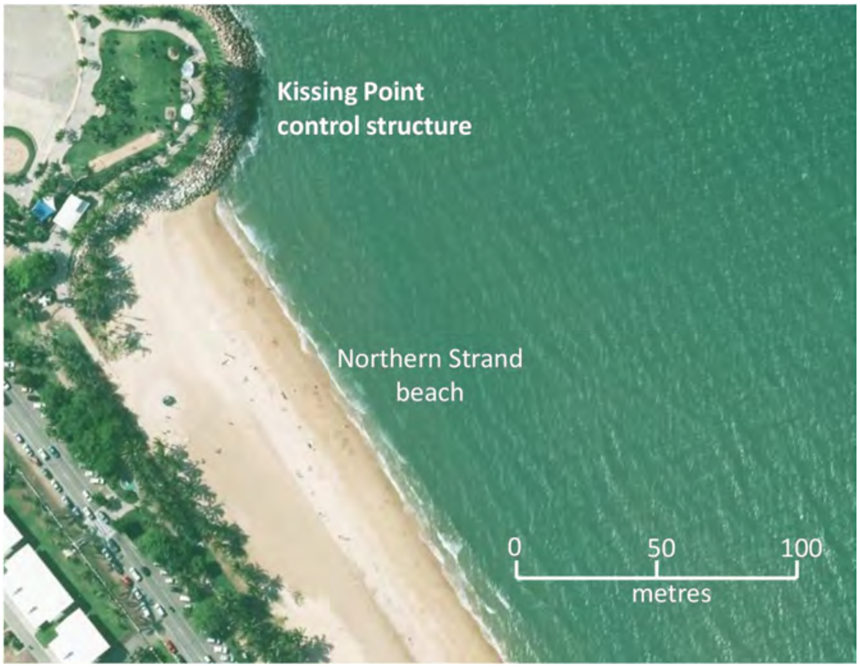


Figure B.3.65 Northern Strand Beach (aerial image – Google Maps)

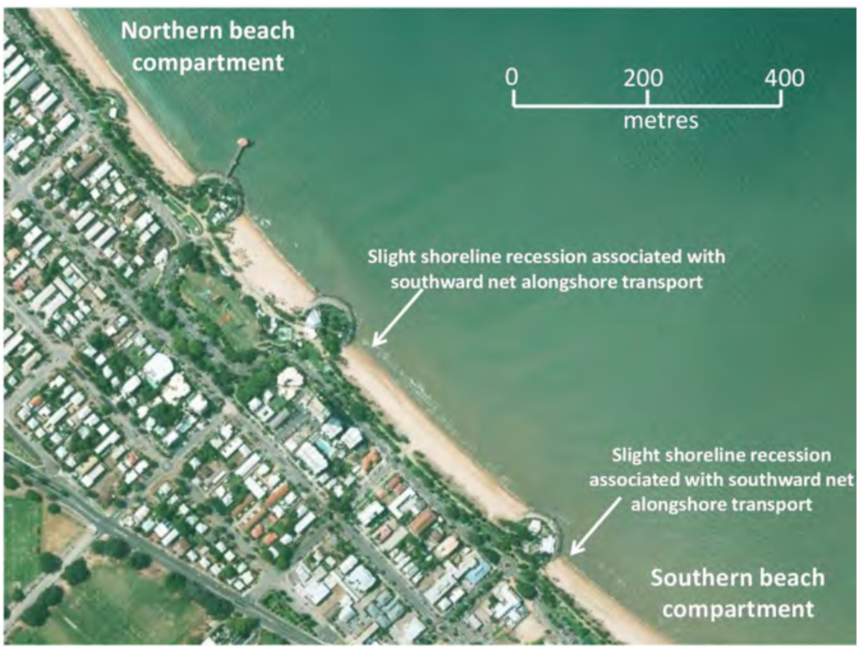


Figure B.3.66 Mid Strand Beach Compartments Indicating Locations of Reduced Buffer Width (aerial image – Google Maps)

It is more difficult to quantify any potential effects further to the north-west at Rowes Bay and Pallarenda. However it can be stated with confidence that:

- There will be no impacts on wave propagation to those beaches north-west of Kissing Point and thus no direct impact on the sand transport regime there;
- Any potential impact at Rowes Bay would be associated with a reduction in the sand supply past Kissing Point; and

- Any potential impact at Pallarenda would be vastly less than that at Rowes Bay, being effectively a dispersive result of any change in shoreline alignment at and north-west of Rowes Bay.

While Coastal Engineering Solutions (2010) indicate that the natural net sand transport rate at Rowes Bay is about 3,000 to 4,000 m^3/yr, they found a ‘null point’ of zero net transport near Mundy Creek near the southern end of that beach. They note the supply past Kissing Point has already diminished, leading to erosion at Rowes Bay beaches. The implication is that the sand supply (if any) past Kissing Point prior to redevelopment of The Strand would have been minor and, since the redevelopment aims to establish stability with zero net sand transport, the equilibrium condition supply to Rowes Bay is necessarily zero.

The Coastal Engineering Solutions (2010) management plan for the Rowes Bay / Pallarenda Shoreline prepared for Townsville City Council has factored that situation into the overall framework of management of the beach system as a whole, involving beach replenishment at the southern end equivalent to the full transport rate away to the north of 4,000 m^3/yr. As such, the Projected behaviour and stability of that beach unit would not be affected by the PEP.

B.3.4.5.1 Impacts on Ross River Mouth Area

The nature of the existing morphology in the vicinity of the Ross River mouth is illustrated in Figure B.3.32. Sedimentation processes there are dominated by:

- Discharge of fluvial sand and fine sediments from the river;
- Deposition of the coarser sand component in the vicinity of the mouth;
- Wave-induced shoreward migration of the sand component during larger wave events, leading to formation of shore-parallel sand ridges with low inter-tidal mud flats and mangrove areas between; and
- Along the shoreline at the western side of the river channel, accumulation of a small sandy beach with slight wave-induced alongshore sand movement towards the south.

The PEP will have no discernible impacts on flood flow discharges from Ross River, as discussed in Chapter B2 (Water Resources). While past flow retention works have altered flows and reduced the discharge of sand, these will not be further affected by the PEP. As such, the nature and rate of supply of sandy sediments to the mouth area of Ross River will not be impacted by the PEP.

Further, assessment of the wave climate shows that all but a very minor proportion of the incident waves, being the small locally generated wind waves from directions west of north-north-west may be affected by the PEP infrastructure. Wave propagation analyses show that all incident waves with sufficient energy to have effect on sedimentation processes at and near the river mouth will remain unaffected by the works. As such, the existing wave-related processes there will not be impacted discernibly.

Additionally, the modelling indicates that the transport and deposition of the fine marine seabed sediments across the Bay (Figure B.3.48) will not be affected at and near the mouth. The modelling indicates a slight increase in suspended sediment concentrations to the east of the mouth during major flow events (Figure B.3.59 and Figure B.3.60)). However, no ecological or morphological effects are expected due to the small magnitude of the change.

B.3.4.6 Climate Change

A comprehensive description of projected climate change issues and likely effects on weather patterns and associated wave and water level conditions in the Townsville region is presented in Chapter B8 (Climate and Natural Disaster Risks). There are potentially significant climate change implications for the coastal processes across the seabed of Cleveland Bay and at the shoreline and beach system. This section outlines consideration of those implications with particular reference to the PEP.

It is important to distinguish between the effects of climate change that could occur regardless of implementation of the PEP and any incremental impacts that the PEP may have on those climate change effects and/or that those effects may have on the feasibility and viability of the PEP. This requires a conceptual understanding of the fundamental effects and the incremental impacts in the first instance. To the extent that the incremental impacts of the PEP are identified as likely to be significant, further assessment is needed to quantify those impacts.

Implications of climate change for the design factors and criteria of the PEP are described in Chapter B8 (Climate and Natural Disaster Risks). With regard to coastal processes, it is identified (IPCC, 2007; CSIRO, 2008)) that climate change may lead to the following:

- An increase in mean sea level by a mid-range expectation of 0.3m by 2070, but potentially up to 0.8m by 2100;
- Annual average wind-speed could increase by 1.3% (0.1 to 2.9%) by 2030, by 2.2% (0.2 to 4.9%) under a low emission scenario by 2070, and by 4.3% (0.3 to 9.4%) for a high scenario by 2070;
- There could be an increase the frequency of severe cyclones, but it is expected that there will not be a significant change in number of cyclone days;
- Result in an increase storm surge heights due to sea level rise and increases in tropical cyclone intensity; and
- Cause an increase the 1:100 year storm tide level by 0.34m by 2070.

Accordingly, it is likely that the prevailing wave climate will develop to higher energy waves both on average and during extreme cyclone events. Wind-induced currents in Cleveland Bay may also be increased slightly in speed, including during tropical cyclones.

The Projected sea level rise will tend to have the following consequent effects in Cleveland Bay:

- Increased water depths off Cape Cleveland will tend to reduce the sediment supply into the Bay by reducing the wave-induced re-suspension from the bed in that area. This tendency may be offset by increased wave conditions and the net resulting effect is uncertain.
- Increased water depths in Cleveland Bay will reduce the bed friction attenuation of wave heights as they propagate from offshore across the Bay to the Port and adjacent shorelines.
- Increased water depths across Cleveland Bay will tend to reduce the wave-induced sediment re-suspension and transport in the Bay itself. This tendency may be offset by increased wave conditions and the net resulting effect is uncertain.
- Increased water levels and storm wave heights at the shorelines will have the effects of:
  - Causing shoreline recession, and
  - Increasing the extent of wave run-up and over-wash of the dunes and sand ridges.
- Modified wave propagation may alter the existing longshore sand transport regime at the beaches.

Because of the uncertainties remaining and the complexity of interaction of these various effects, it is not feasible to predict any clear climate change induced signal in marine sedimentation processes and siltation in the shipping channel or inner harbour areas. It is reasonable to assume for the purpose of planning and impact assessment that these will not be significantly changed by climate change effects to year 2100. Furthermore, the PEP will not have impacts on those processes in the event of future climate change beyond those assessed for the present climate conditions.

There will be effects on the shorelines and beaches due predominantly to the Projected increases in mean sea level and storm tide levels. These will inundate parts of the existing foreshore with direct recession of the shoreline position. Higher wave run-up levels will cause increased over-wash in those areas where the land and dunes are below the potential run-up extent. This will have the effects of:

- Forcing landward migration of the low lying wave formed sand ridges east of the Port; and
- Causing beach system recession along the shorelines of The Strand and Rowes Bay/Pallarenda west of the Port.

Additionally, any changes to wave propagation to those beach areas have the potential to modify the longshore sand transport regime and the extent of cross-shore storm erosion. These effects will require monitoring and mitigation and/or adaptation action as part of the ongoing management of those beach systems. This will most probably require an increase in height and landward relocation of the dunes. For The Strand beaches, the existing equilibrium condition of zero alongshore sand transport may be altered. Nevertheless, the shoreline alignments of each of the beach compartments will continue to adapt to the new conditions and maintain equilibrium over time. The alongshore sand transport at Rowes Bay /

Pallarenda may be altered and possibly increased due to future climate change. Ongoing monitoring is required to inform the most appropriate management action.

There is no basis for concluding that the PEP will have any additional adverse impacts on these processes beyond those assessed for the present climate conditions. If there are any impacts that the PEP may have, they will involve some minor sheltering of The Strand beaches from wave action, thereby potentially mitigating the effects that climate change may have there.

B.3.5 Mitigation Measures and Residual Impacts

B.3.5.1 Marine Seabed Impacts

Changes to nearshore wave conditions and local current patterns in the vicinity of the Port have been shown to result in some minor changes to bed sedimentation processes. The outer harbour extension as well as channel widening and deepening modifies the pattern of net sediment transport in the inshore region of Cleveland Bay. The modelling indicates that this modification may lead to a small increase in net sedimentation east of the channel and a slight reduction to the inflow of fine sediments to the west towards The Strand and Cape Pallarenda. However, the expected magnitude of the change to the sedimentation regime is expected to be small and probably not perceptible against the background of natural variability.

Mitigation of these minor marine seabed impacts are not feasible outside of significant changes to the proposed design, and none are considered necessary based on the results of the impact assessment.

Maintenance dredging will be required to remove deposited sediment from the approach channel that will have been both widened (at the harbour entrance) and deepened as part of the PEP. While the larger channel cross-section will be more efficient at trapping sediment, the very significant reduction in siltation due to the enclosure of the outer harbour contributes to a predicted net 25% reduction in the annual volume of maintenance dredging in the Ultimate Case relative to the Base Case.

While the existing Port of Townsville DMPA has been shown to be dispersive with respect to placed sediment from both capital and maintenance dredging exercises, the contribution of material re-suspended form the DMPA to gross turbidity and suspended sediment deposition at the sensitive receiving environment of Magnetic Island is assessed to be minor relative to the contributions from material naturally suspended from the remainder of Cleveland Bay. An assessment of alternative locations to the existing DMPA has been undertaken as part of the EIS and has determined that the existing site remains the preferred option based upon a range of criteria. No additional mitigation measures are proposed with regards the use of the DMPA as part of the PEP. Material containing a higher proportion of fines could be preferentially placed in the deeper north-east corner of the DMPA to reduce the rate of resuspension.

B.3.5.2 Beach System Impacts

The impact assessment process has identified only minor impacts to existing coastal processes and beach system stability. Changes to wave conditions and local current patterns have been shown to result in some changes to alongshore sediment transport patterns and bed morphology that are not considered significant enough to warrant pre-emptive mitigation measures.

The main mitigation measures available for reduction of impacts on beach stability (if they become evident) are either:

- Minor local additional beach nourishment, most effectively aimed at upper beach and dune strengthening, to ensure adequate buffer widths to accommodate storm erosion adjacent to the southern sides of the mid and southern beach compartment northern rock control structures; or
- Introduction of hard revetment structures if and when needed to prevent excessive recession of the shoreline at the identified potentially vulnerable locations.

The beach nourishment option is preferred as the more consistent with the amenity of The Strand redevelopment. It is feasible and effective as well as the considerably more cost-effective means of achieving mitigation. A design assessment of the required height, width and extent of such works, based on evidence derived from ongoing monitoring in those areas, and could be readily incorporated into the existing program of monitoring and maintenance.

B.3.6 Cumulative Impacts

The assessment of potential coastal processes impacts has included those caused by the construction and operation of the PEP. A number of other concurrent and future projects are also proposed at the Port of Townsville, which each comprise significant changes to coastal areas. The following projects are relevant to the consideration of cumulative impacts:

- The Marine Precinct development.
- Construction of Berth 12 and associated vessel manoeuvring areas.
- Minor channel improvement works.
- Construction of Berth 10A.

Note that these developments are being undertaken prior to, or concurrently with, the Townsville Port Expansion Project and are included in Base Case considerations of cumulative impacts.

It was noted in the beach sand transport impact assessment that existing port developments have disrupted the natural longshore sediment transport processes in Cleveland Bay. It is identified that the PEP will affect local wind wave propagation to The Strand, altering the sand transport regime and thus the shoreline alignments slightly. These changes will be temporary (extending over about 5 years) until a new equilibrium condition is developed. Beach stability there is only marginally affected and mitigation measures are readily available, as described in Section B3.5.2. None of the other projects included in the cumulative impact assessment will have any additional incremental (or cumulative) effect on waves or longshore transport at The Strand.

Any future proposals causing major changes to the coastline shape will need to be assessed independently and include consideration of the Port Expansion Project.

The changes in bed morphology and sedimentation caused by other projects will not change the impacts of the Port Expansion Project, which are predicted to be minor. The construction of the Marine Precinct may reduce the amount of sediment that is released to Cleveland Bay from the Ross River (due to accumulation in dredged areas), which may slightly reduce the amount of sediment accumulation at the Port.

B.3.7 Assessment Summary

Element	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact	Risk Rating (before mitigation)	Mitigation Measures	Residual Risk
Changes in longshore sand transport regime at The Strand	Construction of breakwaters and reclamation	Minor	Almost Certain	Medium	Monitoring of the beach in potentially vulnerable locations. Minor local dune strengthening as needed.	Low
Reduced storm erosion exposure at southern end of The Strand beach.	Construction of breakwaters and reclamation	Beneficial	Almost Certain	Positive Benefit	Nil	Positive Benefit
Changes in longshore sand transport regime at Rowes Bay	Construction of breakwaters and reclamation	Negligible	Possible	Low	Nil	Low
Changes in velocity magnitudes in the immediate vicinity of the Port	Construction of breakwaters and reclamation	Negligible	Almost Certain	Medium	Nil	Medium
Changes in Cleveland Bay morphology in the immediate vicinity of the Port	Construction of breakwaters and reclamation	Negligible	Almost Certain	Medium	Nil	Medium
Siltation in the harbour and channel	Capital dredging, placement and reclamation	Beneficial (reduction from base case)	Almost Certain	Positive Benefit	Nil	Positive Benefit
Siltation at The Strand due to Ross River sediment discharge	Capital dredging, placement and reclamation	Beneficial	Possible	Positive Benefit	Nil	Positive Benefit
Sediment resuspension from the DMPA	Capital dredging, placement and reclamation	Minor	Likely	Medium	Nil	Medium

Port Expansion Project EIS

Part B

Section B4 – Marine Water Quality

Part B4

B.4 Marine Water Quality

B.4.1 Relevance of the Project to Water Quality

The Townsville Port Expansion Project (PEP) has the potential to influence water quality in Cleveland Bay both during construction and operation. Impacts on water quality could result from dredging the outer harbour area, Platypus Channel, and the Sea Channel, including placement of dredged material, reclamation, construction of breakwaters and the final introduction of various commercial industries using the port facilities. These influences are potentially both short term (i.e. construction) and long term (i.e. maintenance dredging and operation).

This chapter addresses environmental issues and impacts to marine water quality associated with the construction and operation of PEP. This chapter describes the following:

- The ambient water quality of the existing environment in the Study Area.
- Potential impacts on the ambient water quality from the construction and operation of the port facilities.
- Options for managing, mitigating and/or offsetting identified impacts (if required).

In terms of impact mitigation, environmental impacts from construction and operation of PEP were considered and incorporated during the design phase. The mitigation measures outlined in this document are in addition to these and are associated with specific activities. Potential impacts on the marine environment associated with stormwater runoff from the port are discussed in Chapter B2 (Water Resources).

B.4.2 Assessment Frameworks and Statutory Policies

B.4.2.1 Environmental Protection Act 1994 and Environmental Protection (Water) Policy 2009

The Queensland *Environmental Protection Act 1994* is the principal legislative basis for environmental protection in the context of ecologically sustainable development in Queensland. To achieve this aim with regards to water quality, the Act provides the *Environmental Protection (Water) Policy 2009* (EPP Water) and the EPP Water is the principal legislative basis for water quality management in Queensland. The EPP Water includes a process for:

- Identifying environmental values (EVs) of waterways, including both aquatic ecosystems values and human use values.
- Establishing corresponding water quality objectives (WQOs) to protect identified EVs.

The EVs and WQOs for a number of regions are scheduled under the EPP Water. At the time of preparing this EIS, draft EVs and WQOs for the Townsville region had been recently released for public comment. As the Project Area is not in a region currently scheduled under the EPP Water, default environmental values as stated in Part 3, Section 6 of the EPP (Water) are applicable to the Townsville PEP area as follows:

1. Aquatic Ecosystem – The intrinsic value of aquatic ecosystems and habitat, including riparian areas.
2. Primary Industries – Aquaculture and human consumption of aquatic food such as fish, crustacean and shellfish.
3. Drinking Water – The suitability of the water for supply as drinking water (i.e. desalination).
4. Recreation and Aesthetics – Primary recreation, secondary recreation and visual recreation.
5. Cultural and Spiritual Values – Indigenous and non-Indigenous cultural heritage.

The indicators and water quality guidelines for quantitatively measuring the performance of the EV's are determined (in order of precedence) using the following:

1. Site specific documents for the water – document that contains specific information about a water, or part of a water and is recognised by the chief executive as having appropriate scientific authority.

2. Queensland Water Quality Guidelines (QWQG).
3. Australian Water Quality Guidelines:
   a. Water Quality Guidelines for the Great Barrier Reef Marine Park.
   b. The Australian and New Zealand Environment and Conservation Council (ANZECC)/ Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) guidelines for Fresh and Marine Water Quality.
4. Other relevant documents published by a recognised entity.

A summary of the water quality guidelines associated with the above is provided in the following Section B4.2.2.

B.4.2.2 Water Quality Guidelines

Draft WQOs for Townsville Region as per EPP Water

As mentioned previously, at the time of preparing this EIS, draft EVs and WQOs for the Townsville region had been recently released for public comment. Some implications from this draft document include zones of high ecological value around Magnetic Island and the eastern region of Cleveland Bay, which entails 'no change' permitted to water quality. There are also more stringent turbidity (<2.7 NTU) and TSS (<3.7 mg/L) annual median WQOs for the port exclusion area which includes the Platypus and Sea channels.

Black Ross (Townsville) Water Quality Improvement Plan (2010)

Notwithstanding the draft EPP Water guidelines discussed above, currently there are no locally determined water quality guidelines gazetted for the Townsville area. The Black Ross (Townsville) Water Quality Improvement Plan (TCC, 2010a) does include water quality guidelines for the Townville area (based on annual median values), however they have been derived using regional water quality guidelines (i.e. the Queensland Water Quality Guidelines discussed below). The establishment of local water quality guidelines is an implementation action of the Water Quality Improvement Plan.

In lieu of local guidelines, the Queensland guidelines for the Central Coast region have been adopted for freshwaters and estuaries, except for the northern catchments i.e. Crystal Creek and Rollingstone Creek sub-basins, where WQGs for the Wet Tropics region have been used.

Queensland Water Quality Guidelines (2009)

The Queensland Water Quality Guidelines 2009 (QWQG) (DERM, 2009a) are intended to address the need for local guidelines as identified in the ANZECC/ARMCANZ (2000) guidelines by:

- Providing guideline values (numbers) that are tailored to Queensland regions and water types.
- Providing a process/framework for deriving and applying local guidelines for waters in Queensland.

The QWQG provide a mechanism for recognising and protecting local Queensland waters and are not mandatory legislative standards or WQO's. WQOs are generally reserved for the waters' Schedule in the EPP Water.

The QWQG values applicable to the Cleveland Bay locality are that of an enclosed coastal system in the Central Coast region for a '*slightly to moderately*' disturbed water. In the context of QWQG, Cleveland Bay is considered a tropical embayment since it is landlocked around its western and southern margins by the mainland with Magnetic Island providing a natural boundary and shelter from the Coral Sea to the north-west.

Water Quality Guidelines for the Great Barrier Reef Marine Park (2010)

The water quality guidelines for the Great Barrier Reef Marine Park (GBRMP) specifically describe the concentrations and trigger values for sediment, nutrients and pesticides that have been established as necessary for the protection and maintenance of marine species and ecosystem health of the Great Barrier Reef. The guidelines address the ANZECC/ARMCANZ (2000) processes of defining environmental values and defining water quality objectives and support the following initiatives listed below:

- The Australian Government's Reef Rescue Plan, targeting improved farm management practices and supporting water quality monitoring programs.
- The Australian Government's Reef Water Quality Protection Plan.
- The Australian Government's Coastal Catchment Initiative.
- The Australian Government's National Water Quality Management Strategy.

Cognisant of the initiatives above, the guidelines ultimately provide environmentally-based values for water quality contaminants, based upon a compilation of scientific information currently available, which, if breached, will trigger management actions.

The trigger values for sediments and nutrients provided in the water quality guidelines for the GBRMP for an enclosed coastal water body (i.e. that of Cleveland Bay) are adapted from the QWQG to facilitate a complementary system between Queensland and Australian Government water quality guidelines in the Great Barrier Reef Marine Park. As the water quality guidelines for the GBRMP are comparable to the QWQG, reference to water quality guidelines is based on the QWQG where appropriate.

ANZECC/ARMCANZ (2000) Guidelines for Fresh and Marine Water Quality

The Australian and New Zealand Environment and Conservation Council (ANZECC)/ Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) guidelines can be used where regional guidelines (e.g. QWQG) are not adequate or available, for example when assessing toxicants such as metals and metalloids.

The main objective of the recent ANZECC/ARMCANZ (2000) water quality guidelines is to provide an authoritative guide for setting water quality objectives required to sustain current, or likely future, environmental values for natural and semi-natural water resources in Australia and New Zealand. The guidelines are intended to provide Government, industry, consultants and community groups with a sound set of tools for assessing and managing ambient water quality, according to designated environmental values. The guidelines similar to the QWQG were not intended to be applied as mandatory standards but do provide guidelines for recognising and protecting water quality.

With respect to toxicants (heavy metals and pesticides) in marine waters, the ANZECC/ARMCANZ (2000) guidelines provide four levels of protection for different ecosystems (80%, 90%, 95% and 99%). For Cleveland Bay which is considered to be '*slightly to moderately disturbed*' the 95% protection is commonly applied.

B.4.3 Existing Values, Uses and Characteristics

B.4.3.1 Description of Environmental Values

Provided in Table B.4.1 is a summary of the relevant EVs of Cleveland Bay and the Ross River Estuary, and the associated water quality guidelines. Trigger values defined by the water quality guidelines are in turn provided in Table B.4.2. The environmental values and water quality guidelines presented are used to assist in the evaluation of existing (baseline) water quality conditions of Cleveland Bay and Ross river estuary and as an indication of the potential impact from the PEP.

With reference to the trigger values summarised in Table B.4.2 and as noted in Section B4.2.1, the QWQG provide the quantitative measure of performance for the EVs where applicable followed by the water quality guidelines for the GBRMP (2010a)(2010) and the ANZECC/ARMCANZ (2000) in order of precedence. Compliance with the most stringent aquatic ecosystem values will ensure achievement of EV outcomes for Cleveland Bay and the Ross River estuary.

The QWQG guideline values are annual median values, i.e. the annual median from monitoring data is compared to these values. In contrast, the ANZECC/ARMCANZ (2000) toxicity trigger values for metals / metalloids are for instantaneous comparison of data.

Table B.4.1 Environmental Values of Cleveland Bay

Water		Aquatic Ecosystem	Human Consumer	Primary Recreation	Secondary Recreation	Visual Recreation	Cultural Heritage	Industrial Use	Aquaculture	Drinking Water	Irrigation	Stock Water	Oystering	Seagrass	Corals
Cleveland Bay (Enclosed Coastal)		✓	✓	✓	✓	✓	✓		✓					✓	✓
Ross River (mid-estuarine)		✓	✓	✓	✓	✓	✓	✓	✓						
Applicable Water Quality Guideline	QWQG (2009a)[a]	✓													
	ANZECC (2000)[b]		✓	✓	✓	✓									

a) *Queensland Water Quality Guidelines 2009*, prepared by the Environmental Protection Agency, Queensland Government.

b) Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000, prepared by the Australian and New Zealand Environmental and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Table B.4.2 Water Quality Guideline Values

Physico-Chemical Indicator	Cleveland Bay Central Coast, Enclosed Coastal	Applicable Guideline
Dissolved Oxygen (% Saturation)	Lower 90% / Upper 100%	QWQG (2009)[a] (Annual Median Values)
pH	Lower 8.0 / Upper 8.4	
Turbidity (NTU)	6	
Ammonia (µg/L)	8	
Organic Nitrogen (µg/L)	180	
Oxidised Nitrogen (µg/L)	3	
Total Nitrogen (µg/L)	200	
Total Phosphorus (µg/L)	20	
Filterable Reactive Phosphorus (µg/L)	6	
Suspended Solids (mg/L)	15	
Secchi (m)	1.5	
Chlorophyll a (µg/L)	2	
Sedimentation	max. avg./yr = 3mg/cm^2/day daily max = 15mg/cm^2/day	WQGGBRMP (2010)[b]
Arsenic (µg/L)	50*	ANZECC/ARMCANZ (2000)[c] (toxicity trigger values for 95 % level of protection)
Antimony	-	
Barium (µg/L)	1000*	
Cadmium (µg/L)	5*	
Chromium (µg/L)	4.4	
Cobalt (µg/L)	1	
Copper (µg/L)	1.3	
Lead (µg/L)	4.4	
Manganese	-	
Mercury (inorganic) (µg/L)	0.0004	
Molybdenum	-	
Nickel (µg/L)	70	
Silver (µg/L)	1.4	
Vanadium (µg/L)	100	
Zinc (µg/L)	15	
Ammonia (µg/L) [d]	910	ANZECC/ARMCANZ (2000)[c] (Toxicity values for 95 % level of protection)
NO_x (mg/L)	13	

Notes: (*) based on more stringent recreational guideline value

a) Queensland Water Quality Guidelines 2009, prepared by the Environmental Protection Agency, Queensland Government.

b) Water Quality Guidelines for the Great Barrier Reef Marine Park 2010, prepared by the Great Barrier Reef Marine Park Authority, Townsville

c) Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000, prepared by the Australian and New Zealand Environmental and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

d) Ammonia trigger value is dependent on pH. The default ammonia trigger value presented here is for a pH of 8, however ANZECC/ARMCANZ (2000) provides ammonia trigger values for other pH values.

B.4.3.2 Existing Environment (Baseline Water Quality)

This section provides a summary of the available water quality data in the Project Area below the tidal limit. Previous studies, monitoring campaigns and literature were used to characterise the existing water quality and determine baseline levels for impact assessment. In this sense, the water quality components in this baseline assessment were aimed at identifying the plausible linkages (i.e. tides, currents, rainfall etc.) of the existing water quality regime, based on present knowledge.

This baseline assessment has provided water quality results and information on heavy metals, acidity, turbidity, suspended sediment, dissolved oxygen, nutrients and oil in water. Where appropriate this assessment has compared baseline results with the most applicable guideline values.

B.4.3.2.1 Overview

The Port of Townsville is located in Cleveland Bay, which is bordered by Magnetic Island and the Coral Sea to the north, Cape Pallarenda to the west and Cape Cleveland to the east. Major freshwater inflows feed into Cleveland Bay via Ross River near Townsville, with other major river systems feeding in to the north of Cleveland Bay (Bohle River) and the south (Burdekin River). During wet season storm events, these and other smaller river systems deliver pulses of high turbidity and nutrients loads into the Cleveland Bay area.

Water quality is an important environmental asset in the Study Area and surrounds due to the presence of a number of ecological receptors that are sensitive to altered water quality conditions (Chapter B6 - Marine Ecology). These sensitive receptors include seagrass meadows that are located throughout Cleveland Bay, as well as fringing coral communities at Middle Reef and Magnetic Island. The area surrounding the Port of Townsville exclusion zone is designated as Great Barrier Reef Marine Park and has high environmental values.

Naturally high suspended sediment can occur in Cleveland Bay due to its shallowness and the muddy terrigenous nature of the central bay sediment facies (Anderson, et al., 2002; Larcombe & Ridd, 1994). The principal factor controlling suspended sediment in Cleveland Bay is the wind regime and ensuing waves and swells (Orpin, Ridd, & Stewart, 1999; Larcombe P. , Ridd, Prytz, & Wilson, 1995). As demonstrated by Larcombe *et al.* (1995), long wavelength swell caused by strong and steady south-easterly winds produces high oscillatory velocities close to the seabed throughout Cleveland Bay, which can lead to resuspension of sediment.

Larcombe *et al.* (1995) also showed that shorter-wavelength, wind waves have little effect on sediment resuspension in deeper sections of Cleveland Bay. The magnitude of the tide is generally of lesser importance to resuspension. Nevertheless, tidal currents are likely to be important in preventing long term accumulation of sediment in the water column through flushing of Cleveland Bay (Larcombe P. , Ridd, Prytz, & Wilson, 1995).

Anthropogenic activities may also directly cause an increase in suspended sediment. Cleveland Bay comprises a busy port infrastructure area with shipping channels that require regular maintenance dredging. This maintenance dredging has been occurring for more than 100 years and consequently Cleveland Bay is regularly subjected to short duration turbid dredge plumes.

Blue-green algae (*Trichodesmium* spp.) are sometimes known to occur in tropical waters as a result of increased nutrients in the water column. The planktonic *Trichodesmium* sometimes forms blooms, and after the blooms die *Trichodesmium* is visible as a reddish slick on the surface of the water. These blooms usually occur after turbulent water conditions cause resuspension of nutrient rich marine sediment. After the sediment settles, the water column is left relatively clear with a higher level of dissolved nutrients making it ideal conditions for *Trichodesmium* blooms.

A study by Bell *et al.* (1999) on *Trichodesmium* in the Great Barrier Reef Lagoon found that *Trichodesmium* often dominate the microplankton community, especially in the Central Great Barrier Reef Lagoon (off Townsville). *Trichodesmium* blooms in the region have been implicated in direct smothering of corals and the promotion of the bioavailability of heavy metals (Bell, Elmetri, & Uwins, 1999). The available data on the standing crop of *Trichodesmium* in the Great Barrier Reef Lagoon are quite limited but these data do suggest that relatively high concentrations of *Trichodesmium* occur regularly.

B.4.3.2.2 Wind Regime

As mentioned previously, the principal factor controlling suspended sediment in Cleveland Bay is the wind regime and ensuing waves and swells. The Great Barrier Reef lagoon experiences moderate to fresh south-easterly trade winds for around nine months of the year. These generate both shoreward and northward directed currents. Offshore winds are atypical and generally much less intense (Woolfe & Orpin, 1999).

Local and large-scale synoptic wind fields create different wave spectra. For example, the locally generated sea-breeze which is often prominent in Cleveland Bay during the late afternoon and evening generates high frequency, short wavelength ‘wind waves’ (Larcombe & Ridd, 1994). In contrast, large-scale responses to synoptic weather systems, such as the south-easterly trade winds dominant during winter months, produce high and steady winds over the mid-shelf and generate longer wavelength ‘swell’. This swell is refracted into Cleveland Bay from offshore (Larcombe P. , Ridd, Prytz, & Wilson, 1995).

When wavelengths are short compared with water depth, little sediment is resuspended. In contrast, the longer wavelength swell produces high oscillatory velocities at the seabed throughout Cleveland Bay, contributing to the possibility of high suspended sediment (Larcombe P. , Ridd, Prytz, & Wilson, 1995).

The wind regime in Cleveland Bay is discussed further in Chapter B3 (Coastal Processes).

B.4.3.2.3 Information Sources

Cleveland Bay has been subject to a significant volume of study over the past 30 years due, in part, to the continued development of the Port of Townsville and the identified environmental value of the Bay and the Great Barrier Reef Marine Park. The existing information varies considerably in the type, extent, time period and quality of the data collected and thus the emphasis of this review is attributed to the most applicable and recent data available. A summary of the available literature, with respect to applicability to this study is provided in Appendix I1 of the EIS.

Given the significant volume of information available, additional water quality monitoring for the PEP was not considered necessary to further characterise existing water quality. Two recent relevant and detailed monitoring campaigns were undertaken by GHD (2009a) and BMT WBM (2008). These studies are well supported by POTL’s on-going routine water quality monitoring and the detailed Comarine (1993) water quality monitoring campaign.

Despite the overall wealth of information regarding water quality (particularly suspended sediments) gathered from Cleveland Bay, no studies have made any detailed attempt to use this information to derive relevant local water quality criteria for the Bay. While a good understanding of overall water quality can be ascertained from this data, the specific requirements outlined in the QWQG to derive accurate local guidelines have not been undertaken by any one study.

Consequently, further targeted monitoring at locations of sensitive receptors has been implemented to develop ecologically relevant trigger values for management actions.

B.4.3.2.4 Suspended Sediment and Turbidity

Suspended sediment in water is typically reported as either total suspended solids (TSS) or suspended sediment concentration (SSC). The terms SSC and TSS are often used interchangeably in the literature to describe the concentrations of suspended solid-phase material in a water-sediment mixture, reported in milligrams per litre (mg/L).

Previous studies in Cleveland Bay have reported suspended sediment as SSC, however for the purposes of this chapter the term TSS will be used to refer to suspended sediment in water.

TSS and turbidity are the most widely studied physico-chemical parameters in Cleveland Bay. TSS is of particular relevance to the PEP due to capital dredging and on-going maintenance dredging required in the development area and the potential impact upon sensitive ecological habitats (outlined in further detail in Chapter B6 Marine Ecology).

The key existing studies identified as most applicable in characterising the baseline TSS and turbidity in the Bay are as follows:

- BMT WBM (2009). Townsville Port Expansion Preliminary Engineering and Environment Study Oceanographic Data Collection. Monitoring Campaign from 28 September 2008 to 2 May 2009.

- GHD (2009a). Townsville Marine Precinct Project. Monitoring Campaign from 2 September 2008 to 9 February 2009.
- POTL Routine Water Quality Monitoring 2004 to 2010.
- Comarine Consulting (1993) Sediment Data – Final Report Submitted as fulfilment of Environmental Monitoring Program, Townsville Port Authority, Townsville Port Development Stage 1 Contract 62376-12 Oceanographic and Sediment Data.

It is noted that the detailed studies undertaken by both BMT WBM (2008) and GHD (2009a) were influenced by two notable events that impact upon the Bay's ambient water quality as follows:

- Maintenance Dredging during 2 October 2008 to 6 November 2008.
- Significant rainfall during mid-January 2009 to mid-February 2009, with rainfall approximately 2.5 and 3.5 times greater than the historical monthly average, respectively. It is also noted the rainfall in February 2009 is the highest on record since 1940 (BOM, 2010).

As a result, the monitoring data from the above listed studies, for each site presented in Figure B.4.1, was collated and consolidated by sampling location and where appropriate wet and dry time periods. Sampling locations were grouped into seven principal areas (Figure B.4.1) delineated by both geographical features and environmental sensitivity of the area. The delineated areas include:

1. Central Cleveland Bay:
    a) Inner Bay.
    b) Outer Bay.
2. Outer harbour.
3. The Strand.
4. Eastern Near Shore Seagrass.
5. Ross River Estuary.
6. East Coast Magnetic Island Coral Reefs (Picnic Bay, Nelly Bay, Geoffrey Bay and Florence Bay).
7. Western Channel.

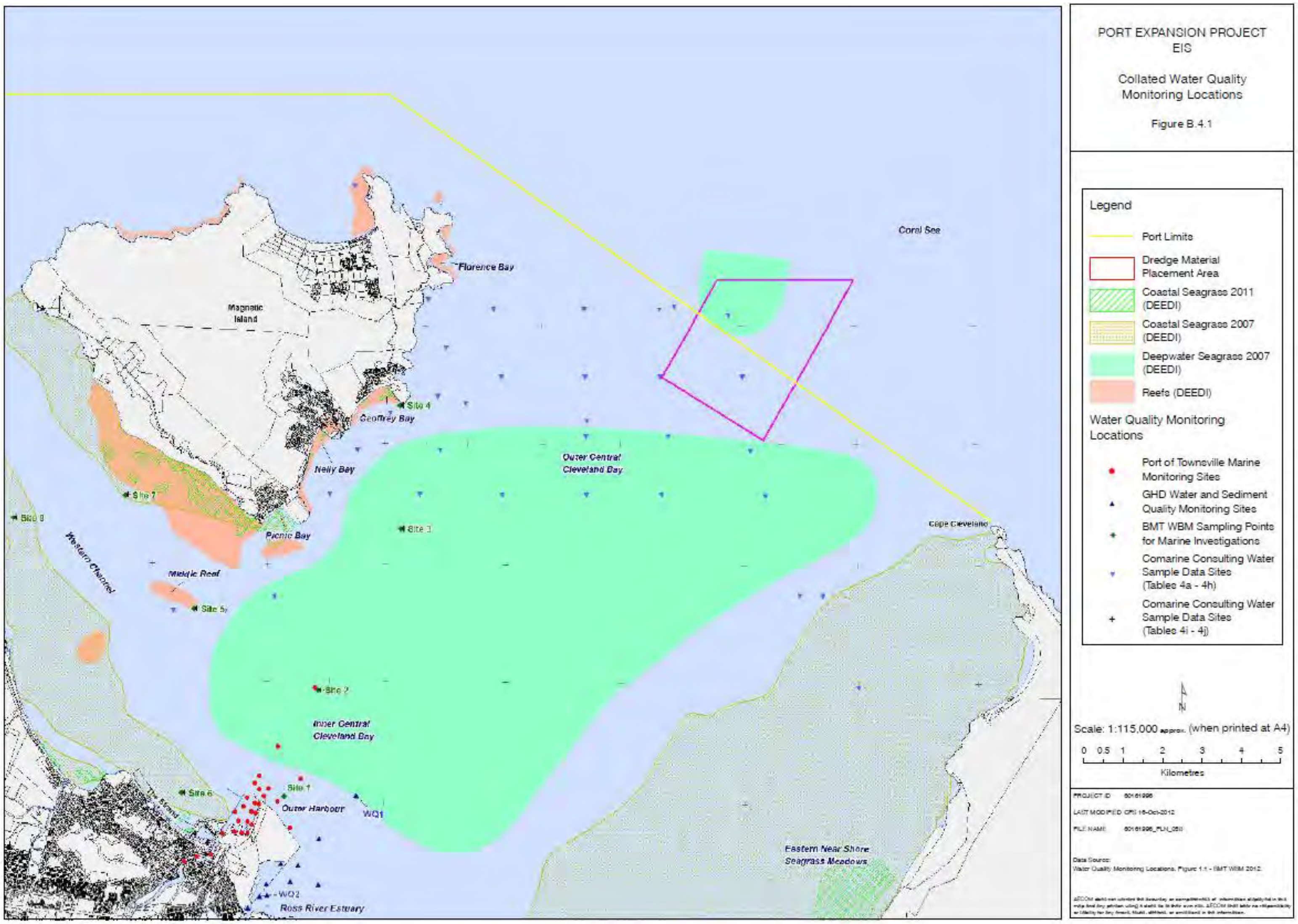


Figure B.4.1 Collated Water Quality Monitoring Locations

A summary of the literature review and results of the water quality analysis for each of the seven sampling areas are discussed in the following sections.

B.4.3.2.5 Central Cleveland Bay

Overview

The Central Cleveland Bay area represents the largest area in the bay and is directly in the PEP dredge zone. Due to the large extent of the area and the amount of water quality information in this region, this area was further divided into sub-regions representing the 'inner' area adjacent to the existing port and the 'outer' area towards the open ocean.

A summary of the TSS and turbidity data available for review is provided in Table B.4.3 below with the QWQG levels provided for comparison purposes.

Table B.4.3 Central Bay TSS (mg/L) and Turbidity (NTU) Monitoring Data

Study (parameter)	Site		Min	Percentile		Median	Mean	Percentile			Max
				10th	20th			80th	95th	99th	
Inner Central Bay											
BMT WBM Sept 08 - May 09 (TSS)	S2 (Optical data)	Wet/Windy (mid Jan09-Feb09)	2	8	10	**20**	62	97	254	442	837
		Dry/Calm	*0*	*3*	*5*	*9*	*17*	*20*	*44*	*115*	*465*
GHD *Sept. 08 - Feb 09*	WQ1 - continuous data TSS (mg/L) *(Turbidity - NTU)*		0 *(0)*	- *(7)*	- *(13)*	- ***(29)***	120 *(34)*	- *(52)*	- *(78)*		*1,490 (179)*
POTL 2004-2011 (mid) (TSS)	PC14 (inner area - 21 grab samples)		3	6	7	11	11	18	18	20	21
	OH31 (inner area - 8 grab samples)		3	4	4	6	7	9	13	15	15
	OH36 (inner area - 8 grab samples)		4	4	4	11	11	16	18	19	19
	Combined (inner area - 37 grab samples)		3	4	5	10	10	15	18	20	21
Outer Central Bay											
BMT WBM Sept 08 - May 09 (TSS)	S3 Optical Data	Wet/Windy (mid Jan09-Feb09) *(Turbidity – NTU)*	0 *(0)*	3 *(2)*	4 *(2)*	11 *(4)*	29 *(9)*	35 *(10)*	101 *(31)*	311 *(97)*	561 *(275)*
		Dry/Calm *(Turbidity – NTU)*	0 *(0)*	4 *(2)*	5 *(2)*	8 *(4)*	13 *(9)*	14 *(10)*	33 *(31)*	90 *(97)*	561 *(275)*
Comarine January 1993 (TSS)	Numerous Sites (168 grab samples at various depths)		5	15	18	**29**	31	44	58	70	101
Queensland Water Quality Guideline (2009)			TSS (mg/L)			15					
			Turbidity (NTU)			6					

Note:
TSS – Total Suspended Solids (mg/L) – referred to as Suspended Sediment Concentrations (SSC) in some studies using optical backscatter technology
Bold red text – Median value exceeds Guideline level for TSS or turbidity

Inner Bay

The estimated median[1] of dry (calm) weather TSS (10 mg/L) for the inner portion of Cleveland Bay is below the QWQG guideline value of 15 mg/L. The estimated median of wet weather median TSS (20 mg/L) slightly exceeds the QWQG guideline value and represents a period of significant wet weather with associated high wind and swell conditions.

The dry weather 20th and 80th percentile TSS range observed in the inner bay varies between 5 to 20 mg/L for the BMT WBM S2 optical backscatter measurements and is reasonably well supported by POTL grab samples that range between 5 to15 mg/L. Other previous studies reported slightly higher TSS concentrations, with Comarine Consulting (1993) reporting an average concentration in the inner bay area of 22 mg/L (at the surface) and 24 mg/L (at a depth of 5 m) with a range between 15 to 75 mg/L. Dredeco (1996) also noted TSS ranges between 0.3 mg/L to over 50 mg/L with higher concentrations generally associated with strong winds and lower concentrations with calm conditions.

Turbidity was also recorded and detailed by GHD (2009a)in the inner bay area with a median value of 29 NTU for site WQ1 located approximately 3 km offshore from the mouth of the Ross River. This median value is significantly above the QWQG of 6 NTU (Table B.4.2). The GHD (2009a) monitoring campaign that extended from September 2008 to February 2009 also included the two distinct events: maintenance dredging during 2 October to 5 November 2008, and the unprecedented rainfall event during mid-January 2009 to February 2009. Given the monitoring campaign duration and the lack of data availability to BMT WBM to isolate these notable events, the results should not be relied upon to determine dry or wet weather ambient conditions in the bay.

Outer Bay

For the outer portion of Cleveland Bay, the estimated median of TSS values based on the BMT WBM (2009) optical backscatter measurements (S3) indicates a dry weather median concentration in the order of 8 mg/L which is well below the QWQG value of 15 mg/L. The wet weather median concentration was similar to the dry weather concentration at 11 mg/L, indicating the impacts from catchment runoff and resuspension by wind and wave action are diminished further out in the bay. The Comarine (1993) water sampling for the outer bay region, undertaken during the wet season, indicates TSS concentrations to be approximately 2 to 4 times higher than that recorded by the optical backscatter measurements with a wet weather median value of 29 mg/L and a range between 18 to 44 mg/L for the 20th and 80th percentiles. The optical backscatter measurements have the advantage of being integrated over a long time period in comparison to grab samples, thus it is likely that these measurements provide a more reliable estimate of the ambient TSS levels for the outer bay area.

The TSS range observed in the outer bay for the BMT WBM (2009)data varied between 5 to 14 mg/L for the dry weather 20th and 80th percentile values and 4 to 35mg/L for the wet weather 20th and 80th percentile values. These TSS ranges were also notably lower than the inner bay area for both dry and wet weather conditions, further supporting the observation that flow from the Ross River, wind and swell have less of an impact in the outer, deep-water bay area.

General Observations

The BMT WBM (2009) continuous logger data showed a correlation between increased wind action and increased turbidity. Specifically, the monitoring data showed a correlation with sustained easterly wind and strong northerly winds >30 km/hr with an increased median turbidity at all sites monitored. Additionally, light levels were lowest during easterly winds >30 km/h, whereas highest light levels were recorded when winds were <20 km/h. These climatic TSS observations reported by BMT WBM (2009) suggest that wind- and wave-induced resuspension are primarily responsible for elevated suspended solids, and therefore turbidity, in the Cleveland Bay area.

Larcombe and Ridd (1994) also noted that during calm conditions and on extreme neap tides, TSS in the western portion of Cleveland Bay did not exceed 8 mg/L, while on high spring tides (3 cm below HAT) and with calm conditions, TSS rarely exceeded 40 mg/L and mostly did not exceed 30 mg/L. These findings are in line with the monitoring observations, made by BMT WBM (2009) and supported by

[1] The estimated value was determined from both the dry weather optical backscatter measurements at S2 from BMT WBM, and the POTL monitoring data.

Muslim and Jones (2003), that indicate that under suitable conditions low TSS can exist in the bay, and a natural range in the order of 4 to 30 mg/L can be expected.

B.4.3.2.6 Outer Harbour

The outer harbour area (Figure B.4.1) is in close proximity to the Port operations. Water quality monitoring information in this area consists of both the BMT WBM (2009)monitoring and POTL outer harbour monitoring sites as depicted on Figure B.4.1 and presented in Table B.4.4.

Table B.4.4 Outer Harbour TSS (mg/L) Monitoring Data

Study (parameter)	Site	Min	Percentile		Median	Mean	Percentile			Max
			10th	20th			80th	95th	99th	
BMT WBM	Dry Weather (i.e. results from 1 Mar 09 to 2 May 09) – 33 days of data									
Sept 08 - May 09 (TSS)	S1 (inner area - continuous data)	0	11	21	**64**	113	171	369	760	1479
	Wet Weather (i.e. results from 13 Jan 09 to 28 Feb 09) – 46 days of data									
	S1 (inner area - continuous data)	*0*	*11*	*20*	***73***	*175*	*213*	*735*	*1476*	*1476*
POTL	Wet and Dry Weather (i.e. results from 7 years of data)									
2004-2011 (mid) (TSS)	OH 1,2,3,7,9 and 11 (inner area - 86 Samples)	3	4.5	6	13	14.1	21	33	36	38
Queensland Water Quality Guideline (2009)		Suspended Solids (mg/L)			15					

Note:
TSS – Total Suspended Solids
Bold red text – Exceed Guideline Level

For the outer harbour area, the estimated medians of TSS differ widely, with values of the order of 13 mg/L for POTL and 64 mg/L for the BMT WBM (2009)dry weather conditions. POTL monitoring data is below the QWQG value of 15 mg/L while the BMT WBM (2009) optical backscatter data is well above for both dry and wet weather conditions. Furthermore, the BMT WBM (2009)optical backscatter monitoring results at this location are approximately 4 to 5 times higher in this area compared with the other six optical backscatter monitoring results (i.e. sites S2, S3, S4, S5, S7 and S8).

The TSS range observed in the immediate outer harbour area based on POTL monitoring data varied between 6 to 21 mg/L (20th and 80th percentile values). The BMT WBM (2009) optical backscatter measurements for the 20th and 80th percentile values ranged between 21 to 171 mg/L during dry conditions and 20 to 213 mg/L during wet weather conditions. The BMT WBM (2009)data represents a short period (i.e. 33 to 46 days) compared to POTL data (i.e. seven years).

Notably the high 20th percentile values indicate that this area is, in general, a turbid system that is likely to be influenced by shipping, wet weather and associated winds and swells, which are also known to influence TSS in shallower areas through resuspension.

B.4.3.2.7 The Strand

The Strand area (Figure B.4.1) represents a geographical area that includes the environmentally sensitive seagrass meadows. Water quality information in this area is limited to the BMT WBM (2009) monitoring campaign and is presented in Table B.4.5.

Table B.4.5 The Strand TSS (mg/L) Monitoring Data

Study (parameter)	Site	Min	Percentile		Median	Mean	Percentile			Max
			10th	20th			80th	95th	99th	
BMT WBM Sept 08 - May 09 (TSS)	Dry Weather (i.e. results from 1 Mar 09 to 2 May 09) – 33 days of data									
	S6 (offshore from the Strand – all continuous data)	0	14	18	**47**	74	119	218	351	749
	Wet Weather (i.e. results from 15 Jan 09 to 28 Feb 09) – 44 days of data									
	S6 (offshore from the Strand – all continuous data)	0	34	53	**116**	179	259	568	993	1621
Queensland Water Quality Guideline (2009)		Suspended Solids (mg/L)			15					

Note:
TSS – Total Suspended Solids
Bold red text – Exceed Guideline Level

For the Strand area, the estimated median TSS value indicates a large concentration range in the order of 47 to 116 mg/L during dry and wet weather conditions respectively with both values notably above the QWQG of 15 mg/L. Comparisons of the 20th and 80th percentile ranges indicates an increase in TSS during the wet season compared to the dry season, with 18 to 53 mg/L for the 20th percentile and 119 to 259 mg/L for the 80th percentile. This notable difference between wet and dry periods is likely the result from runoff from the Ross Creek and the local urban drainage area of Townsville, notwithstanding the influence from strong winds and swells during wet weather conditions that are likely to impact this shallow location.

Similar to the outer harbour results (site 1), the BMT WBM (2009) optical backscatter monitoring results at the Strand are in general approximately 4 - 5 times higher in this area compared with other optical backscatter monitoring results located in deeper waters of Cleveland Bay (e.g. sites S2, S3, S4, S7 and S8). The monitoring data suggest that under both dry and calm conditions, the Strand area is more likely to be influenced by tides, winds and swells that may cause continual resuspension of sediments in this area. This observation is supported by Larcombe *et al.* (1995)that noted that shorter wavelength wind waves will have little effect on sediment resuspension in deeper sections of Cleveland Bay, while conversely have a larger impact on shallower sections of the bay.

B.4.3.2.8 Eastern Near Shore Seagrass Meadows (Central Cleveland Bay)

The area as depicted in Figure B.4.1 and herein referred to as 'Eastern Near Shore' represents the largest near-shore seagrass meadows of Cleveland Bay. The area is located well outside the PEP dredge zone and correspondingly has a limited amount of water quality information. The monitoring information available for suspended solids in this area is derived from the Comarine (1993) monitoring campaign and is summarised in Table B.4.6.

Table B.4.6 Eastern Near Shore TSS (mg/L) Monitoring Data

Study (parameter)	Site	Min	Percentile		Median	Mean	Percentile			Max
			10th	20th			80th	95th	99th	
Comarine January 1993 (TSS)	8 Sites (23 grab samples @ various depths)	7	19	26	**29**	30	32	47	50	50
QWQG	Suspended Solids (mg/L)				15					

Note:
TSS – Total Suspended Solids
Bold red text – Exceed Guideline Level

Based on the monitoring data available as presented in the Table B.4.6 above, the ambient TSS in the Near Shore Seagrass Meadows area of Cleveland Bay is estimated as 29 mg/L with a range of 26 to 32 mg/L for the 20th and 80th percentile values. This data was recorded during January 1993 and represents the wet season.

Given the limited amount of data specifically in this area, the more complete set of monitoring data for the Strand (Section B4.3.2.7) is considered more indicative of ambient conditions. TSS ranges are likely to be high in this near-shore area due to its relatively shallow depth, similar to the Strand, and as previously mentioned, Larcombe *et al.* (1995) noted that wind-induced waves (long and short wavelength) may lead to re-suspension of sediment in shallower sections of the bay.

B.4.3.2.9 Ross River Estuary

The Ross River Estuary is located adjacent to the existing port and in the immediate vicinity of the land reclamation area (i.e. discharge of tailwater) of the PEP. Existing water quality information is summarised in Table B.4.7 with optical backscatter data recorded by GHD (2009a) as part of the Marine Precinct project and bi-annual monitoring data from POTL.

Table B.4.7 Ross River TSS (mg/L) Monitoring Data

Study (parameter)	Site	Min	Percentile		Median	Mean	Percentile			Max
			10th	20th			80th	95th	99th	
GHD Sept 08 (TSS)	WQ 02 (continuous Sept 08 only)	0	n/a	n/a	n/a	31	n/a	n/a	n/a	531
GHD Sept 08 – Feb 09 (Turbidity)	WQ 02 (continuous Sept 08 only)	*0*	*3*	*4*	***7***	*9*	*12*	*22*	*37*	*152*
	WQ-03 to WQ-12 (monthly water samples from Sept 08 to Feb 09	*no discrete data available*								
POTL 2004-2011 (mid) (TSS)	RC1, RC4, RC6, RC8, RC10 (73 grab samples 04-11)	3	4	5	11	13	19	30	36	38
QWQG		Suspended Solids (mg/L)			15					
		Turbidity (NTU)			*6*					

Note:
TSS – Total Suspended Solids
Bold red text – Exceed Guideline Level
n/a – data not available (i.e. raw TSS data was not available for analysis - only reported min, mean and max values)

Average (mean) TSS for the Ross River estuary from the GHD (2009a) and POTL monitoring data differ considerably with average concentrations between 31 mg/L and 13 mg/L respectively. TSS and turbidity results for GHD (2009a) indicate that the Ross River estuary and the area immediately offshore from the river mouth is a turbid system. The continuous logger data indicate turbidity was slightly elevated above the QWQG guideline value. GHD's WQ2 optical backscatter monitor was only deployed for the month of September, but importantly was not influenced by maintenance dredging or abnormal runoff conditions from the Ross River.

GHD (2009a) also observed that increased turbidity at shallow monitoring sites resulted from wind-induced and wave-induced resuspension of fine sediments from the seafloor. Furthermore, GHD (2009a) indicated that no strong correlation between tidal state (neap/spring), turbidity or TSS was evident and that tidal currents may not be a driving factor for turbidity in the vicinity of the Ross River. GHD (2009a) did hypothesise that it was possible that on a low spring tide, when water depth is substantially reduced, tidal currents out of the Ross River mouth resulted in resuspension of bottom sediments.

Results from POTL data indicate a modest increase in TSS median values (+1 mg/L) compared to the inner central Cleveland Bay area. TSS for the 20th to 80th percentile ranged between 5 mg/L to 19 mg/L respectively and is again consistent with the inner central Cleveland Bay area.

B.4.3.2.10 Western Channel

The Western Channel is located between the mainland and Magnetic Island (Figure B.4.1). From anecdotal assessments, this area has the potential to be influenced by the PEP dredge zone. Water quality monitoring data relevant to this area is summarised in Table B.4.8 and consists of continuous optical backscatter data monitored by BMT WBM (2009) and grab sampling by Comarine (1993).

Table B.4.8 Western Channel TSS (mg/L) Monitoring Data

Study (parameter)	Site		Min	Percentile		Median	Mean	Percentile			Max
				10th	20th			80th	95th	99th	
BMT WBM (TSS) Sept 08 to May 09	S5 Middle Reef	Dry	0	3	4	8	16	20	54	125	1,219
		Wet (mid Jan09-Feb09)	7	14	17	**28**	44	65	129	197	354
	S7 - Magnetic Island Seagrass (*Wet/Windy conditions only*)		0	4	5	9	12	16	30	52	120
	S8 - Cape Pallarenda Seagrass *(Dry/Calm conditions only)*		0	3	4	5	26	20	76	531	1,412
Comarine (TSS) January 1993	1-3 Sites 10 grab samples @ various depths)		22	26	28	**39**	42	53	60	73	74
QWQG		Suspended Solids (mg/L)				15					
		Turbidity (NTU)				6					

Note:
TSS – Total Suspended Solids
Bold red text – Exceed Guideline Level

The estimated median TSS values provided by the BMT WBM (2009) continuous optical backscatter measurements (S5, S6 and S8) indicate a concentration range in the order of 5 to 28 mg/L for the Western Channel of Cleveland Bay. The Comarine (1993) water sampling indicates TSS levels to be approximately 2 to 3 times higher than that recorded by the optical backscatter measurements with a median value of 39 mg/L and a range between 28 to 53mg/L for the 20th and 80th percentiles. The Comarine (1993) grab samples are limited in number (10 only) in this region.

The TSS range of the BMT WBM (2009) optical backscatter levels are between 4 to 65 mg/L for the 20th and 80th percentiles (across all three sites) which is within the bounds of that recorded for the central Cleveland Bay area. Interestingly, the measurements recorded at S5 (Middle Reef) are approximately 2 times greater than those recorded in the two near-shore seagrass areas (S7 and S8) and are a likely result of wind-induced waves causing resuspension of sediments in the shallower reef sections.

B.4.3.2.11 Magnetic Island Coral Reef

The Magnetic Island Coral Reef area represents an area located adjacent to the PEP Sea Channel dredging area. Water quality monitoring data relevant to this area is summarised in Table B.4.9 and consist of continuous optical backscatter data monitored by BMT WBM (2009).

Table B.4.9 Magnetic Island Coral Reef TSS (mg/L) Monitoring Data

Study (parameter)	Site		Min	Percentile		Median	Mean	Percentile			Max
				10th	20th			80th	95th	99th	
BMT WBM (TSS) Sept 08 to May 09	S4 – Geoffrey Bay	Dry	0	4	7	11	14	17	41	62	137
		Wet	0	5	7	15	39	57	145	308	1,040
QWQG			Suspended Solids (mg/L)			15					
			Turbidity (NTU)			6					

Note:
TSS – Total Suspended Solids

While the monitoring data for this region was limited in duration, two distinct periods were captured representing both dry (calm) and wet (strong wind) weather conditions. The estimated median dry period TSS indicates a value in the order of 11 mg/L, while a wet period median TSS of 15 mg/L was calculated, both of which is either at or below the QWQG of 15 mg/L.

The TSS ranges between 7 to 57 mg/L for the combined dry/wet wind conditions for the 20th and 80th percentiles values. The TSS ranges are to some extent supported by monitoring undertaken by Muslim and Jones (2003), who measured TSS fortnightly for one year (1993-1994) in the Nelly Bay area east of Magnetic Island with an average TSS of 9 mg/L and a range of 4 to 27mg/L.

B.4.3.2.12 Frequency and Duration of Elevated TSS Events

To characterise natural fluctuations of TSS in Cleveland Bay, the frequency and duration of events when TSS was elevated above the 95th percentile was calculated using the BMT WBM (2009) monitoring data. All monitoring data was used, excluding the data during the large rainfall event in January/February 2009.

The method used to derive these numbers is based on the McArthur *et al.* (2002) method (Section B4.4.2) whereby the 95th percentile is used as the threshold value to determine the frequency and duration of events occurring above this threshold. Event durations are categorised into duration classes, with the highest duration class representing the duration guideline (i.e. the 95th percentile longest duration event). The frequency and duration of elevated TSS events per month is presented in Table B.4.10.

Table B.4.10 indicates that Cleveland Bay is dominated by short duration (i.e. less than 30 minutes) peaks in TSS above the 95th percentile, with only minimal occurrence of longer duration (i.e. longer than 2 hours) events per month. Sites 2 to 8 are shown in Figure B.4.1.

Table B.4.10 Frequency of Events for each Specified Duration per Month

Monitoring Site	Location	95th Percentile TSS	Duration (Consecutive Hours in Excess of 95th Percentile) and Frequency Per Month						
Site 2	Inner Cleveland Bay	44 mg/L	<30 mins	0.5 - 1 hour	1 - 2 hours	2 - 4 hours	4 – 6 hours	6 – 8 hours	>8 hours
			57	*10*	*1*	*1*	*1*	*1*	*1*
Site 3	Outer Cleveland Bay	33 mg/L	<30 mins	0.5 - 1 hour	1 - 2 hours	2 - 3 hours	3 – 4 hours	4 – 6 hours	>6 hours
			67	*7*	*5*	*1*	*1*	*1*	*1*
Site 4	Geoffrey Bay – Magnetic Island	41 mg/L	<30 mins	0.5 - 1 hour	1 - 2 hours	2 - 4 hours	4 – 5 hours	5 – 7 hours	>7 hours
			16	*3*	*2*	*1*	*1*	*1*	*3*
Site 5	Middle Reef	54 mg/L	<30 mins	0.5 - 1 hour	1 - 2 hours	2 - 3 hours	3 – 4 hours	4 – 6 hours	>6 hours
			40	*7*	*3*	*2*	*1*	*1*	*1*
Site 6	The Strand	218 mg/L	<30 mins	0.5 - 1 hour	1 - 2 hours	2 - 4 hours	4 – 5 hours	5 – 7 hours	>7 hours
			65	*4*	*2*	*2*	*1*	*1*	*1*
Site 7	Southern Magnetic Island	30 mg/L	<30 mins	0.5 - 1 hour	1 - 2 hours	2 - 3 hours	3 – 4 hours	4 – 5 hours	>5 hours
			35	*7*	*3*	*2*	*1*	*1*	*1*
Site 8	Cape Pallarenda	76 mg/L	<30 mins	0.5 - 1 hour	1 - 2 hours	2 - 3 hours	3 – 4 hours	4 – 5 hours	>5 hours
			61	*8*	*5*	*1*	*1*	*1*	*1*

B.4.3.2.13 Photosynthetically Active Radiation (PAR)

The photosynthetically active radiation (PAR) is used to measure the amount of light available for photosynthetic processes of the benthic marine community (e.g. seagrasses). BMT WBM (2009) measured PAR at the seabed as part of their monitoring campaign during October 2008 to May 2009 as reported in Section B4.4.4 for TSS. GHD (2009a) also recorded PAR at their two monitoring sites WQ1 and WQ2.

PAR levels from the BMT WBM (2009) monitoring campaign are tabulated in Table B.4.11 for times between 10:00am and 3:00pm and total (i.e. 24hrs). These PAR levels are measured at the seabed to represent the amount of light reaching sensitive ecological receptors such as seagrass meadows. The PAR levels in Table B.4.11 are dependent on the depth of water at each site, with shallower sites allowing more light to reach the seabed.

Table B.4.11 Percentile statistics for PAR (µE/cm2) measured at each site

Location	Site	Percentiles				
		10th	25th	50th	75th	90th
Outer Harbour	1	1.8 *(0.02)*	4.9 *(0.01)*	14.7 *(1.8)*	38.5 *(7.3)*	63.0 *(25.6)*
Inner Cleveland Bay	2	0.05 *(0.05)*	1.4 *(0.05)*	1.4 *(0.05)*	2.8 *(1.4)*	4.9 *(1.4)*
Outer Cleveland Bay	3	1.1 *(0.0)*	1.4 *(0.05)*	9.7 *(0.05)*	15.2 *(2.8)*	23.5 *(12.4)*
Magnetic Island Coral Reef	4	12.2 *(0.0)*	22.5 *(0.0)*	30.9 *(1.4)*	43.8 *(15.8)*	66.3 *(34.5)*
Western Channel	5	4.1 *(0.2)*	17.4 *(2.2)*	58.6 *(4.3)*	86.8 *(23.9)*	106.4 *(67.3)*
	7	17.4 *(0.0)*	38.1 *(0.0)*	71.0 *(0.0)*	93.6 *(20.8)*	107.4 *(79.7)*
	8	0.4 *(0.0)*	0.6 *(0.2)*	2.2 *(0.6)*	10.9 *(8.4)*	23.2 *(23.2)*
The Strand	6	15.9 *(0.03)*	60.7 *(0.2)*	98.9 *(3.2)*	150.8 *(38.3)*	181.9 *(11.7)*

Note:
Non-bracketed values are recording between 10:00am and 3:00pm
Bracketed values are 24hr recordings

From Table B.4.11, median 24 hour PAR levels ranged from < 0.05 µE/cm^2 at sites 2 (Inner Cleveland Bay), 3 (Outer Cleveland Bay) and 7 (Western Channel), to 4.3 µE/cm^2 at site 5 (Middle Reef in Western Channel). This indicates that there was less light reaching the seafloor in the deeper water sites relative to the shallow water sites during the monitoring period (i.e. Oct 2008 to May 2009). Furthermore, the period between 10:00 and 15:00, which generally represents the period when PAR levels are greatest, had median PAR levels that ranged from 1.4 µE/cm^2 at site 2 (Inner Cleveland Bay) to 98.9 µE/cm^2 at site 6 (the Strand).

Comparison of TSS and PAR indicated that high TSS in the water column can result in lower light levels close to the sea floor. Sustained periods of high TSS, as noted at Site 1 (i.e. outer harbour), effectively blocked the light from reaching the seabed for periods of days to several weeks. However, this monitoring period coincided with maintenance dredging activities (Oct-Nov 2008) and a high rainfall period (Jan-Feb 2009), which may have impacted on TSS levels in the vicinity of Site 1. It should be noted that the Strand (i.e. Site 6), despite having relatively high median TSS levels (47 and 116 mg/L for dry and wet weather periods respectively), also had the highest PAR levels. This is most likely attributable to the shallow depth of water at Site 6, whereby the amount of light reaching the seabed is higher than that at deeper water locations despite the water being more turbid.

Wind speed can also influence PAR levels. At all sites, median PAR values were lowest during easterly winds with speeds >30 km/hr, which was consistent with the temporal trends in TSS previously reported. Median PAR values were generally greatest when winds were <20 km/hr, again consistent with trends in TSS.

To determine the approximate TSS concentration at which light extinguishment occurs at the seabed at various sensitive receptor locations, the PAR and TSS time series data was analysed. The results are presented in Figure B.4.2 with the approximate point of light extinguishment indicated by the dashed lines. TSS levels above these points generally resulted in no light reaching the seabed. A light extinguishment point was not determined for Site 6 as generally light was recorded at the seabed even with TSS in excess of 150 mg/L. The results in Figure B.4.2 indicate light extinguishment occurs at each site at *approximately* the following TSS concentrations:

- Site 4 - 35 mg/L.
- Site 5 – 30 mg/L.

- Site 6 – greater than 150 mg/L.
- Site 7 – 20 mg/L.
- Site 8 – 50 mg/L.

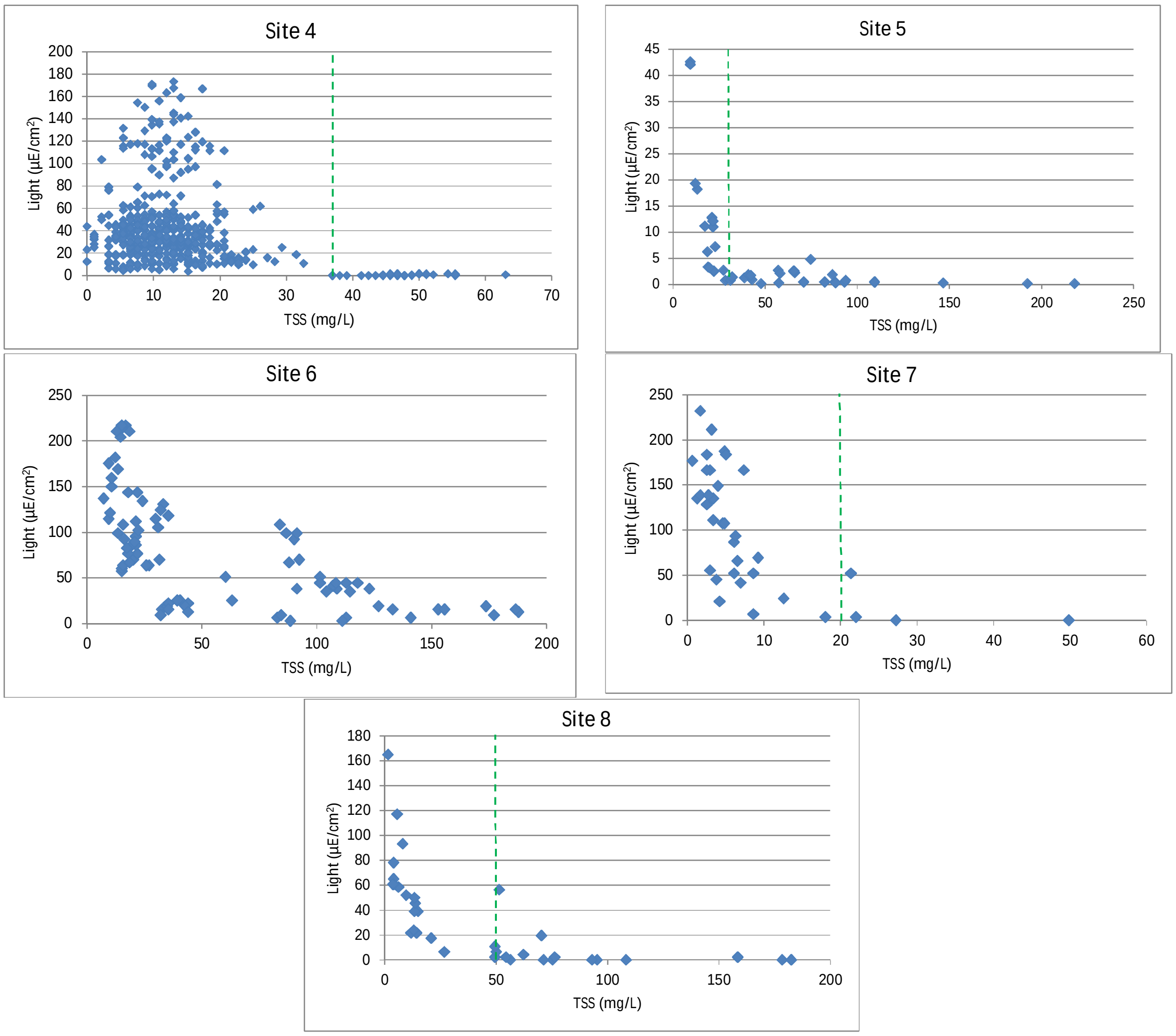


Figure B.4.2 Relationship between TSS (mg/L) and Light (µE/cm2) Reaching the Seabed at Sensitive Receptor Locations (Dashed Lines Represent Approximate Light Extinguishment Points)

For sites which had depth data recorded (i.e. Sites 4, 7 and 8), the light attenuation coefficient (Kd) was also calculated. This calculation provides a relationship between TSS and light attenuation through water at each site, and was calculated using the following formula derived from Anthony *et al.* (2004):

$$Kd = \ln\left(\frac{E(s)}{E(z)}\right)/z$$

In this equation, E(s) is the PAR at the water surface and E(z) is the PAR at a depth of z. PAR levels at the surface were obtained from the Australian Institute of Marine Science data centre.

Light attenuation results are presented in Figure B.4.3. When compared to the results in Figure B.4.2 above, it can be seen that the light attenuation coefficient (per metre depth of water) coinciding with light extinguishment at the seabed is approximately 0.7, 1.0 and 1.25 for Sites 4, 7 and 8 respectively (based on the lines of best fit in Figure B.4.3).

Further PAR monitoring data is currently being recorded off the east coast of Magnetic Island, the Strand and Cape Pallarenda. This data will enable further assessment of light attenuation as it relates TSS / turbidity levels, which may be used to develop light-based trigger levels during dredge monitoring.

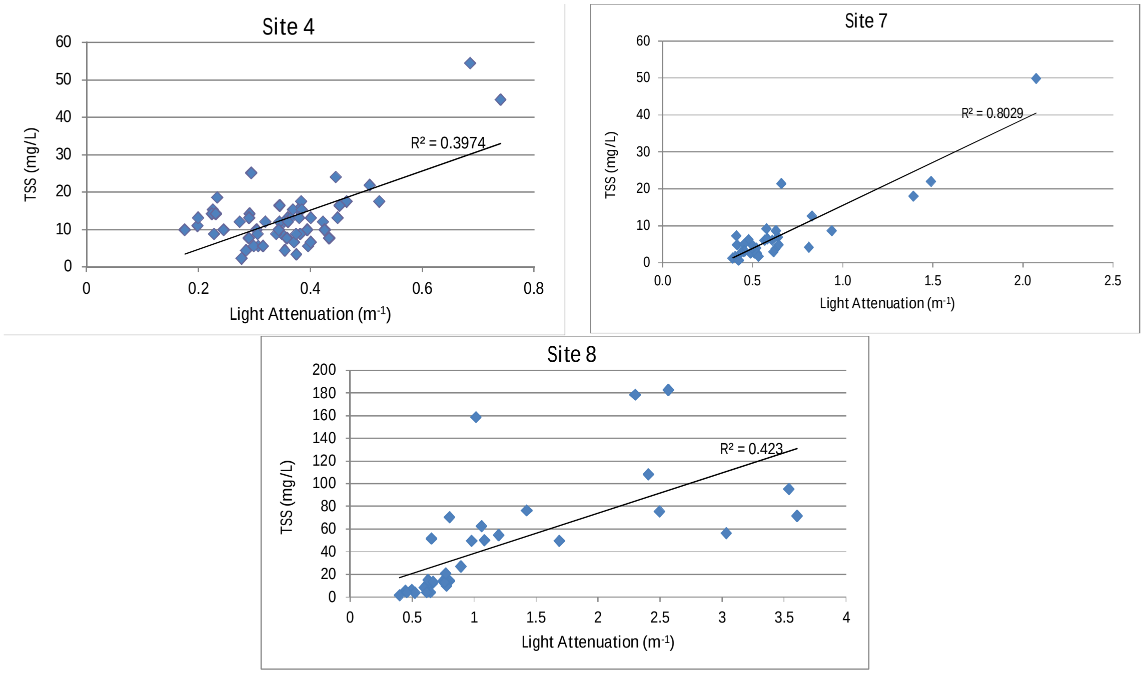


Figure B.4.3 Light Attenuation (m-1) as a Function of TSS (mg/L)

B.4.3.2.14 Metals/Metalloids

Monitoring of dissolved metals/metalloids in the surface water is recorded by POTL as part of their routine monitoring campaign. The available monitoring data in Cleveland Bay are summarised in Table B.4.12 below, with the ANZECC/ARMCANZ (2000)trigger levels provided for comparison purposes.

Table B.4.12 POTL Collated Metals/Metalloids (mg/L) Monitoring Data

Metals/Metalloids						
Area	Metal	Percentile				ANZECC/ARMCANZ (2000) Trigger Level (95% Species Protection)
		50th	80th	95th	99th	
Outer Harbour	Ag	All values < 0.005				0.0014
	Ba	0.009	0.011	0.012	0.012	1
	Cd	All values < 0.001				0.005
	Co	All values < 0.005				0.001
	Cr	0.002	0.002	0.003	0.003	0.0044
	Cu	All values < 0.005				0.0013
	Mn	0.001	0.006	0.010	0.016	-
	Mo	0.01	0.015	0.015	0.017	-
	Ni	0.003	0.003	0.005	0.006	0.07
	Pb	0.001	0.001	0.001	0.003	0.0044
	Sb	0.01	0.01	0.02	0.03	-
	Zn	0.003	0.003	0.007	0.019	0.015
	As	0.001	0.002	0.002	0.002	0.050
Inner Cleveland Bay	Ag	All values < 0.005				0.0014
	Ba	0.005	0.010	0.011	0.013	1

Metals/Metalloids						
	Cd	All values < 0.001				0.005
	Co	All values < 0.005				0.001
	Cr	0.001	0.002	0.002	0.003	0.0044
	Cu	All values < 0.005				0.0013
	Mn	0.001	0.004	0.016	0.023	-
	Mo	0.015	0.015	0.015	0.015	-
	Ni	All values < 0.005				0.07
	Pb	All values < 0.001				0.0044
	Sb	0.01	0.01	0.01	0.01	-
	Zn	All values < 0.005				0.015
	As	0.005	0.0005	0.0005	0.0008	0.050
Ross River	Ag	All values < 0.005				0.0014
	Ba	0.012	0.021	0.035	0.058	1
	Cd	All values < 0.001				0.005
	Co	All values < 0.005				0.001
	Cr	0.002	0.003	0.004	0.004	0.0044
	Cu	All values < 0.005				0.0013
	Mn	0.006	0.017	0.036	0.041	-
	Mo	0.015	0.015	0.019	0.028	-
	Ni	0.003	0.003	0.005	0.005	0.07
	Pb	0.005	0.0005	0.0008	0.0025	0.0044
	Sb	0.01	0.01	0.01	0.02	-
	Zn	0.003	0.003	0.003	0.004	0.015
	As	0.001	0.001	0.002	0.006	0.050

Note:
Bold red text – Exceed Guideline Level

The ANZECC/ARMCANZ (2000) guidelines state that for toxicants in water (such as metals/metalloids), the 95th percentile of monitoring data should be compared to the trigger level. From the table above, it can be seen that in general (with the exception of those at limits of detection) all 95th percentile values comply with the ANZECC/ARMCANZ (2000) 95% species protection trigger levels. When comparing the more conservative 99th percentile of monitoring data to the trigger levels, it can be seen that all metals/metalloids comply with the ANZECC/ARMCANZ (2000) 95% protection trigger levels, except for zinc in the outer harbour which slightly exceeds the trigger level.

B.4.3.2.15 Nutrients

Monitoring of nutrients (i.e. nitrogen and phosphorus) is limited in comparison to TSS, with data only available from POTL and comments from the GHD (2009a) monitoring campaign available for review. The available monitoring data in the general Cleveland Bay area is summarised in Table B.4.13 below, with the QWQG for total nitrogen and phosphorus provided for comparison purposes.

Table B.4.13 Collated Total Nitrogen and Total Phosphorus (mg/L) Monitoring Data

Study (parameter)	Site	Min	Percentile		Median	Mean	Percentile			Max
			10th	20th			80th	95th	99th	
Total Nitrogen										
POTL	Outer Harbour (90 grab samples)	0.09	0.11	0.11	0.15	0.158	0.200	0.226	0.251	0.26
	Inner Cleveland Bay (37 grab samples)	0.09	0.10	0.102	0.12	0.129	0.140	0.202	0.216	0.22
	Ross River (77 grab samples)	0.09	0.106	0.11	0.14	0.154	0.200	0.224	0.252	0.26
QWQG		Total Nitrogen (mg/L)			0.2					
Total Phosphorus										
POTL	Outer Harbour (90 grab samples)	0.006	0.010	0.011	0.014	0.016	0.020	0.030	0.040	0.040
	Inner Cleveland Bay (37 grab samples)	0.009	0.011	0.011	0.014	0.016	0.021	0.026	0.028	0.029
	Ross River (77 grab samples)	0.009	0.010	0.011	0.014	0.017	0.020	0.030	0.040	0.040
QWQG		Total Phosphorus (mg/L)			0.02					

Note:
Bold red text – Exceed Guideline Level

Results from the long-term POTL monitoring data indicate that the median concentrations for total nitrogen and phosphorus are compliant with the QWQG. Additionally, the 80th percentile concentrations are also within the guideline range indicating the general Cleveland Bay area water quality is within the guideline values, but does occasionally experience elevated nutrient levels. As mentioned previously, the QWQG guideline values are for comparing annual medians, and the medians in Table B.4.13 are derived from only a few months of data. Therefore, this assessment should be considered as a high level 'screening' type assessment only.

Comments from GHD (2009a) *in-situ* grab sampling monitoring indicated high nutrient concentrations in the existing boat moorings of the Ross River. These elevated levels were considered to be related to anthropogenic influences.

B.4.3.2.16 Oil and Grease

Monitoring of oils and grease is limited with records only available from POTL summarised in Table B.4.14 below and comments from the GHD monitoring campaign available.

Table B.4.14 Oils and Grease (mg/L) Monitoring Data

Oils and Grease										
Study (parameter)	Site	Min	Percentile		Median	Mean	Percentile			Max
			10th	20th			80th	95th	99th	
POTL	Outer Harbour (90 grab samples)	All values < 1								
	Inner Cleveland Bay (37 grab samples)	<1	<1	<1	<1	<1	<1	1.0	1.0	1.0
	Ross River (77 grab samples)	<1	<1	<1	0.5	0.7	0.5	1.0	3.6	4.0
ANZECC (2000)		Oil and petrochemical should not be noticeable as a visible film on the water nor should they be detectable by odour								

In general the concentrations of oils and grease analysed were below the laboratory level of detection and thus in line with the environmental values for recreation and aesthetics. There would appear to be some notable presence of oils in the Ross River possibly attributable to the boat mooring area.

B.4.3.2.17 Accumulated Sediment Surface Density (ASSD)

BMT WBM (2009) measured accumulated sediment surface density (ASSD) as part of their monitoring campaign during October 2008 to May 2009. The analysis of ASSD showed that there was no simple linear relationship between wind and ASSD.

For most of the time, ASSD was <0.1 mg/cm^2. During periods when sediment deposition was >1 mg/cm^2, winds were typically between ~8 and 35 km/hr, with the strength of this pattern varying among sites. The influence of wind on ASSD was not readily apparent at the Strand (i.e. site 6), where high ASSD levels were recorded at both low and high wind speeds.

Overall, the ASSD results indicate that both low and high wind speeds were generally associated with low deposition. Little or no sediment resuspension will occur at low wind speeds and associated low wave action. Hence, deposition of sediment is expected to be low. On the other hand, strong winds and associated high wave action keep the sediment in suspension, resulting in low levels of deposition during the high wind period. Eventually though, once the wind speed decreases, sediment deposition would likely occur.

B.4.3.2.18 Summary

A summary of estimated ambient water quality in Cleveland Bay, based upon the analyses presented in Section B4.3.2.4 to Section B4.3.2.17, is provided in Table B.4.15.

The ambient water quality values in Table B.4.15 have been derived by calculating the average (mean) of the BMT WBM (2009) and POTL data sets, excluding the wet weather BMT WBM (2009) data. This wet weather data represents a period of extremely high rainfall (i.e. Jan - Feb 2009) and does not reflect ambient or typical conditions. Consequently, from the BMT WBM (2009) data, only the dry weather (i.e. March to May 2009) period has been used to derive the values presented in Table B.4.15.

Additionally, the Comarine (1993) data has not been used to calculate ambient water quality as it represents a relatively short period during the wet season. The exception to this is the Eastern Near Shore Seagrass Meadows area, where the Comarine (1993) data is the only available data.

Table B.4.15 Estimated Ambient Water Quality in Cleveland Bay

Site / Parameter		Mean Value
Total Suspended Solids (TSS) Concentrations (mg/L)		
Cleveland Bay - Central	Inner Bay	9
	Outer Bay	8
Eastern Near Shore Seagrass Meadows		**29**
Ross River		11
Western Channel		7
The Strand		**47**
Magnetic Island Coral Reef		11
Outer Harbour Area		**39**
QWQG	TSS (mg/L)	15
Nutrients (mg/L) (Cleveland Bay Area including Ross River)		
Total Nitrogen		0.14
QWQG		0.20
Total Phosphorus		0.014
QWQG		0.020
Metals/Metalloids (mg/L) – Combined Cleveland Bay Area (Median Value)		
Silver		<0.005
Barium		0.009
Cadmium		<0.001
Cobalt		<0.005
Chromium		0.002
Copper		<0.005
Manganese		0.003
Molybdenum		0.013
Nickel		0.003
Lead		0.002
Antimony		0.010
Zinc		0.005
Arsenic		0.002

Note: **Bold red text** – Exceed Guideline Level

Based on Table B.4.15, the ambient TSS levels in the greater Cleveland Bay area are within the QWQG value, except for the Eastern Near Shore Seagrass Meadows, the Strand and the outer harbour. The cause of elevated TSS at these three locations is most likely due to the wind regime and shallower water depth at these locations. As previously mentioned, Larcombe *et al.* (1995) noted that wind-induced waves (long and short wavelength) may lead to resuspension of sediment in shallower sections of the bay. Also, the inflow of sediments from the Ross River and local mainland drainage during rainfall events can lead to elevated TSS in near shore areas.

Ambient levels of nutrients and metal/metalloids are within the QWQG and ANZECC/ARMCANZ (2000)guideline levels respectively.

B.4.4 Assessment of Potential Impacts

B.4.4.1 Overview

This section outlines the potential impacts the PEP may have on the marine water quality in Cleveland Bay associated with the construction and operation of the new port facilities. Development components of the PEP that could affect water quality include:

- Capital dredging of the outer harbour and construction of breakwaters.
- Platypus and Sea Channel deepening and widening.
- At-sea dredged material placement into an approved dredged material placement area (DMPA).
- Land reclamation (tailwater discharge).

This section describes:

- Potential impacts on the ambient water quality from the construction and operation of the port facilities with particular attention to suspended solids, nutrients, heavy metals, oils and grease.
- Options for managing, mitigating or offsetting identified impacts during both construction and operation.

A risk-based approach was adopted in this assessment of potential impacts to water quality in Cleveland Bay. The approach is based on the identification of potential impacting processes, and characterisation of the likely level of impact to the existing water quality. The general risk assessment process (including likelihood and consequence tables) is described in Part A of this EIS, while Table B.4.16 identifies the impact magnitude criteria, specific to water quality, that have been derived for the purpose of the impact assessment described in this chapter.

Table B.4.16 Impact Magnitude Criteria for Cleveland Bay and Surrounds Water Quality

Level of Impact	Criteria: Water Quality
Very High	Permanent change in the Ecosystem for Cleveland Bay and surrounds resulting from changes to water quality due to direct impacts of the construction or operational phases of the PEP and associated activities.
High	Water quality in Cleveland Bay and surrounds is permanently altered due to direct impacts of the construction or operational phases of the PEP and associated activities such that the scheduled Environmental Values and Water Quality Guidelines are no longer achievable if currently being achieved, or are prevented from being achieved in the future if currently not being achieved.
Moderate	Water quality in Cleveland Bay and surrounds is temporarily altered due to direct impacts of the construction phase of the PEP and associated activities such that the scheduled Environmental Values and Water Quality Guidelines are no longer achievable if currently being achieved, or are prevented from being achieved in the future if currently not being achieved.
Low	Water quality in Cleveland Bay and surrounds is temporarily impacted such that mitigation measures prevent changes to water quality over an annual period, though short term exceedances may occur during construction activities.
Negligible	No perceptible impacts on the water quality in Cleveland Bay and surrounds through the use of effective mitigation measures during the construction and operational phases and no perceptible change to long term water quality through altered flow regimes or other hydrologic changes resulting from the Project.
Beneficial	Existing water quality is improved in Cleveland Bay and surrounds due to altered flow regimes, hydrological changes or operational phase mitigation measures.

B.4.4.2 Assessment Methods and Tolerance Limits

The typical approach to assessing the impacts from construction and operations works is to assess compliance against the QWQG values. This method allows a direct comparison of the likely compliance with established guidelines to ensure protection and/or enhancement of environmental values for the waters of concern.

As detailed in the construction program, dredging works are not anticipated to extend greater than 45 weeks, and the main dredging campaign of the Platypus and Sea channel will span only 11 weeks. As such, impacts over this sub annual scale cannot be meaningfully compared for compliance against annual median water quality guidelines as detailed in the QWQG. Specifically, calculation of an annual median from only 11 weeks of impact would result in significant underestimation of potential impacts.

Given this, two levels of assessment were undertaken to support assessment of the potential impacts from the dredging works. Firstly, median concentrations for the dredging campaign only were assessed against the QWQG. Although we acknowledge (as above) that this approach is not strictly precise, it does provide a high level ‘screening’ type assessment tool to allow rapid identification of potential impacts, worthy of subsequent more rigorous assessment.

Secondly, and more defensibly, trigger values for TSS specific to this Project and setting have been developed to assess the potential impacts to ecologically sensitive areas (Chapter B6 Marine Ecology). This approach used the McArthur *et al.* (2002) method of assessment to do so. The McArthur *et al.* (2002) method is summarised below.

McArthur *et al*. (2002)

McArthur *et al*. (2002) suggested that marine species regularly encounter episodic pulsed turbidity and sedimentation events; therefore, if water quality is maintained within the range of natural variability, then marine species and communities will be maintained. This methodology can be used to determine impacts to hard corals and seagrasses, and involves the following process using data collected from a single site (i.e. the assessment is undertaken on a site by site basis):

- Based on long-term monitoring data, the 95^{th} (threshold concentration) and the 99^{th} (intensity) percentile total suspended solid (TSS) concentration are calculated.

- The data set is then analysed to determine the duration of all events (exposure times) during which the threshold value is exceeded. The 95th percentile longest event is calculated as the duration guideline value.
- The data-set is again analysed to develop 'frequency' guideline values. To develop frequency guidelines, all events exceeding the threshold value are grouped into classes by duration. A nominal timeframe is then adopted, and the 95th confidence limit is then selected as the total allowable frequency.

This approach essentially establishes a 'no change' limit for individual locations, where the assessment is referenced with regard to the historical exceedance profile of each location. The concentration limits were calculated based on the baseline conditions presented in Section B4.3.2 and primarily on BMT WBM logger data results (September 2008 to May 2009) at sites 2-8.

As the long-term data for Cleveland Bay shows large variability in TSS among sites during the same time period, site-specific thresholds were deemed more appropriate than a 'one size fits all' approach. These thresholds were refined for specific areas using background data of suitable quality and quantity. Thus, the continual collection of water quality monitoring from a range of receptors sites in the Study Area will further support the robustness of the McArthur *et al*. (2002) approach.

Modelling Outputs

To assist with the impact assessment, dredge plume modelling results from the Modelling Technical Report (Appendix H1 of the EIS) are used. These modelling results consist of both time series results and percentile plots (Appendix H1). Time series plots represent the change to ambient concentrations over time at site specific locations, while contour plots represent a conservative approach by representing the maximum concentrations over the Study Area. The results should be viewed in a comparative sense; that is, the results of the impacts assessed are reported as changes to ambient concentrations, rather than explicit values, to assist in gauging the likely effects on existing water quality.

When interpreting contour plots presented throughout this chapter, it is important to note that these are not snap-shots in time and do not represent the spatial extent of the dredge plume at any given time. Importantly, these plots are the composite of a number of simulated periods that have been superimposed to give an estimate of the maximum footprint associated with each of the dredge scenario.

Additionally, to provide another level of assessment in regard to the channel dredging works, modelled excess TSS in the dredge plumes was separated out into natural resuspension and dredged sediment for a particular modelling period. This was undertaken to aid in the assessment of impacts at particular locations by identifying the proportion of excess suspended sediment originating naturally and from dredging works.

The approach is applied to each key project phase below.

B.4.4.3 Construction

As outlined in the Project Description (Part A of the EIS), the PEP is to be constructed in four stages (A, B, C and D) from 2014 through to 2035, Stage A comprises the majority of the works. The key construction processes that have the potential to impact on water quality in Cleveland Bay are discussed in the following sub-sections as:

- Harbour Dredging and Construction Works.
- Platypus and Sea Channel deepening and widening.
- At-sea dredged material placement into an approved dredged material placement area (DMPA).
- Land reclamation (tailwater discharge).

Detailed construction staging and methodology for the for the PEP is provided in Part A of this EIS, while a summary of the staging and works together with the potential construction impacts on the water quality is provided in Table B.4.17. Furthermore, Chapter B1 (Land) and Chapter B5 (Marine Sediment Quality) provide the results of the geotechnical, acid sulfate soil and sediment assessments that characterise the materials to be dredged.

The principal concern regarding water quality for the PEP is from the resulting release of a wide range of sediment particles to the water body during the dredging component of construction. Visible turbid plumes together with the potential release of contaminants into the water column will occur to some extent as a result of project activities and particularly from dredging in the Platypus and Sea Channel.

Turbid plumes of suspended sediment carried by current across the Project Area and into the greater Cleveland Bay area could impact upon nearby sensitive ecological receptors (Chapter B6 Marine Ecology). The extent of the plume will depend on a range of factors including season, wind strength and direction, currents, tide status, location and type of dredge, as well as working methods and productivity.

Table B.4.17 Staging, Processes and Impacts from Construction Works

Stage	Construction Aspect		Construction Process	Time Frame (Weeks)	Potential Impacts to Water Quality
A	Harbour Dredging (Areas 1a, 1b, 2)	A.1	Mechanical dredging to remove surface sediments for construction of the revetment (north-eastern and eastern) and breakwater (north-eastern)	24	1. Increased turbidity from the backhoe excavator removing sea bed material to separate barge 2. Increased turbidity from barge overflow 3. Increased turbidity and potential mobilisation of contaminants from the seabed material that is placed at the dredged material placement area (DMPA) via barge bottom dump.
		A.2	Construction of revetments and breakwater via rock placement including construction of the western breakwater via rock placement if needed	85	4. Increased turbidity by resuspension of sediments from rock placement 5. Potential source of external contaminants from rock 6. Mobilisation of contaminants into the water column
		A.3	Small Trailer Suction Hopper Dredge (TSHD) to remove the remainder of the surface sediments where reclamation and dredging is proposed with at-sea placement at the dredged material placement area (DMPA)	24	7. Increased turbidity from the trailing suction drag head 8. Increased turbidity and potential mobilisation of contaminants into the water column from waters that discharge form the TSHD via an internal overflow system 9. Increased turbidity and potential mobilisation of contaminants from the dredged material that is placed at DMPA via the TSHD's 'green valve'
		A.4	Cutter Suction Dredge (CSD) to dredge harbour. Material transported to land reclamation site	45	10. Increased turbidity and potential mobilisation of contaminants resulting from significant disturbance of dredge material from the rotary cutter with respect to either a TSHD or mechanical dredge 11. Increased turbidity and potential mobilisation of contaminants resulting from tailwater discharge from the reclamation site
	Platypus and Sea Channel widening and deepening	A.5	Mechanical dredging to widen the Platypus Channel	11	12. Increased turbidity from the rotary cutter 13. Increased turbidity and potential mobilisation of contaminants from the dredged material that is placed at DMPA via the TSHD's 'green valve'
		A.6	Medium TSHD to deepen Platypus and Sea channels		14. Increased turbidity from the trailing suction drag head 15. Increased turbidity and potential mobilisation of contaminants into the water column from waters that discharge form the TSHD via an internal overflow system 16. Increased turbidity and potential mobilisation of contaminants from the dredged material that is placed at DMPA via the TSHD's 'green valve'
	Land reclamation	A.7	Tailwater discharge from the land reclamation process		17. Increased turbidity and potential mobilisation of contaminants into the water column from the reclamation site tailwater
	At-sea dredged material placement	A.8	Placement of dredged material at sea at an approved DMPA	11	18. Increased turbidity and potential mobilisation of contaminants from the dredged material that is placed at DMPA

Stage	Construction Aspect	Construction Process		Time Frame (Weeks)	Potential Impacts to Water Quality
B	Harbour Dredging (Area 3)	B.1	Cutter Suction Dredge (CSD) to dredge harbour	47	As per items 10 and 11 above
	Land reclamation	B.2	Tailwater discharge from the land reclamation process		As per item 17 above
C / D	Harbour Dredging (Area 1a, 1b, 2, 3 and 4)	C.1	Cutter Suction Dredge (CSD) to dredge harbour	56	As per items 10 and 11 above
	Platypus and Sea Channel widening and deepening	C.2	Medium TSHD to deepen Platypus and Sea channels	11	As per items 14, 15 and 16 above

B.4.4.3.1 Outer Harbour Dredging and Construction

The outer harbour dredging and construction of revetment and breakwaters (Table B.4.17), A.1 to A.4) using a mechanical dredge, a small trailer suction hopper dredge (TSHD), and a cutter section dredge (CSD), including the rock placement, will generate turbid plumes in the outer harbour area. The construction works include scenarios 1 through to 3 which represent the following discrete harbour works:

- Scenario 1 (mechanical dredging of outer harbour area) = > construction process A.1.
- Scenario 2 (construction of revetment and breakwaters) = > construction process A.2.
- Scenario 3 (small TSHD dredging of outer harbour area) = > construction process A.3.

For the harbour dredging works and construction, Scenario 3 representing the dredging of the outer harbour area using the TSHD (Table B.4.17, A.3) generally has the largest impact on water quality as identified in the Modelling Technical Report (Appendix H1). As a result, the potential water quality impacts associated with this scenario in Cleveland Bay are principally discussed herein.

Construction works (including dredging) in the outer harbour area may increase suspended sediment levels in Cleveland Bay. The turbid plumes have the potential to migrate and impact upon nearby sensitive ecological receptors, by reducing light levels required for photosynthesis and smothering of plants and animals. Based on the results of the receiving water quality model, the harbour dredging works have the potential to impact upon the following sensitive ecological receptors (Chapter B6 Marine Ecology):

- Deepwater seagrass meadows in the inner portion of central Cleveland Bay.
- Seagrass meadows at the Strand, located on the coastline approximately 2km west of the PEP.

Potential Impact: *Generation and migration of turbid plumes from dredging works.*

As previously noted, the construction program for the harbour dredging works is for 45 weeks, hence conversion to annual medians for comparison to QWQG is not meaningful. Nevertheless, it does provide a high level 'screening' type assessment which is followed by further assessment using the McArthur *et al.* (2002) method.

An initial impact assessment using a conservative comparison of the likely compliance with the established QWQG has been undertaken and the results are presented in Table B.4.18 below at the nearest two sensitive receptor locations.

Table B.4.18 TSS (mg/L) Impacts from Harbour Construction Works (Scenario 3)

Monitoring Site	Location	Water Quality Condition	Median TSS (mg/L)
Site 2	Inner Cleveland Bay	Monthly Increase above Ambient	+0
		Ambient Condition	9
Site 6	The Strand	Monthly Increase above Ambient	+0.1
		Ambient Condition	47
QWQG (annual)			15

As noted in the table above, the median increase in ambient TSS is predicted to be negligible to the two nearest sensitive locations. Furthermore, the highest predicted change to ambient water quality conditions is approximately 0.1 mg/L above the median TSS at the Strand. An increase (albeit of short duration) of 0.1 mg/L to ambient conditions at these sensitive sites is not considered to be of ecological significance.

To further clarify the potential impact from the harbour dredging and construction works, preliminary impact zones for TSS based on the McArthur *et al.* method were mapped and are presented as a figure in Appendix I2. From this figure it can be seen that no impact outside of the outer harbour area results from construction of the harbour. This figure, together with the times series plots and the percentiles plots (Appendix H1 - Modelling Technical Report), and including the construction median concentrations results provided in the table above, demonstrate that construction of the harbour is likely to result in '*negligible to minor*' impacts to the adjacent sensitive receptor locations as per Table B.4.16.

Mitigation Measures

In line with best practice, while significant impacts are not predicted, the following mitigation measures will be employed to ensure minimal potential turbidity impacts generated by outer harbour dredging works:

- A model validation water quality monitoring program: short term monitoring program following commencement of capital dredging and tailwater discharge to validate model findings.
- Implement a reactive water quality monitoring program: This strategy will be incorporated to ensure compliance with proposed trigger values and guidelines (Chapter C2.1 – Dredge Management Plan) during dredging and construction works. Monitoring data would be downloaded remotely and the duration and frequency assessed against threshold triggers, with appropriate management actions implemented if threshold triggers are exceeded.

Potential Impact: *Mobilisation of nutrients and toxicants into the water column from disturbance of marine sediments.*

Results of sediment porewater and elutriate analyses from samples collected in the outer harbour and Platypus Channel by BMT WBM in November 2010 are discussed and provided in Chapter B4 (Marine Sediment Quality). Of particular relevance to the potential impact from contaminants are the relationships of the elutriate results to relevant water quality guidelines and/or toxicity limits. While there are no set water quality guidelines for sediment porewater; previous dredging-related assessments elsewhere (URS, 2008; Hydrobiology, 2003a; BMT WBM, 2008) were required to assess porewater (and elutriate) concentrations with acute toxicity trigger values (TTVs) associated with water column as outlined in the ANZECC/ARMCANZ (2000) guidelines. In the case of nutrients, the key species of interest are ammonia and NOx, both of which have listed TTVs. The maximum elutriate NOx concentration recorded in both the outer harbour and Platypus Channel by BMT WBM in 2010 was 0.011 mg/L, which is well within the TTV of 13 mg/L. As such, the concentrations recorded present a '*negligible*' impact in this regard.

For ammonia, the TTV varies according to pH, thus assuming a pH of 8.0 and 95% protection of species for '*slightly to moderately*' disturbed systems, the TTV for ammonia is 0.91 mg/L (ANZECC & ARMCANZ, 2000). Although four out of six sites (103, 104, 105 and 108) had elutriate test results which exceeded this value (Chapter B4 - Marine Sediment Quality), it is noted that the ammonia concentrations reported above are consistent with those found previously by others at separate locations in and around Port of Townsville, for example Hydrobiology (2004). Importantly, those previous studies conducted detailed and extensive risk assessments associated with these levels of porewater ammonia, which is an approach supported by the ANZECC/ARMCANZ (2000) guidelines (i.e. collection of locally specific data is preferably to use of generic global TTVs or WQOs). The studies were able to show that toxicity risks were low and therefore the PEP construction works present a '*negligible*' risk.

Mitigation Measures

As demonstrated in the 'Potential Impacts' section above, nutrient impacts from sediment pore water are negligible and no mitigation measures are required.

B.4.4.3.2 Platypus and Sea Channel Dredging

The Platypus and Sea Channel dredging work (Table B.4.17) will be undertaken using a TSHD that will generate turbid plumes in the dredging area. The construction works and impacts to water quality are detailed in the Modelling Technical Report (Appendix H1) with scenarios 4a and 4b representing the following discrete dredging processes during different seasons:

- Scenario 4a (Platypus and Sea Channel dredging during summer months) => construction process A.5, A.6 and A.8.
- Scenario 4b (Platypus and Sea Channel dredging during winter months) => construction process A.5, A.6 and A.8.

As previously noted, construction using the CSD in the harbour as noted as item A.4 in Table B.4.17 is included in the channel dredging to provide a potential 'worst case' scenario. Dredging and construction work in the channels and the outer harbour area will increase suspended sediment levels in Cleveland

Bay and similarly to the harbour works may result in the potential release of contaminants through the migration of the turbid plumes.

The turbid plumes have the potential to impact upon nearby sensitive ecological receptors, by reducing light levels required for photosynthesis and smothering of plants and animals. Based on the results of the receiving water quality model, the channel dredging works have the potential to impact upon sensitive ecological receptors (Chapter B6 - Marine Ecology) that include:

- Deepwater seagrass meadows in the inner portion of central Cleveland Bay.
- Seagrass meadows at the Strand and Cape Pallarenda, located on the coastline.
- Magnetic Island Corals and seagrass.
- Central Cleveland Bay seagrass.
- Eastern Near Shore seagrass.

Potential Impact: *Generation and migration of turbid plumes from dredging works.*

The modelling described in Chapter B3 (Coastal Processes) and the Modelling Technical Report (Appendix H1) predicts TSS concentrations above background levels. This modelling included resuspension of sediments generated by dredging and dredged material disposal.

Modelling assumptions are described in detail in the Modelling Technical Report, and these assumptions have been built into the modelling of an ‘expected case’. Modelling was also undertaken for alternate scenarios including ‘worst case’ and ‘north-westerly wind’ scenarios.

The relevant plume modelling results consist of both time series results and percentile plots. As the construction program for the channel dredging works is for 11 weeks only (Table B.4.17) conversion of predicted plume results to annual medians for comparison to QWQG is again not possible.

Impact Assessment Approach

The impact assessment of turbid plumes from channel dredging has been undertaken using the following process:

- A high level ‘screening’ assessment against water quality guidelines and baseline data.
- Assessment of ‘expected case’ seasonal impacts using the McArthur *et al.* (2002) method.
- Assessment of natural resuspension vs. dredged sediment in turbid plumes.
- Assessment of alternate scenarios, such as ‘worse case’ and ‘north-westerly wind’ scenarios using the McArthur *et al*. (2002) method.

These are discussed below.

Screening Assessment against Water Quality Guidelines and Baseline Data

An initial high level screening assessment of the potential impacts to the median water quality concentrations based on the seasonal modelling data was undertaken for the sensitive receptor sites where ambient monitoring was previously undertaken (refer to Figure B.4.1 for locations).

Results for this approach are presented in Table B.4.19 and Table B.4.20 for summer and winter respectively as increases to median monthly concentrations at the sensitive receptor locations. Due to the lack of seasonal data, it has been assumed that median TSS values are similar for both winter and summer. Nevertheless, seasonal differences would be expected.

Table B.4.19 TSS (mg/L) Impacts from Platypus and Sea Channel Dredging and Harbour Works (Summer)

Monitoring Site	Location	Water Quality Condition	Median TSS (mg/L)
Site 2	Inner Cleveland Bay	Monthly Increase above Ambient	+6
		Ambient Condition	9
Site 3	Outer Cleveland Bay	Monthly Increase above Ambient	**+9**
		Ambient Condition	8
Site 4	Geoffrey Bay – Magnetic Island	Monthly Increase above Ambient	+3
		Ambient Condition	11
Site 5	Middle Reef	Monthly Increase above Ambient	+2
		Ambient Condition	8
Site 6	The Strand	Monthly Increase above Ambient	**+2**
		Ambient Condition	**47**
Site 7	Southern Magnetic Island	Monthly Increase above Ambient	+0.3
		Ambient Condition	9
Site 8	Cape Pallarenda	Monthly Increase above Ambient	+0.3
		Ambient Condition	5
QWQG (annual)			15

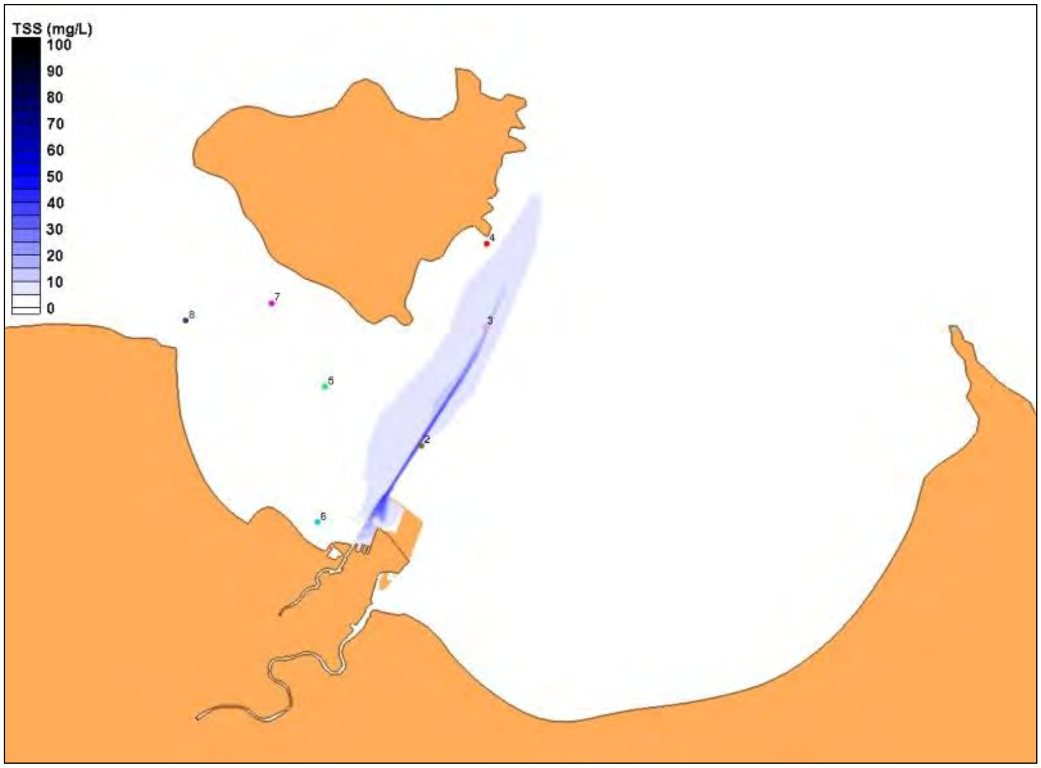
Note: **Bold red text** indicates exceedance of the QWQG guideline value.

Table B.4.20 TSS (mg/L) Impacts from Platypus and Sea Channel Dredging and Harbour Works (Winter)

Monitoring Site	Location	Water Quality Condition	Median TSS (mg/L)
Site 2	Inner Cleveland Bay	Monthly Increase above Ambient	**+10**
		Ambient Condition	9
Site 3	Outer Cleveland Bay	Monthly Increase above Ambient	**+13**
		Ambient Condition	8
Site 4	Geoffrey Bay – Magnetic Island	Monthly Increase above Ambient	**+5**
		Ambient Condition	11
Site 5	Middle Reef	Monthly Increase above Ambient	+3
		Ambient Condition	8
Site 6	The Strand	Monthly Increase above Ambient	**+7**
		Ambient Condition	**47**
Site 7	Southern Magnetic Island	Monthly Increase above Ambient	+1
		Ambient Condition	9
Site 8	Cape Pallarenda	Monthly Increase above Ambient	+1
		Ambient Condition	5
QWQG (annual)			15

Note: **Bold red text** indicates exceedance of the QWQG guideline value.

The results in the above tables are presented visually in Figure B.4.4 as contour plots of 50% exceedance (i.e. median) above background levels.



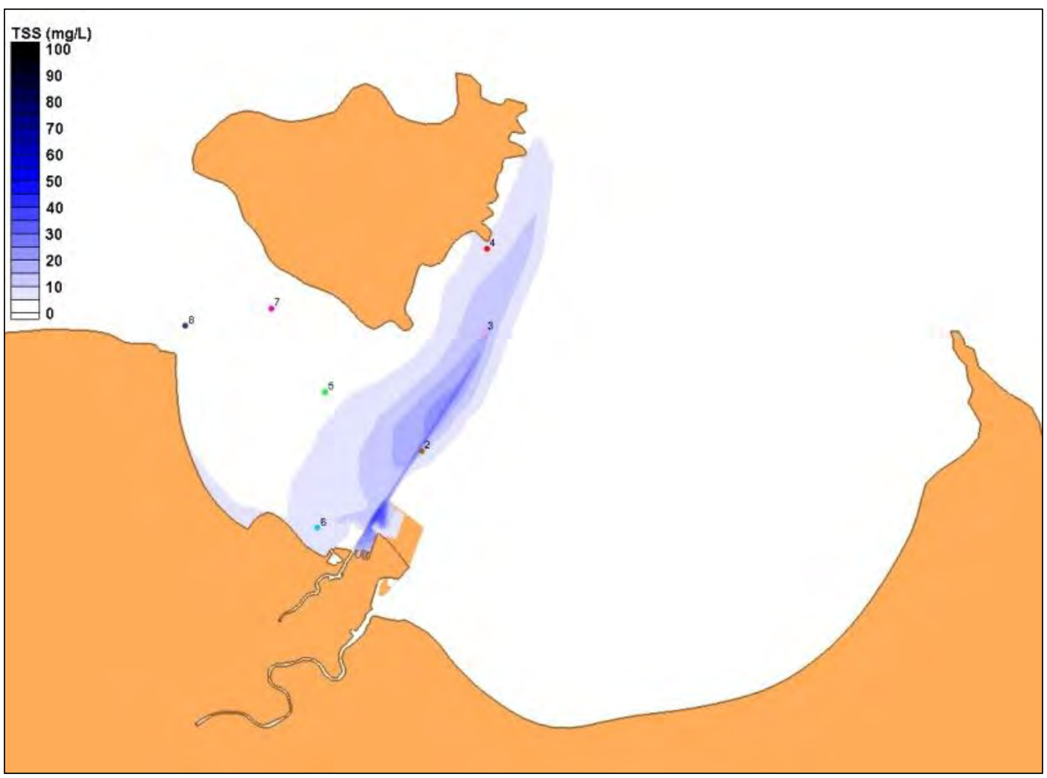


Figure B.4.4 Modelled Median TSS above Background for Summer (top) and Winter (bottom)

The results in Table B.4.19, Table B.4.20 and Figure B.4.4 indicate that dredging will only minimally increase median TSS values at Sites 5, 6, 7 and 8 during summer and winter compared to ambient conditions. Median TSS is predicted to increase approximately twofold at Sites 2 and 3, however these sites are in the dredge footprint. The median TSS at Site 4 (Geoffrey Bay) would also increase to a large extent (i.e. increase of 3 to 5 mg/L above background of 11 mg/L), with the most substantial increase occurring during winter.

Based on comparisons of median TSS with QWQG, there is a potential for turbid plumes to migrate and impact Magnetic Island Coral communities (i.e. Site 4). Given the potential for impacts to these sensitive receptors, more detailed assessment using the McArthur *et al.* (2002) method was undertaken as described in the following sections.

Expected Case – McArthur *et al* (2002) Method

The 'expected case' scenario represents modelling of the entire dredge campaign using weather data recorded during winter 2010 and summer 2010 / 2011.

Based on the procedures identified from the McArthur *et al.* (2002) method (Section B4.4.2) to establish 'no change' limits for sensitive receptors, the 95th percentile TSS values have been calculated from the existing water quality data (Section B4.3). To be able to compare the 95th percentile values with the modelling outputs from the receiving water quality model (which provide an indication of excess TSS *above* ambient conditions), it is necessary to subtract the median ambient TSS from the 95th percentiles to give the site-specific 'no change threshold' concentrations presented in Table B.4.21.

Table B.4.21 Site Specific No Change Thresholds (mg/L)

Monitoring Site	95th percentile	Median (ambient)	Threshold (95% minus median ambient)*	Area description	Sensitive receptors
S2	44	9	35	Inner Central Cleveland Bay	Deepwater seagrass
S3	33	8	25	Outer Central Cleveland Bay	Deepwater seagrass
S4	41	11	30	Eastern Magnetic Island	Coral and seagrass
S5	54	8	46	Middle Reef	Coral and seagrass
S6	218	47	171	The Strand	Seagrass
S7	30	9	21	Southern Magnetic Island	Coral and seagrass
S8	76	5	71	Cape Pallarenda	Seagrass

Note: * Ambient TSS was subtracted from the 95th percentile since receiving water quality model results exclude ambient conditions

Detailed times series plots (for the period modelled in the receiving water quality model) were produced for five of the sensitive receptor locations (Sites 2 and 3 not included due to their location in the dredge footprint) and are presented in Figure B.4.5 to Figure B.4.14. These time series plots represent TSS levels above background during dredging of the Platypus and Sea channels during summer and winter, and include the site-specific McArthur *et al.* (2002) thresholds as per Table B.4.21 above.

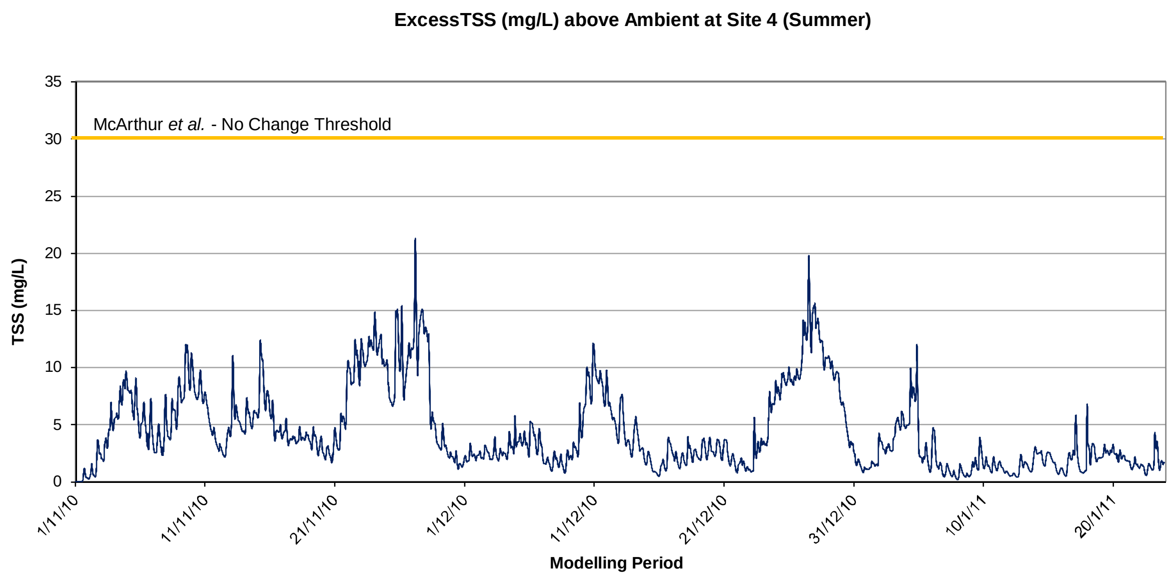


Figure B.4.5 Impacts from Dredging at Eastern Magnetic Island (Site 4) during Summer

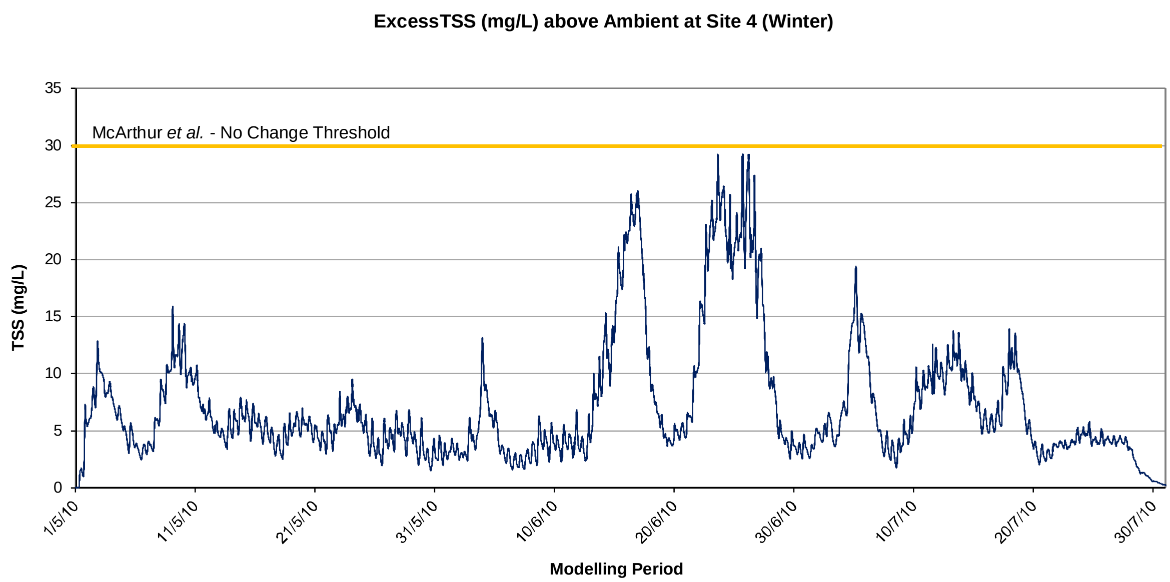


Figure B.4.6 Impacts from Dredging at Eastern Magnetic Island (Site 4) during Winter

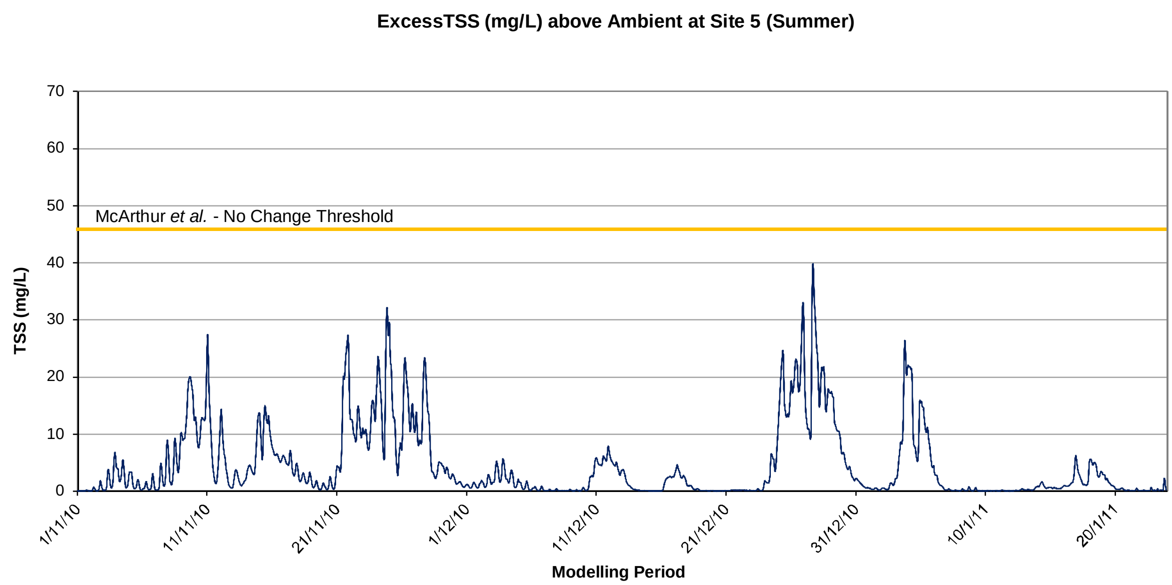


Figure B.4.7 Impacts from Dredging at Middle Reef (Site 5) during Summer

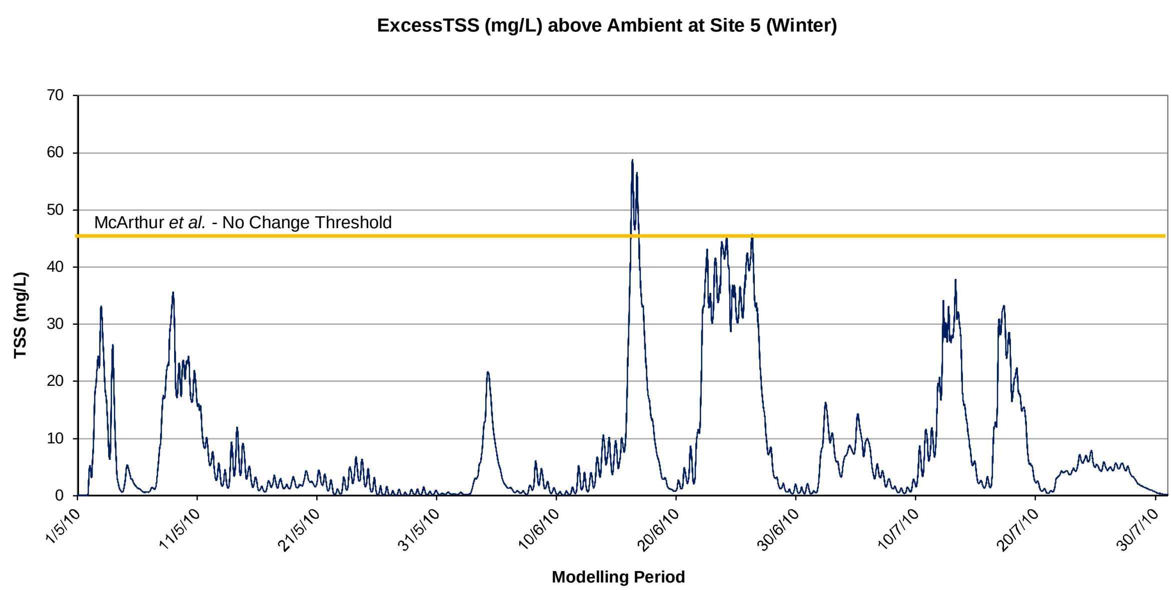


Figure B.4.8 Impacts from Dredging at Middle Reef (Site 5) during Winter

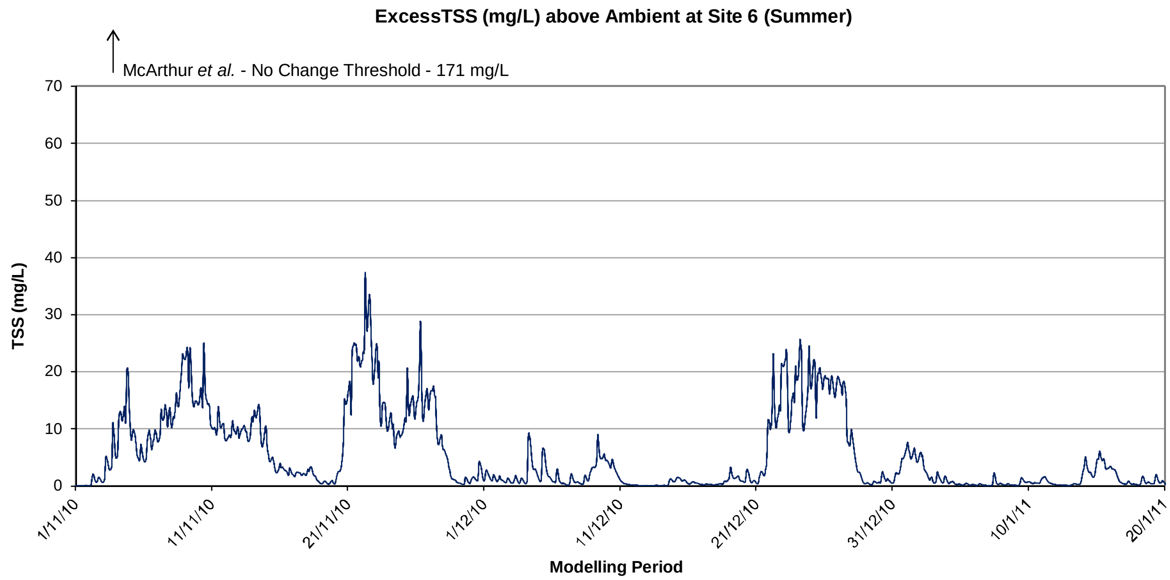


Figure B.4.9 Impacts from Dredging at The Strand (Site 6) during Summer

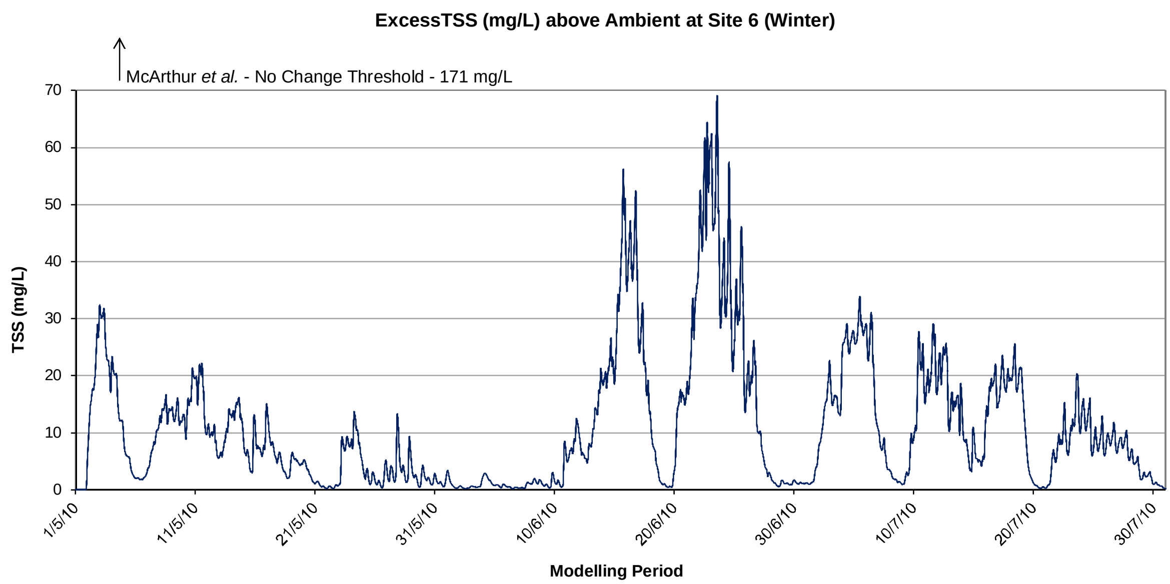


Figure B.4.10 Impacts from Dredging at The Strand (Site 6) during Winter

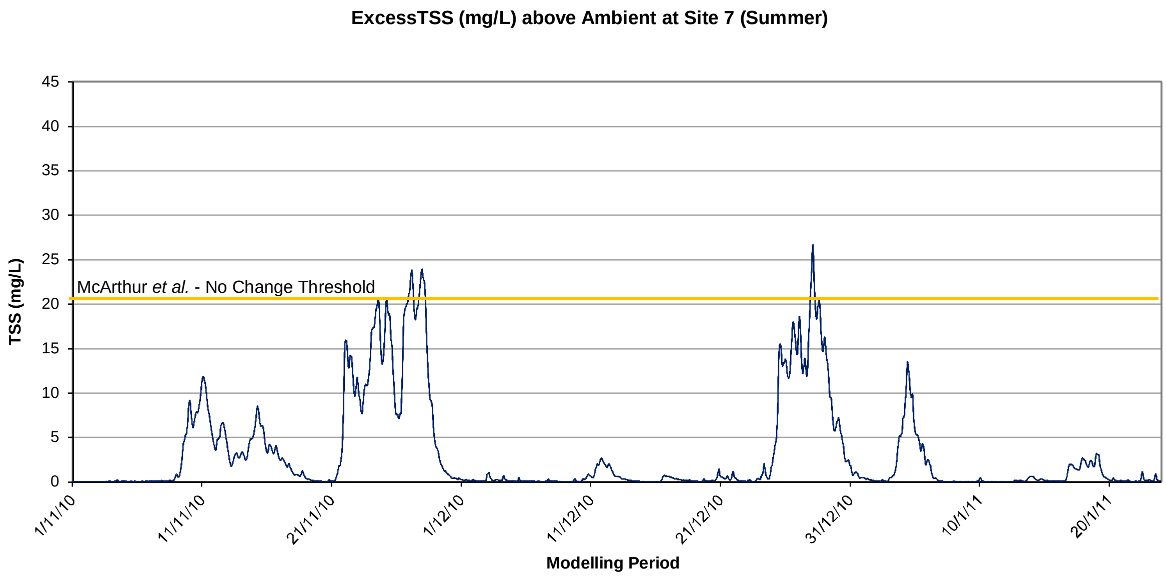


Figure B.4.11 Impacts from Dredging at Southern Magnetic Island (Site 7) during Summer

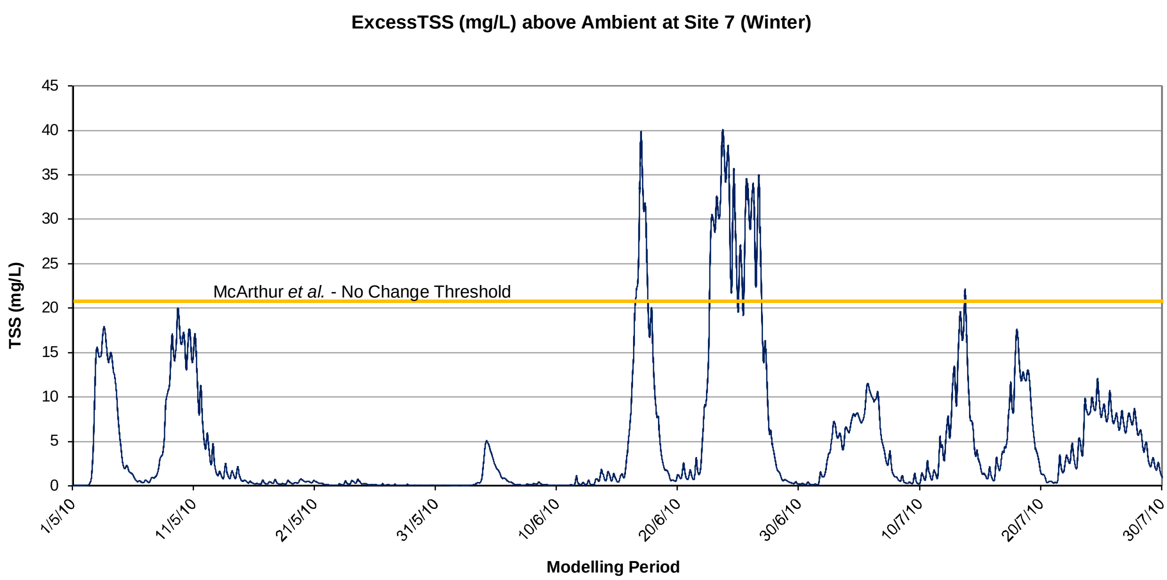


Figure B.4.12 Impacts from Dredging at Southern Magnetic Island (Site 7) during Winter

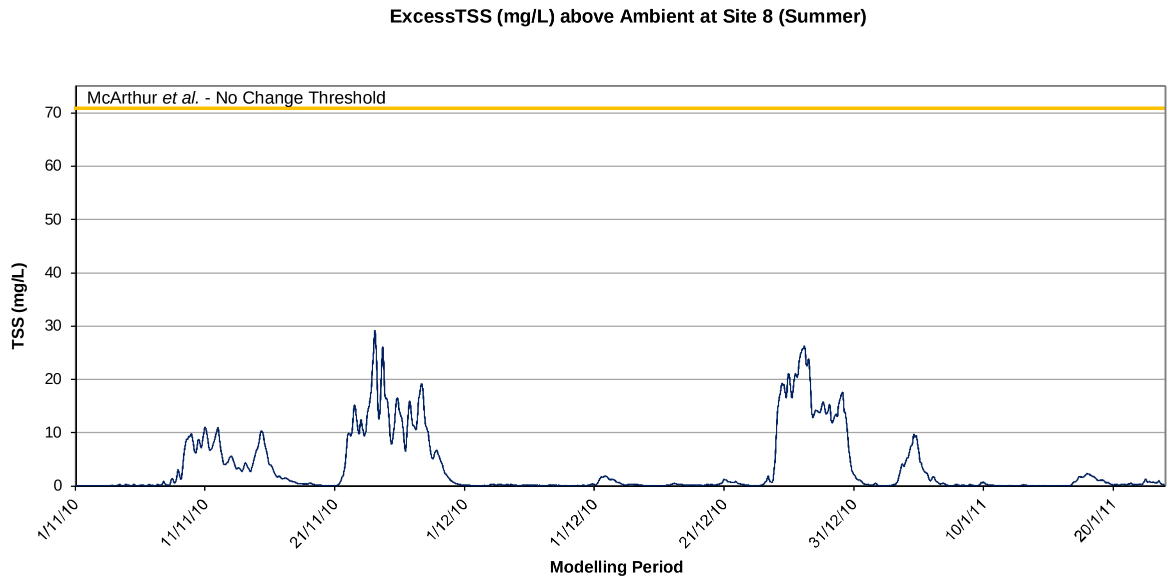


Figure B.4.13 Impacts from Dredging at Cape Pallarenda (Site 8) during Summer

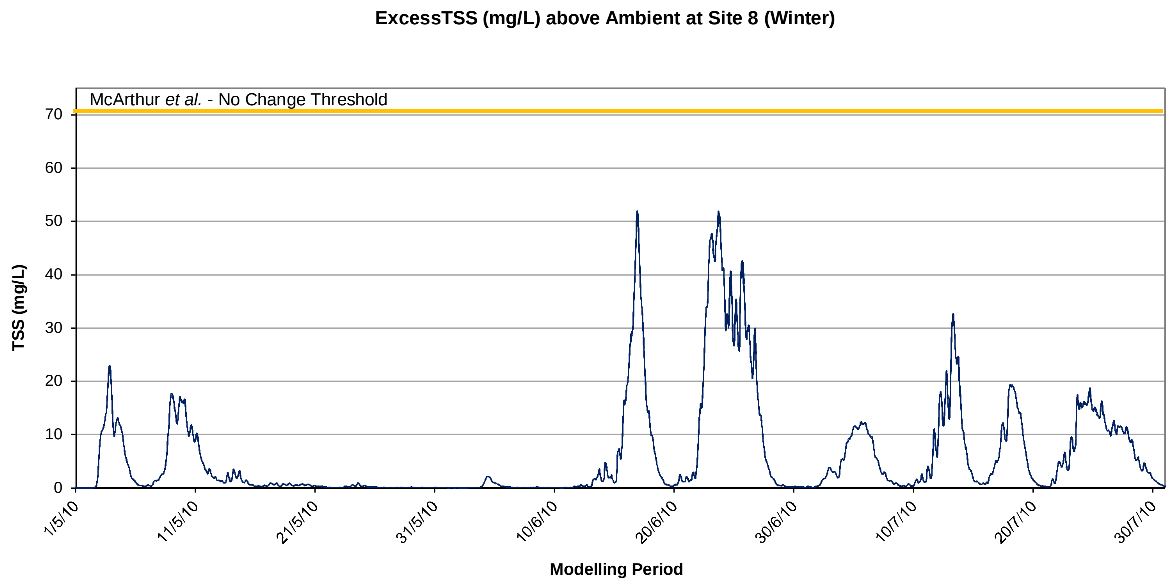


Figure B.4.14 Impacts from Dredging at Cape Pallarenda (Site 8) during Winter

As the McArthur *et al.* (2002) thresholds in Table B.4.21 are 95th percentile values, it is expected that up to 5% of the time the TSS will exceed these thresholds without any predicted impact. This can be seen in Figure B.4.5 to Figure B.4.14, where there are some peaks in TSS which exceed the threshold value. An impact is predicted when TSS exceeds the threshold for greater than 5% of the dredging period. Therefore, to confirm the spatial extent of predicted impacts, 5% exceedance contour plots of TSS during both summer and winter are provided in Figure B.4.15 to Figure B.4.16 respectively. When interpreting these figures, it is important to note that each monitoring site has a site-specific TSS threshold, and the contour intervals represent these site-specific threshold values. To assist with this interpretation, separate figures for each monitoring site based on the site-specific threshold are included in Appendix I3.

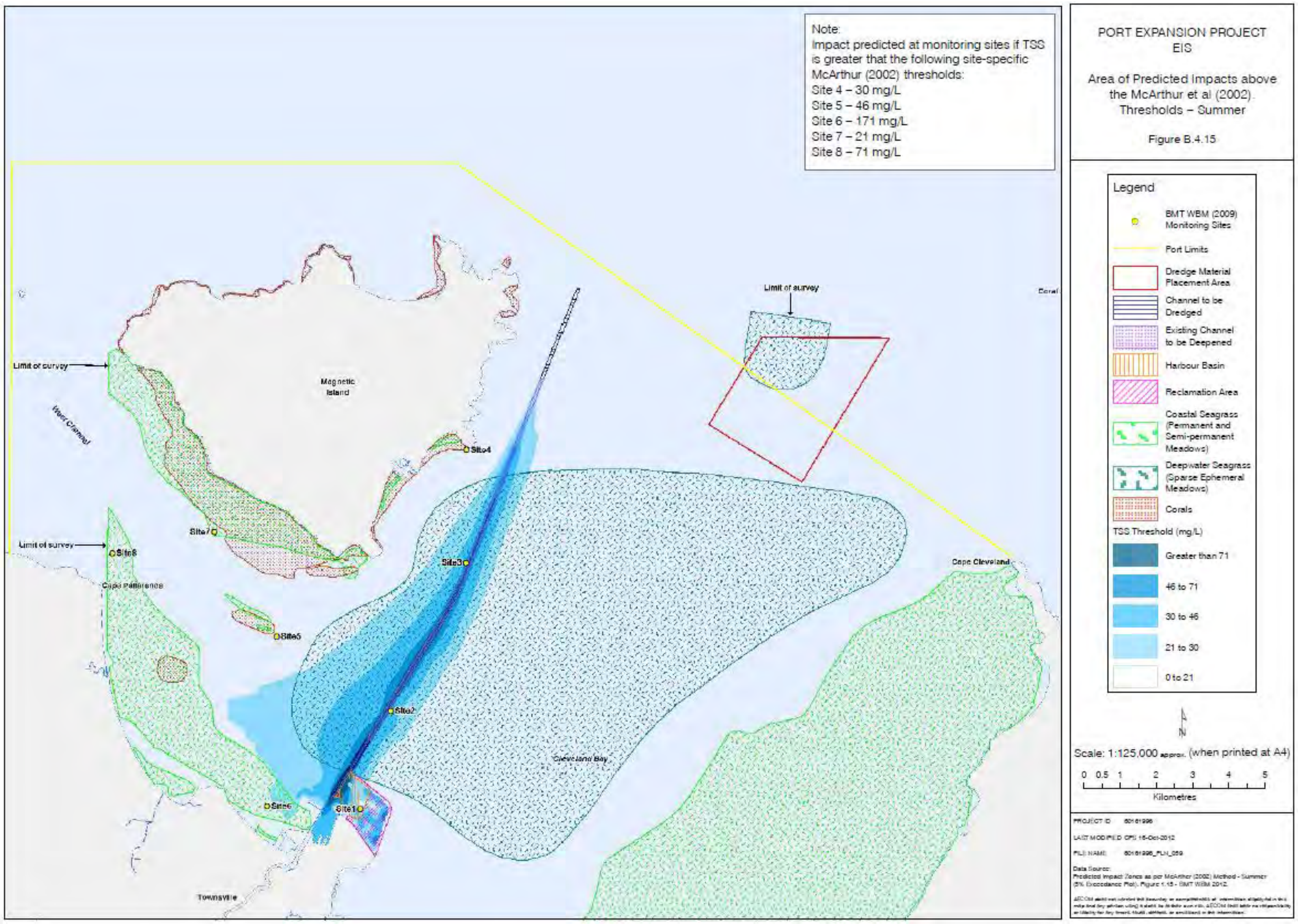


Figure B.4.15 Area of Predicted Impacts above the McArthur et al (2002). Thresholds – Summer

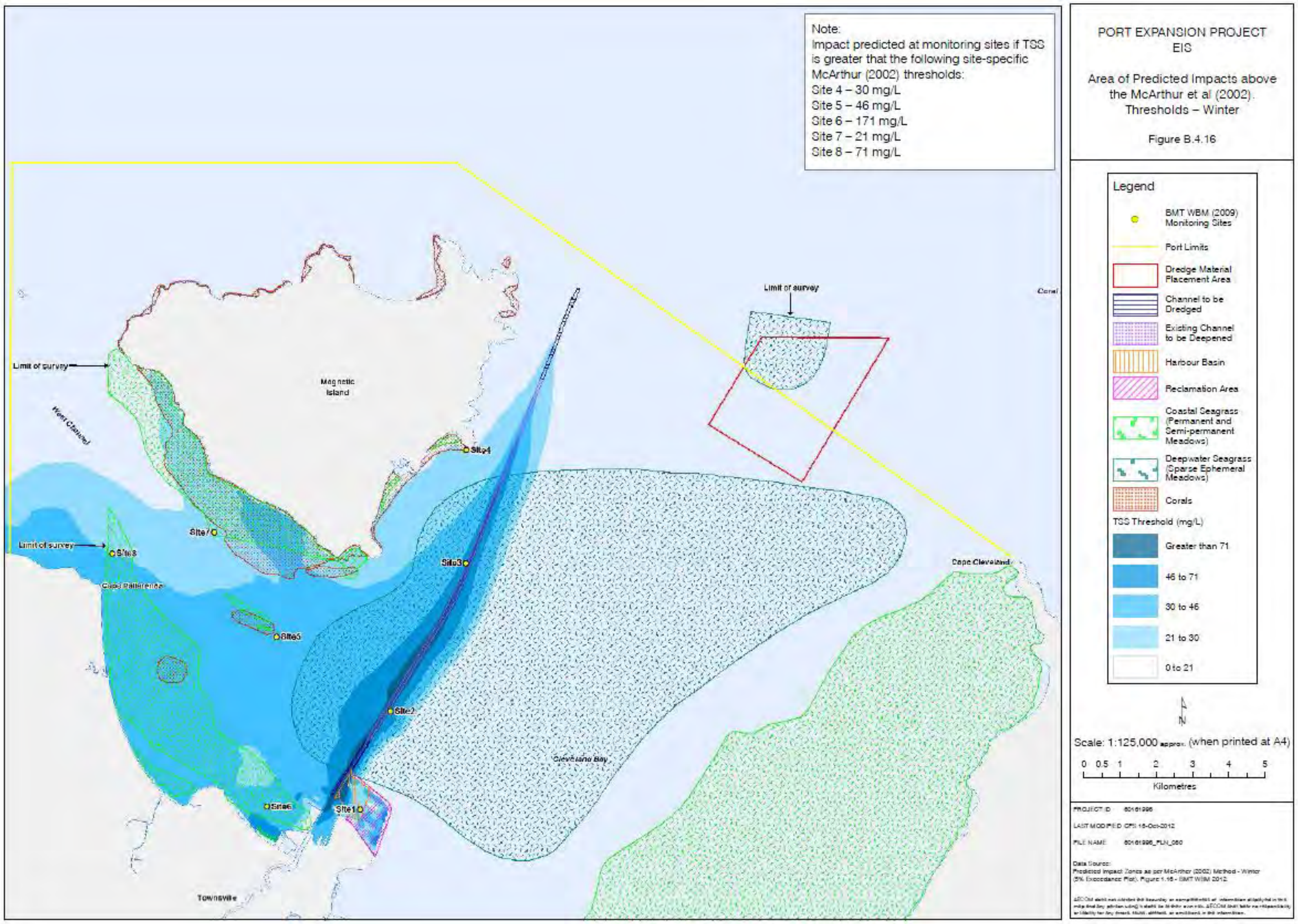


Figure B.4.16 Area of Predicted Impacts above the McArthur et al (2002). Thresholds – Winter

The time series plots presented in Figure B.4.5 to Figure B.4.14 (showing modelled TSS above background levels) indicate that most sites are characterised by peaks in TSS followed by periods of little to no excess TSS from dredge plumes. The exception to this is Site 4, which would be subjected to an almost constant period of excess TSS in the order of 3 to 5 mg/L above background, especially during winter. While the McArthur *et al.* (2002) threshold is not exceeded at Site 4, the consistent levels of TSS above background may still have some ecological implications (Refer to Chapter B6 - Marine Ecology for further details).

In regard to the contour plots in Figure B.4.15 to Figure B.4.16, modelling predicts that TSS concentrations generated by dredging activities (above background) will be greater during winter than in summer.

During winter (Figure B.4.16),it is predicted that reefs and seagrass from Geoffrey Bay (Site 4) on the east coast of Magnetic Island around to the southern coast of Magnetic Island would be periodically (i.e. 95th percentile) influenced by dredge plumes with a TSS of >21 mg/L. While the McArthur threshold for Geoffrey Bay (Site 4) is 30 mg/L (i.e. indicating impacts are not expected along the east coast), the McArthur threshold for southern Magnetic Island (Site 7) is 21 mg/L, indicating some impacts are expected at this location.

During summer (Figure B.4.15), it is predicted that the 95th percentile TSS concentrations (above background) are predicted to be <21 mg/L for all sensitive receptor locations, except a small area of seagrass at the Strand (Site 6). However, the McArthur threshold value for the Strand is 171 mg/L, indicating that excess TSS of around 21 mg/L would not be likely to result in adverse impacts at this location.

Other sensitive receptor locations, such as Middle Reef, the Strand and Cape Pallarenda, would be influenced by dredge plumes with 95th percentile TSS concentrations of 30 to 46 mg/L above background. However, the McArthur *et al.* (2002) thresholds for these three sites are 46 mg/L, 171 mg/L and 71 mg/L respectively, indicating impacts are not likely at these locations based on the McArthur *et al.* (2002) method.

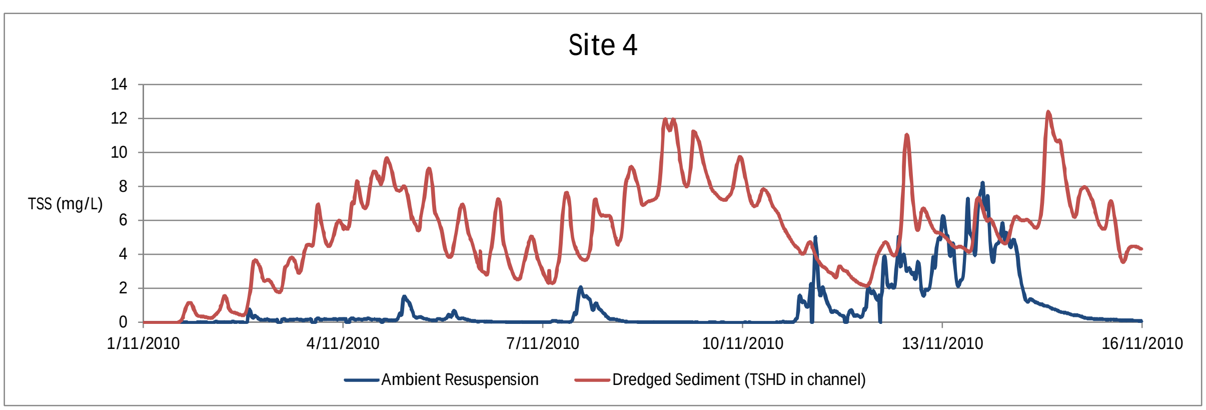
The predicted impacts from the 'expected case' are summarised later in this section.

Assessment of Natural Resuspension

The above sections presented the turbid plumes predicted by modelling of the capital dredging campaign in the Platypus and Sea channels. These predicted turbid plumes would consist of suspended sediment from the dredge plume and subsequent resuspension of dredged material during windy conditions. In addition to the suspended sediment from dredged material, there would also be a proportion of naturally occurring suspended sediment in the water column from natural resuspension during windy conditions.

To put the magnitude of modelled turbid plumes into some context at locations of sensitive receptors, natural resuspension was modelled for a time period when both calm and windy conditions occurred (i.e. November 2010). This enables a comparison of sediment from natural resuspension to dredged sediment at sensitive receptors.

Figure B.4.17 presents time series plots of natural resuspension versus dredged sediment, with natural resuspension shown as blue lines and dredged sediment shown as red lines.



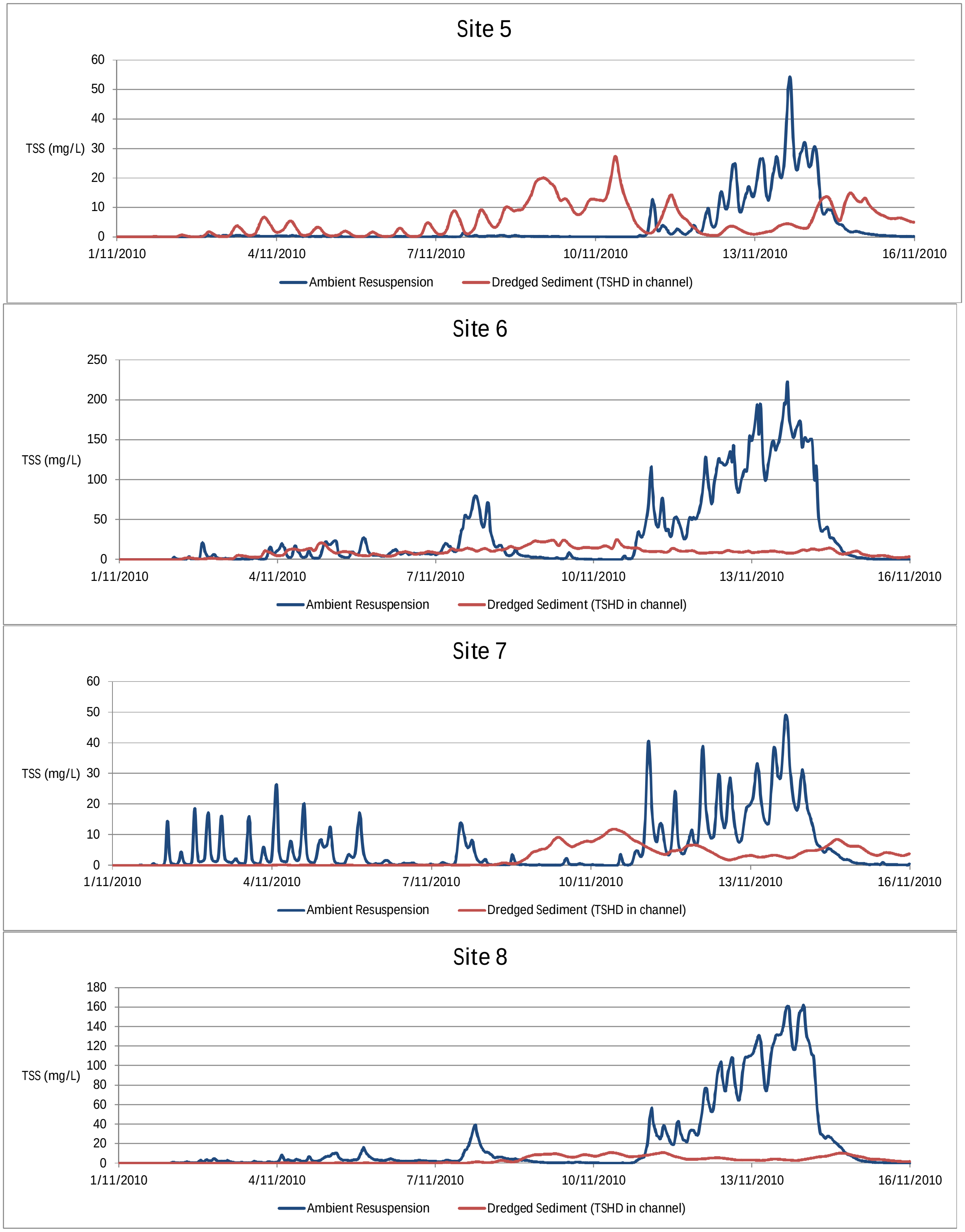


Figure B.4.17 Natural Resuspension vs. Dredged Sediment

The plots in Figure B.4.17 indicate that sediment from natural resuspension is the dominant source of sediment at Sites 6 (the Strand), 7 (Southern Magnetic Island) and 8 (Cape Pallarenda). Smaller events at Site 5 (Middle Reef) are dominated by dredged sediment, while the larger event towards the end of the period at Site 5 is dominated by natural resuspension. Sediment composition at Site 4 (Geoffrey Bay) is shown as being dominated by dredged sediment, with natural resuspension comprising a relatively small proportion.

Assessment using the McArthur *et al.* (2002) method discussed previously indicated that the east coast of Magnetic Island (around Site 4) would not exceed its McArthur *et al.* (2002) threshold value, and therefore not be impacted. However, the above plots indicate that Site 4 would experience noticeable levels of elevated dredged sediment when compared to natural resuspension during summer (i.e. modelling period in November 2010). Ecological implications of this are discussed further in Chapter B6 (Marine Ecology).

At other locations, such as Site 7 (which was shown previously to exceed its McArthur *et al.* (2002) threshold), impacts would be minimal relative to sediment from natural resuspension. A similar pattern would be expected to occur during winter.

Alternate Scenarios

The section above discusses the 'expected scenario' based on typical weather patterns. To indicate the effect that varying weather patterns may have on turbid plumes, two alternate scenarios were modelled, including:

- Worst case scenario.
- North-westerly wind scenario.

Worst Case Scenario

To provide an indication of potential impacts in a 'worst case' scenario as required by the EIS Guidelines, 1% exceedance plots were developed for both winter and summer. These 1% exceedance plots represent the excess TSS levels above background which occur for 1% of the time, otherwise referred to as 99th percentile TSS values.

The use of 1% exceedance plots to depict the worst case scenario instead of 5% exceedance plots used for the expected case assumes either one or both of the following:

- Sustained windy weather occurs for the duration of the dredging campaign.
- Higher than expected sediment loads are produced from the dredging works.

The 99th percentile TSS plots representing the worst case scenario for summer and winter are presented in Figure B.4.18 to Figure B.4.19 respectively. These figures indicate that in a worst case scenario, dredge plumes would extend further out through the Western Channel and to the east of Cape Pallarenda in winter. Nevertheless, southern Magnetic Island (Site 7) would be the only location which would exceed its McArthur (2002) site-specific threshold value (i.e. 21 mg/L). In summer, dredge plume extents would be less than winter, with the eastern coast of Magnetic Island not experiencing TSS greater than 21 mg/L. Again, Site 7 would be the only location to exceed its McArthur (2002) site-specific threshold value.

While the worst case has been presented in these figures, it is noted that this scenario is considered to be unlikely. This is due to the low probability of sustained volatile weather occurring throughout the dredging campaign, and of the dredge operating during these conditions. Furthermore, the 99th percentile value is almost the maximum value and is a highly conservative measure of plume concentrations.

The predicted impacts from the 'worst case scenario' are summarised later in this section.

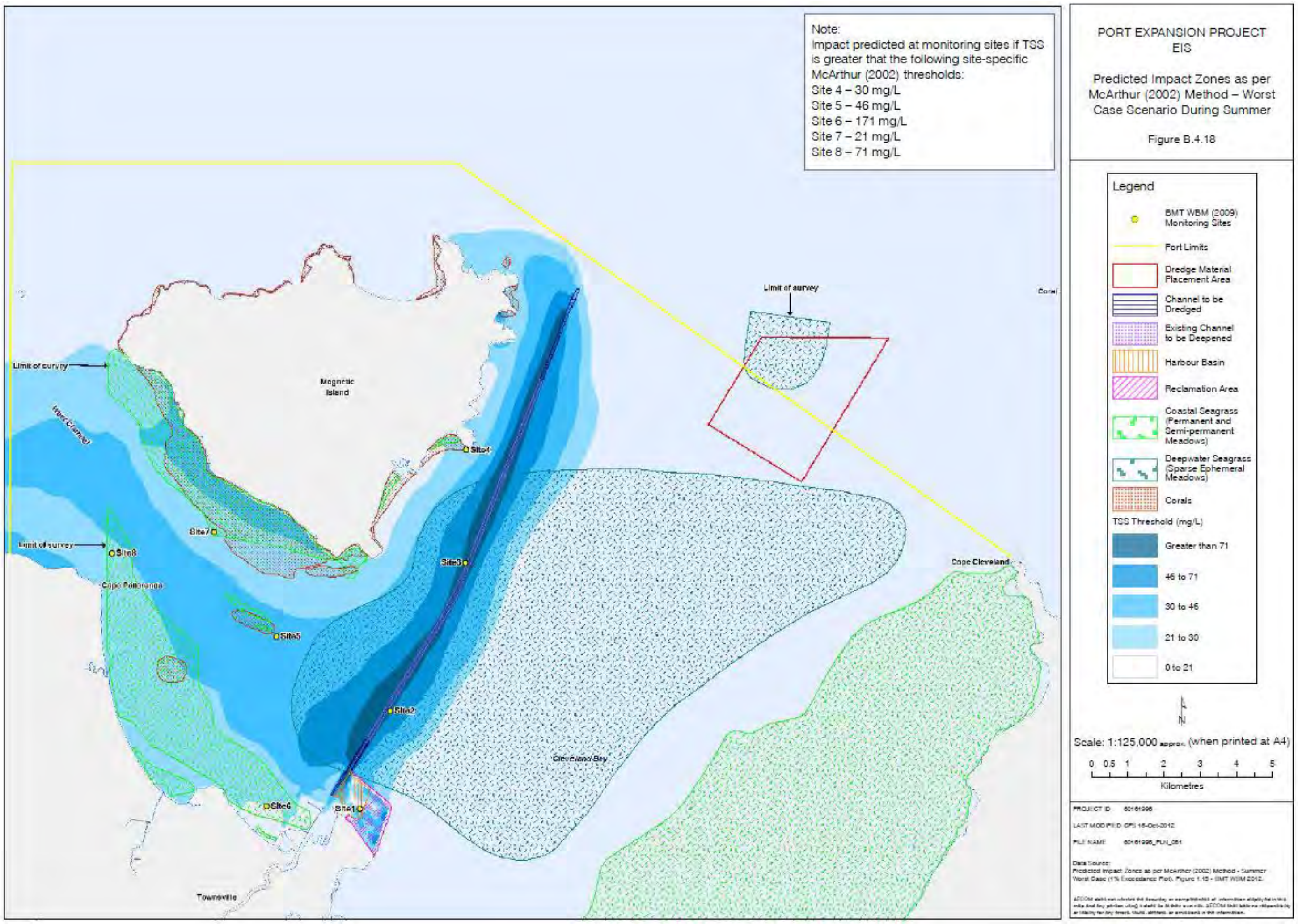


Figure B.4.18 Predicted Impact Zones as per McArthur (2002) Method – Worst Case Scenario during Summer

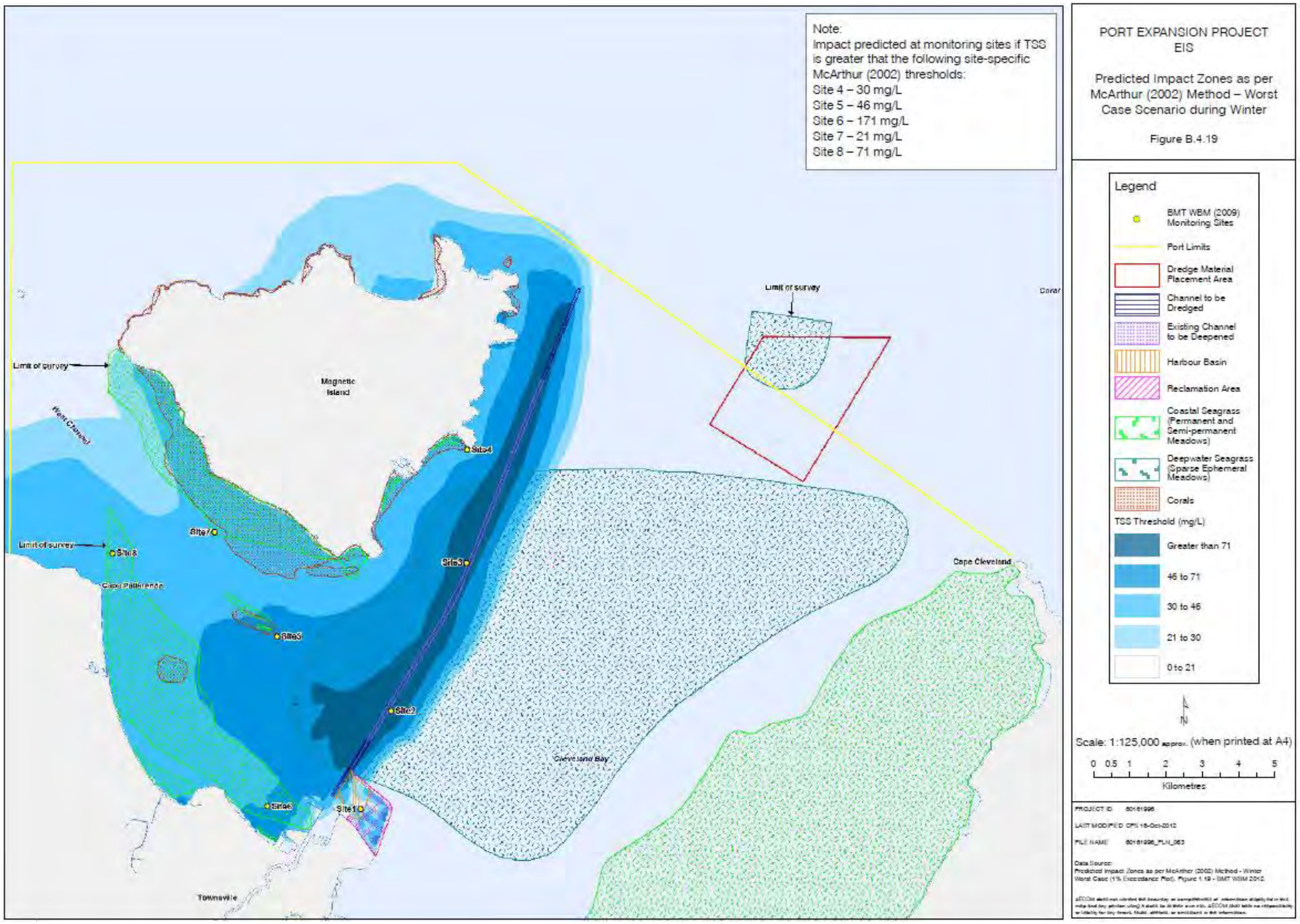


Figure B.4.19 Predicted Impact Zones as per McArthur (2002) Method – Worst Case Scenario during Winter

North-Westerly Wind Scenario

A sustained north-westerly wind scenario was also modelled to determine the extent of turbid plumes if winds were from a north-westerly direction for a sustained period of time. The purpose of modelling this scenario was to provide an indication whether the eastern near shore seagrass meadows of Cleveland Bay (Figure B.4.1) would be impacted if winds were predominately from the north-west during the dredging campaign.

The north-westerly wind case was run for two weeks using a wind boundary condition from early February 2010 (Figure B.4.20) for wind rose showing north-westerly winds). The results are presented in Figure B.4.21 as 95th percentile TSS above background, with TSS thresholds as per McArthur *et al.* (2002).

Figure B.4.21 indicates that if dredging were to occur during a sustained north-westerly wind, turbid dredge plumes would not impact upon the eastern near shore seagrass meadows. The north-westerly wind would have minimal effect on migration of the turbid plumes most likely due to the shielding effect provided by Magnetic Island in a north-easterly wind.

The predicted impacts from the ‘north-westerly wind scenario’ are summarised later in this section.

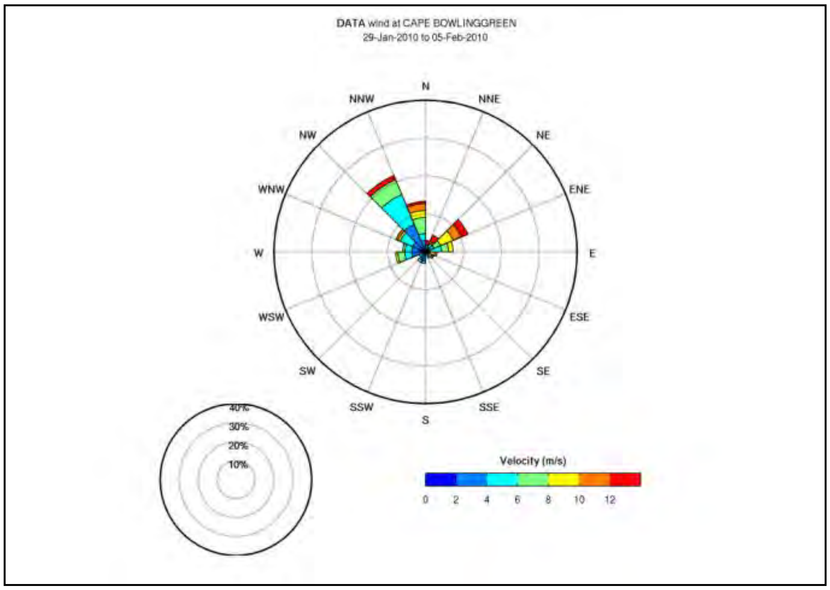


Figure B.4.20 Wind Rose of Modelled Period Showing Northerly Winds

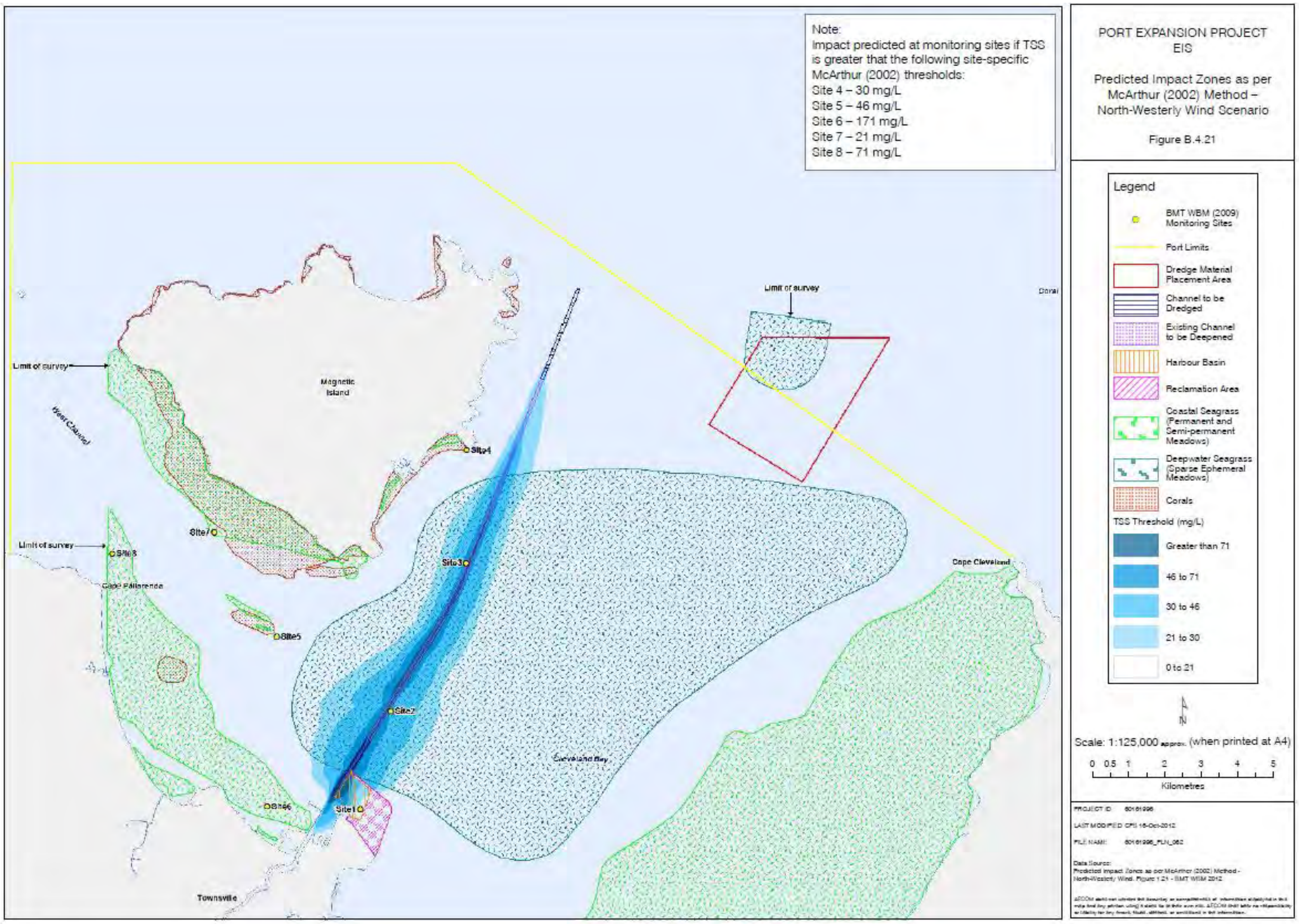


Figure B.4.21 Predicted Impact Zones as per McArthur (2002) Method – North-Westerly Wind Scenario

Summary of Predicted Impacts

The predicted impacts for each scenario can be summarised as follows:

- *Expected Case*

Based upon the high level assessment against the QWQG, median TSS levels along the east coast of Magnetic Island (Site 4) are expected to increase above the QWQG guideline value as a result of channel dredging. Furthermore, assessment of natural resuspension versus dredged sediment indicated that this area would receive a larger proportion of dredged sediment compared to natural resuspension. Additionally, time series plots also indicated that sustained excess TSS (3 to 5 mg/L) is expected along the east coast of Magnetic Island.

Using the McArthur *et al.* (2002) method, it was concluded that impacts are expected along the southern coast of Magnetic Island (Site 7) during winter.

While dredging is not expected to have long term impacts on water quality, the short term impacts to water quality may have longer term impacts to sensitive ecological receptors. This is discussed further in Chapter B6 (Marine Ecology).

Based on these assessments, '*Moderate'* impacts are expected due to potential impacts that could occur in the portion of the reef adjacent to Magnetic Island and seagrass meadows of southern Magnetic Island.

- *Worst Case*

Based upon the impact assessment of McArthur *et al*. (2002), it can be concluded that '*Moderate'* impacts are expected under a worst case scenario channel dredge campaign during both summer and winter. Under a worst case scenario, potential impact zones could extend along the eastern and southern coastlines of Magnetic Island and throughout the Western Channel and Cape Pallarenda.

- *North-Westerly Wind*

Based upon the impact assessment of McArthur *et al*. (2002), it can be concluded that '*Moderate'* impacts are expected from the channel dredge campaign during a sustained north-westerly wind scenario. Predicted impacts would be similar to the expected case scenario during summer.

Mitigation Measures

A number of mitigation measures will be employed to reduce potential suspended sediment impacts generated by channel dredging works, as follows:

- Ensure the dredge operates in the approved dredge footprint.
- Ensure the dredge avoids excessive overflowing (i.e. dredging must not continue after a full hopper load has been achieved).
- Dredge hopper compartment is to be kept water tight during dredging activities, except disposal.
- Ensure the top of overflow valves are not lowered during the transport component of the dredging cycle (i.e. dredging area to DMPA).
- Loading to be to a hopper level, to ensure supernatant water is not lost over the hopper coaming during transport to the DMPA.
- No high pressure jets to be used on dragheads to loosen materials.
- The dredge is to be fitted with a 'green valve' in order to reduce the areal extent of turbidity plumes generated by dredge operation. The green valve ensures that overflow from the dredge vessel is released under the keel of the vessel rather than the water surface.
- Ensure dredge material placement at the DMPA occurs evenly across the breadth of the predetermined sub-section (cell) of the DMPA, with the TSHD steaming at low speed or stationary to avoid causation of larger plumes.
- Washing of the hopper compartment and pumping out of the hopper must not take place outside the predetermined sub-section of the DMPA.

- A reactive water quality monitoring program will be implemented during the dredge campaign to monitor water quality at locations of sensitive receptors (including the same monitoring locations used in the impact assessment section). This strategy will be incorporated to ensure compliance with guidelines (Chapter C2.1 Dredge Management Plan) for dredging and construction works. Monitoring data would be downloaded remotely and the duration and frequency assessed against threshold triggers, with appropriate management actions implemented if threshold triggers are exceeded.
- The above monitoring will be undertaken concurrently with reactive ecological monitoring as outlined in Chapter B6 (Marine Ecology).
- Threshold triggers for the reactive water quality monitoring program are to be developed once further monitoring data becomes available (i.e. 12 months of data being captured along Magnetic Island, the Strand and Cape Pallarenda).

The reactive water quality monitoring program will be used in ‘real time’ to guide the dredging campaign and to monitor the effectiveness of the above mitigation measures. If trigger levels are exceeded, the dredge contractor will be responsible for taking actions to ensure impacts are avoided at sensitive receptors. Some of these actions could include the following (refer to Chapter C2.1 Dredge Management Plan for further details):

- Dredging certain sections of the Platypus and Sea channels only during flood or ebb tidal currents.
- Movement of the dredge to other areas.
- Dredging on high tides.
- Limitation of overflow.

Modelling of the effectiveness of implementing flood / ebb tide dredging (i.e. first bullet point above) has been undertaken and is presented in the Modelling Technical Report. In general, such an approach would provide some improvement to water quality, particularly in the southern section of the Sea Channel which is closest to sensitive receptors at Geoffrey Bay and Nelly Bay.

Through the implementation of mitigation measures, the Port Expansion Project is not expected to have significant impacts to water quality in Cleveland Bay.

Potential Impact: *Mobilisation of nutrients into the water column from dredging of marine sediments*

Results of sediment porewater and elutriate analyses for nutrients were previously discussed. Further to the porewater sample results, these results were conservatively incorporated (i.e. at maximum porewater concentration) into the receiving water quality model dredging scenarios for the Platypus and Sea channels to produce plots of nutrient plumes. Results from the receiving water quality model enable a comparative analysis to the QWQG annual median concentrations (Table B.4.2).

From inspection of the receiving water quality model output, nutrient plumes were not able to be detected in the nutrient plots above a concentration of 0.00001 mg/L. The highest concentration (0.00001 mg/L) was found in the Channel areas (i.e. at the immediate dredging location). To put this in context, the guideline values from the QWQG for total nitrogen (TN) and total phosphorus (TP) are 0.2 mg/L and 0.02 mg/L respectively. This indicates that even in the Channel areas, nutrient concentrations in the water column are expected to be 3 to 4 orders of magnitude lower than the QWQG guideline values.

It can be seen that nutrient levels are well below the compliance levels to effect or impact upon ambient conditions. These results confirm the PEP construction works present a ‘*negligible*’ risk to the environmental values of Cleveland Bay in terms of nutrients, even at the immediate dredge location.

Mitigation Measures

As demonstrated in the ‘Potential Impacts’ section above, nutrient impacts from sediment pore water are negligible and no mitigation measures are required.

Potential Impact: *Mobilisation of metals into the water column from dredging of marine sediments*

Similar to the potential impacts from mobilisation of nutrients discussed above, mobilisation of metals from dredging of marine sediments is also a potential impact. While sediment quality is discussed further in Chapter B5 (Marine Sediment Quality), the mobilisation of metals from dredging can be assessed using elutriate testing results of sediments, which is discussed in the following.

Previous studies have analysed marine sediments in the vicinity of the PEP to determine suitability of dredged sediments for ocean disposal. One such study undertaken by URS (2008) investigated metal concentrations in the inner harbour area and Berth 11 pocket. As part of this study, elutriate testing was undertaken on metals which were found in concentrations above the National Ocean Disposal Guidelines (NODG) Screening Levels in the inner harbour, which included copper, lead, nickel and zinc. No metals were found above NOGD Screening Levels at Berth 11.

Elutriate testing assesses the behaviour of contaminants in sediment under laboratory conditions replicating sediment dispersion in the water column during dredging and placement at the DMPA. Elutriate tests assess whether contaminant concentrations in the water column are likely to exceed relevant ANZECC/ARMCANZ (2000) water quality guidelines.

The elutriate test results reported in URS (2008) involved an initial dilution of 1:4 as part of the laboratory methodology. These results were further diluted by a factor of 43 to approximate the effects of mixing and dilution of contaminants released from sediment into the water column during dredging or disposal. The highest elutriate concentrations recorded in the inner harbour are presented in Table B.4.22, and represent a 1:172 dilution.

Table B.4.22 Elutriate Metal Concentrations (µg/L) in the Inner Harbour (URS, 2008)

Metal	Maximum Elutriate Concentration (1:172 Dilution)	ANZECC/ARMCANZ (2000) Trigger Level
Copper (µg/L)	0.56	1.3
Lead (µg/L)	0.01	4.4
Nickel (µg/L)	0.37	70
Zinc (µg/L)	3.96	15

The results in Table B.4.22 are considered conservative in terms of the PEP project, as they represent the highest recorded concentrations from sediments in the inner harbour which typically has higher concentrations of metals in sediments compared to the outer harbour area (Chapter B5 Marine Sediment Quality). Nevertheless, the concentrations are well below the ANZECC/ARMCANZ (2000) trigger levels. Assuming that elutriate testing results for the inner harbour are a conservative representation of the PEP, the mobilisation of metals present a '*negligible*' risk to the environmental values of Cleveland Bay.

Mitigation Measures

As demonstrated in the 'Potential Impacts' section above, potential impacts from metals in sediment pore water are negligible. Nevertheless, the development and implementation of a Sampling and Analysis Plan (Chapter B5 – Marine Sediment Quality) prior to commencement of works will identify any potential impacts further.

B.4.4.3.3 Dredged Material Placement

As noted in Table B.4.17, the dredged material from capital dredging of the initial layer of the outer harbour Area and the capital dredging of the Platypus and Sea channels will be placed at the offshore dredged material placement area (DMPA) via a bottom discharge process (i.e. dredged material is offloaded through the bottom of the vessel) and has the potential to generate turbid plumes. The predicted impacts to water quality are detailed in Table B.4.17 with Scenario 3 (outer harbour dredging) and Scenarios 4a and 4b (Platypus and Sea Channel dredging in summer and winter) representing the discrete construction processes and dredged material placement required.

The existing offshore DMPA is located approximately 6 to 7 km east of Magnetic Island on the limits of the Port of Townsville exclusion area. The DMPA has been in use since 1972 for the offshore placement of capital and maintenance dredged material.

Potential Impact: *Generation and migration of turbid plumes during dredged material placement*

Impacts associated with mobilisation of sediment particles into the water column during disposal are similar to those previously mentioned in that there is a potential for increased suspended sediment levels. The main difference being that the impacts are related to how the dredged material is placed and the behaviour of the dredged material as it sinks to the seabed. Upon release, most dredged material will sink directly to the seabed or form a dense layer of suspended sediment just above it. Generally, this material will settle within hours or days, although if fine and of high water content, it is liable to be resuspended and could be dispersed by currents or waves (DEWHA, 2009).

The DMPA is located adjacent to the following significant sensitive ecological receptors:

- Seagrass meadows along the western coast of Magnetic Island.
- Coral communities along the western and northern coast of Magnetic Island.
- Seagrass meadows in the south-east of Cleveland Bay (i.e. Eastern near shore seagrass meadows).

There is also a designated General Use Great Barrier Reef Marine Park zone directly to the north of the DMPA.

Receiving water quality model results presented for Scenarios 3, 4a, and 4b as plots in Chapter B3 (Coastal Processes) indicate that turbid plumes would extend out approximately 2 km from the DMPA, with a TSS concentration of between 5 to 10 mg/L above background. From the plots, the turbid plume would largely be contained in the port exclusion area; however it would approach the border of the Great Barrier Reef Marine Park to the north.

Larcombe and Ridd (1994) reported a range of dredge-related effects in outer Cleveland Bay associated with dredged material placement from capital dredging. In particular, the disposal event generated near-bed sediment plumes that were up to 10 times greater than recorded under ambient (non-dredging) conditions. These plumes lasted for periods of hours up to days. Despite these localised impacts, Larcombe and Ridd (1994) concluded that there was confidence that no TSS concentration outside the range of natural variation occurred at Magnetic Island bay sites as a direct result of dredging and placement activities, and that the TSS concentrations appeared to lie in the normal variation of seagrass sites in South-east Cleveland Bay and the coral systems at Middle Reef.

Resuspension of dredged material placed at the DMPA may occur during periods of high winds. A portion of this resuspended material has been shown to reach the east coast of Magnetic Island (Chapter B3 - Coastal Processes). During these windy periods there is also a significant amount of natural resuspension of sediment occurring throughout Cleveland Bay. Consequently, the proportion of resuspended dredged material likely to migrate to Magnetic Island relative to natural sediment from the rest of Cleveland Bay is very minimal (Chapter B3 - Coastal Processes).

Based upon the potential for turbid plumes generated at the DMPA to be relatively localised (i.e. likely to be contained within 2 km of the DMPA), dredged material placement presents a '*minor*' risk.

Mitigation Measures

When dredged material is placed at the DMPA, the following mitigation measures will be implemented to reduce the risk of generating turbid sediment plumes at the DMPA:

- Dredge operators will be required to only dispose of dredged material in the nominated DMPA. This will ensure that any detrimental impacts which may arise are confined to a known area, with the possible exception of fine particles that have a slower settling rate and may disperse beyond the DMPA, depending on the prevalent current and sea conditions at the time of dispersal.
- The method used to dispose of dredged material at the DMPA will be bottom discharge - where dredged material is disposed of below the waterline through the bottom of the vessel.
- Submerged diffusers may also be used to reduce water column impacts as they release the dredged material lower in the water column and reduce the velocity of discharge.
- Material is to be placed in the predetermined sub-section (cell) of the DMPA in accordance with the placement strategy (Chapter A1).
- Implement a reactive water quality monitoring program: This strategy will ensure compliance with proposed guidelines for dredging and construction works. The monitoring program is to be developed in accordance with the Long Term Dredging and Disposal Management Plan, and commenced at the beginning of the dredging campaign. Monitoring data would be downloaded remotely and the duration and frequency assessed against threshold triggers, with appropriate management actions implemented if threshold triggers are exceeded.

Potential Impact: *Mobilisation of contaminants/nutrients into the water column from placement of marine sediments*

The potential impact from mobilisation of contaminants/nutrients at the offshore DMPA will be similar to that for the Channel dredging works.

Results of sediment porewater and elutriate analyses (discussed previously) indicate that concentrations of nutrients released into the water column from dredged material placement would be well below QWQG guideline values. Furthermore, elutriate testing of metals in sediments undertaken in previous studies (URS, 2008) indicate that metals mobilised into the water column from dredging works would be below ANZECC/ARMCANZ (2000) trigger levels. Consequently, mobilisation of contaminants/nutrients from placement of dredged material at the DMPA presents a '*negligible*' risk. Therefore, no mitigation measures are required.

B.4.4.3.4 Land Reclamation

The land reclamation (Table B.4.17) involves the fluidisation of seabed materials to a slurry to enable hydraulic placement. The bunded area (reclamation) receiving the discharged dredged material will settle out the sediments and fines into the reclamation area and will result in a supernatant tailwater that will be discharged back to Cleveland Bay near the mouth of the Ross River.

The following assumptions were made in the modelling of the tailwater discharge with respect to assessing the impacts upon water quality in Cleveland Bay:

- Volume of tailwater to be discharged is 0.45 m^3/s of which 0.26 m^3/s is water (based on discharge rate of cutter suction dredge).
- The fill material in the dredge is fluidised with water from Cleveland Bay.
- An assumed conservative TSS of tailwater = 100 mg/L.
- The rock revetment wall surrounding the bunded area is lined appropriately to ensure it is non-permeable.
- The tailwater is assumed to be fully mixed.
- Stormwater runoff from adjoining areas will be directed away from the tailwater ponds, and have sufficient freeboard to accommodate rainfall on the surface of the ponds.

The tailwater TSS assumption (i.e. 100 mg/L) is generally supported by the 80th percentile value (i.e. 110 mg/L) from Dredeco (1996) which undertook monitoring of the tailwater discharge during the previous eastern reclamation at the Port. Monitoring results are provided in Table B.4.23.

Table B.4.23 TSS Tailwater Discharge TSS (mg/L) Results (1996)

Dredeco 1996 Tailwater Sampling Results						
Parameter	QWQG Guideline	Median	Percentile			
			80th	90th	95th	99th
TSS (mg/L)	15	48	110	150	170	335

Turbidity monitoring results from recent monitoring (1 Dec 2010 to 12 Jan 2011) undertaken by GHD as part of the Marine Precinct construction are provided in Table B.4.23. This indicates the extent by which the turbidity of tailwater discharge exceeded the QWQG guideline value.

Table B.4.24 Marine Precinct Tailwater Decant Turbidity (NTU) Results (1/12/10 to 12/112)

Turbidity (NTU)						
Location	QWQG Guideline	Median	Percentile			
			80th	90th	95th	99th
Northern Tailwater Decant	6	70	100	116	171	305
Southern Tailwater Decant	6	78	109	169	320	544

Increases in suspended sediment levels from the tailwater discharged into Cleveland Bay and the Ross River has the potential to adversely affect water quality.

It is noted that the tailwater ponds are designed to ensure that stormwater runoff from adjoining areas is directed away from the ponds. This will ensure that stormwater from large rainfall events does not affect the treatment capacity of the ponds, or cause uncontrolled release of turbid tailwater from the discharge point. Direct rainfall on the surface of the ponds has been accommodated in the design by allowing sufficient freeboard (i.e. up to 1 m).

Potential Impact: *Generation and migration of turbid plumes from tailwater release*

The relevant plume modelling results for the tailwater discharge is combined with the capital dredging works for the outer harbour (i.e. scenario 3). Based on the time series plots (Appendix H1 - Modelling Technical Report), the screening assessment using annual median concentrations (Tables B4.19 and B4.20), and comparisons with McArthur *et al*. (2002) (Appendix I2), *'negligible to minor'* impacts are expected in the immediate vicinity of the tailwater discharge.

Mitigation Measures

In accounting for the potential sources of contamination, the design of the reclamation tailwater ponds has focused upon reasonable and practical measures to manage the fine particulate matter in the tailwater. The management measures include:

- Any contaminated material (i.e. containing elevated levels of TBT) identified through the SAP will be placed onshore in a dedicated dredge spoil pond not connected to the tailwater ponds. This material is to be appropriately treated and disposed of in accordance with guidelines relating to the assessment and management of contaminated land in Queensland (EPA, 1998). Refer to Chapter B5 (Marine Sediment Quality) for further details.
- Cells to be established in a manner that maximises settlement of sediments and reduces further erosion and mobilisation of sediments.
- Implement a tailwater quality monitoring program as per tailwater management in Chapter C2.1 (Dredge Management Plan) to monitor TSS/turbidity of tailwater prior to discharge. This strategy will ensure compliance with proposed guidelines for tailwater management. Monitoring data would be assessed against threshold triggers, with appropriate management actions implemented if threshold triggers are exceeded.

Potential Impact: *Discharge of acidic tailwater from ASS in reclamation ponds*

As discussed in detail in the acid sulfate soil (ASS) section of Chapter B1 (Land), there is the possibility that potential acid sulfate soils (PASS) may be present in dredged material. While placement of this PASS at sea presents a minimal risk due to limited exposure to air, if this material is placed in the reclamation area there is the potential for the PASS to become actual acid sulfate soil (AASS) upon oxidisation. If this were to occur and is not managed appropriately, tailwater could become acidic which may adversely impact upon receiving waters and sensitive ecological receptors in the vicinity of the tailwater release.

Based on the impact assessment of ASS in Chapter B1 (Land), '*minor*' impacts are expected in regard to discharge of acidic water from ASS in the reclamation ponds.

Mitigation Measures

When dredged material is placed in the reclamation area, the following mitigation measures will be implemented to reduce the risk of generating acidic water due to ASS:

- ASS is to be managed in accordance with the ASS Management Plan (Part C of this EIS).
- Implement a tailwater quality monitoring program as per tailwater management in Chapter C2.1 (Dredge Management Plan) to monitor pH of tailwater prior to discharge. This strategy will ensure compliance with proposed guidelines for tailwater management. Monitoring data would be assessed against threshold triggers, with appropriate management actions implemented if threshold triggers are exceeded.

B.4.4.3.5 Constructions Works – General Considerations

Potential Impact**:** *Fuel/oil (and other contaminants) from dredge equipment entering water*

Due to the necessity to use dredging plant and equipment for construction of the outer harbour area, there is the potential that fuel/ oil spills and other contaminants may pollute the marine waters of

Cleveland Bay if inappropriately managed and impact upon both the aquatic ecology and recreation and aesthetic values of the Bay.

Dredge operators must, by law, comply with established fuel/oil storage and handling standards and protocols to reduce the risk of incidents. Appropriate operational procedures are included in the Dredge Management Plan (Chapter C2.1 - Dredge Management Plan) which set outs management measures to ensure that the risk of fuel/oil spills and contaminants are minimised. Nevertheless, the potential for fuel/oil spills presents a 'minor' impact.

Mitigation Measures

Standard operational procedures are to be implemented to reduce the risk of fuel/oil spills and other contaminants entering the marine waters, including:

- Development of a Dredge Management Plan which includes management measures to be followed by dredge staff. This document is to be kept onboard dredge equipment and readily accessible to dredge staff.
- A hydrocarbon spill kit is to be located on the dredge and transport barges. This spill kit is to contain such items as absorbent material for spills on deck and also floating booms to contain hydrocarbon slicks if spills manage to enter the water. This spill kit is to be maintained regularly to ensure contents are fully stocked and in good condition.
- All fuel and chemical supplies on the dredge and transport barges are to be stored in bunded areas as per the requirements of *AS1940:2004 - The storage and handling of flammable and combustible liquids 2004.*

Potential accidental discharges of contaminants during construction and operation of the Project will be fully documented in the Construction and Operations Management Plans. Release of contaminants from marine structure and vessels, including anti-foulant coatings will be managed as specified in the Operations Management Plan.

B.4.4.4 Operational Impacts

The operational phase of the PEP is expected to be similar to existing operations of the current port. Three main activities will have the potential to impact upon water quality as follows:

1. Operation of the new business area from the port reclamation area and the new berths.
2. Shipping operations and movement.
3. Maintenance dredging to ensure the channel, swing basins and berths are maintained at the required depths.

Potential impacts on the marine environment associated with land based activities and stormwater runoff from the new business and berths areas are discussed in Chapter B2 (Water Resources), while potential operational impacts and mitigation measures directly relating to marine waters is summarised in Table B.4.25 at the end of this section.

B.4.4.4.1 Operational areas of the PEP

Materials which are handled and stored within the operational business areas and berths associated with the PEP (e.g. hydrocarbons) could potentially become marine water contaminants if uncontrolled releases occur (e.g. during extreme weather events). While the operation of these business areas and berths would be controlled by environmental licences held by operators, there is the potential for release of contaminants as outlined below.

Potential Impact: *Release of contaminants from operational areas of PEP*

Under normal operating conditions, all contaminants handled and stored in the operational areas will be adequately managed and contained in accordance with standard operational plans. However, if not managed appropriately, or if extreme weather events occur, the operation of business areas and berths may result in the release of contaminants from:

- Hydrocarbon spills.
- Airborne contaminants from exposed materials (e.g. bulk product) entering the water column.

- Solid waste such as packaging materials.

As discussed in Chapter B8 (Climate & Natural Disaster Risks), climate change may potentially result in an increased frequency of severe tropical cyclones in the region, with an associated increase in extreme wave climate and storm surge water levels. This may lead to overtopping of marine structures and inundation of the PEP (without adequate mitigation). This in turn could result in the uncontrolled release of contaminants, stored in the operational areas and berths, into the marine environment. Mitigation measures to address this potential impact are discussed in Chapter B8 (Climate & Natural Disaster Risks).

Cyclone management is part of the overall management of the Townsville Port. All contractors and operators are required to have a cyclone management plan that detail actions for cyclone season generally and also specific controls if risk of cyclone is expected to hit (or be within vicinity of) Townsville. All operational areas are required to have appropriate tie downs and controls for their sites during both construction and operation. Port of Townsville has a whole of port cyclone plan that covers the entire port, while MSQ has cyclone plans and contingency for shipping management and evacuation.

The potential for introduced contaminants from operational areas of the PEP presents a '*minor*' impact. Mitigation of these potential impacts will be addressed by compliance with the environmental licences held by operators, by following cyclone management plans, and by taking into consideration the predicted wave climate and storm surge water levels in the design of marine structures for PEP (wharves, breakwaters and revetments).

B.4.4.4.2 Shipping Operations

A description of the anticipated number of vessel movements is provided in Part A of this EIS. With regards to marine water quality, the growth in trade in POTL is predicted to triple by 2025 and will be dominated by imports of nickel and fertiliser component, and exports of coal, mineral concentrate, sugar, fertiliser and magnetite. While loading and unloading of these imports and exports is controlled by existing environmental licences held by operators, there is the potential for introduced contaminants as detailed below.

Potential Impact: *Introduced contaminants from increased shipping*

Current and increased shipping operations may introduce contaminants from:

- Ballast water.
- Antifouling systems.
- Black water and grey water release.
- Other wastewater.
- Airborne contaminants from exposed materials (e.g. bulk product) entering the water column.
- Solid waste such as packaging materials.

Ballast water, antifouling and wastewater are regulated by the following conventions and legislation which vessels operating in Australia need to comply with:

<u>International Obligations:</u>

- Convention for the Prevention of Pollution from Ships 1973.
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London Convention) 1972.
- Convention on the Control of Harmful Antifouling Systems on Ships (IMO-AFS Convention) 2001.
- Convention for the Control and Management of Ship's Ballast Water and Sediments 2004.

<u>Commonwealth Legislation:</u>

- Quarantine Act 1908 for management of introduced pests in ballast water, managed by the Australian Quarantine and Inspection Service (AQIS).
- Environment Protection (Sea Dumping) Act 1981.

<u>State Legislation:</u>

- Environmental Protection (Waste Management) Regulation 2000, and Environmental Protection (Water) Policy 2009.
- Transport Operations (Marine Pollution) Act 1995 and Transport Operations (Marine Pollution) Regulation 2008.
- Maritime Safety Queensland Act 2002.

In Queensland's jurisdiction, the international conventions are given force through the *Transport Operations (Marine Pollution)* Act 1995 and *Regulation 2008* which aim to protect Queensland's marine and coastal environment from the adverse effects of shipsourced pollution. Section 93A(2) of the Act appoints the General Manager, Maritime Safety Queensland as the Marine Pollution Controller to direct the marine pollution response in Queensland coastal waters. Other relevant Queensland legislation is the *Maritime Safety Queensland Act 2002* which establishes Maritime Safety Queensland and empowers it to 'deal with the discharge of shipsourced pollutants into Queensland Coastal Waters'.

The potential for introduced contaminants from increased shipping presents a '*minor*' impact. Mitigation of these potential impacts will be addressed by compliance with the above legislation administered by the above authorities.

B.4.4.4.3 Maintenance Dredging

Maintenance dredging will be required to ensure that the shipping channels, swing basins and berths remain at the required depths. Maintenance dredging will be similar to current operations and will be based on a short-term dredging campaign by a trailer suction hopper dredge (TSHD). Volumes of material to be dredged and frequency of maintenance dredging is detailed in Part A of this EIS. Disposal of this material will be in accordance with State and Commonwealth requirements and approvals.

Potential Impact: *Generation and migration of turbid plumes from maintenance dredging works*

The impacts of maintenance dredging will be similar to current maintenance dredging and significantly less than those predicted from capital works. Compared to capital dredging, much smaller volumes of material are involved in maintenance dredging and the timeframes over which dredging will occur will be shorter. Impacts from maintenance dredging are considered to be localised and short-term with limited increases in TSS adjacent to sensitive environments.

To determine the likely impacts from maintenance dredging, modelling of dredge plumes was undertaken using monitoring data recorded during a maintenance dredging campaign in January 2011. The maintenance dredging campaign was undertaken by the TSHD 'Brisbane', and during this campaign BMT WBM performed Acoustic Doppler Current Profiler (ADCP) transects and water quality instrument measurements in the vicinity of the dredge.

The BMT WBM three-dimensional (3D) TUFLOW-FV hydrodynamic and plume dispersion model was used for this assessment. The simulation period used for both model validation and impact assessment is based upon seven days of maintenance dredging from the 1st to the 7th of January 2011, as derived from the TSHD 'Brisbane' dredge logs. During this period the TSHD 'Brisbane' was operating primarily in the Platypus Channel and the outer harbour.

Using the McArthur *et al.* (2002) method, potential impacts from maintenance dredging was assessed. The level of potential impact is based on the magnitude, frequency and duration of dredge plume events, which is derived from data extracted from the TUFLOW-FV model as exceedance plots. The areas of potential impact for the maintenance dredging of the outer harbour and Platypus Channel are included in Figure B.4.22.

The results presented in Figure B.4.22 show that elevated levels of TSS above background is relatively localised, and do not extend far beyond the Platypus Channel. The reef communities around Middle Reef, Magnetic Island or nearshore seagrass meadows between the Port and Cape Pallarenda are not affected.

Based upon the impact assessment of McArthur *et al.* (2002), it can be concluded that '*minor*' impacts are expected from a typical maintenance dredging campaign in the outer harbour and Platypus Channel. As the Sea Channel is located closer to sensitive receptors at Magnetic Island compared to the Platypus Channel, maintenance dredging of the Sea Channel would potentially pose a greater risk in terms impacts to sensitive receptors. Nevertheless, it is understood that maintenance dredging of the Sea Channel has not previously been required.

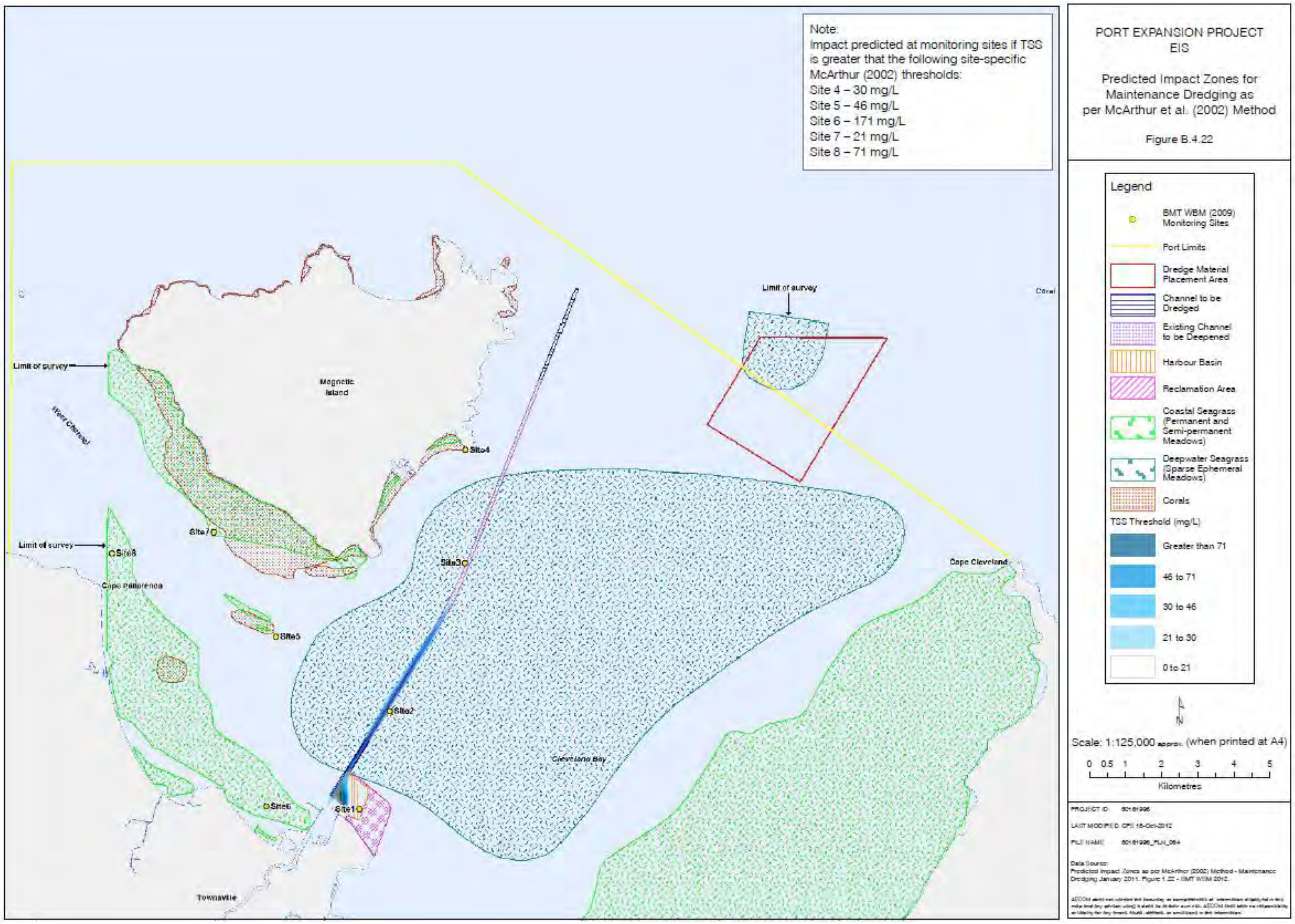


Figure B.4.22 Predicted Impact Zones for Maintenance Dredging as per McArthur et al. (2002) Method

Mitigation Measures

The following mitigation measures are to be implemented to manage the potential impacts from increased TSS and mobilisation of contaminants during maintenance dredging works:

- Maintenance dredging is to be undertaken in accordance with the Long Term Dredging and Disposal Management Plan.

Table B.4.25 General Operational Impact and Mitigation Measures

Aspect	Activity	Potential impacts	Management Controls and Mitigating Measures
Discharge of ballast water	Routine operations of offshore vessels and facilities.	Contamination of the marine environment by hydrocarbons.	Vessels will comply with the *Quarantine Act 1908* for management of introduced pests in ballast water, managed by the Australian Quarantine and Inspection Service (AQIS); Implementation of vetting procedures for condensate tankers, ensuring that ballast-water tanks are segregated from fuel and product tanks.
Antifouling leachate	Routine operation of vessels.	Toxic effects on marine biota from leached copper and biocide chemicals.	Vessels will comply with the International Convention on the Control of Harmful Antifouling systems on Ships, managed by Maritime Safety Queensland. Antifouling paints or methods with the least potential for environmental harm will be used on subsea infrastructure, subject to operational requirements. Antifouling paints containing TBT compounds will not be renewed on any vessels or equipment.
Accidental hydrocarbon spills	Offshore hydrocarbon spills.	Exposure of offshore waters to surface oil. Reduced growth of benthic communities.	Range of management controls including the following: • Facility integrity will be provided through initial design and shutdown systems (operator) • Industry standard equipment and procedures will be employed (operator and POTL) • Ongoing maintenance such as integrity testing and regular inspections will be carried out (operator and POTL) • Radio contact between vessels and POTL will be maintained during refuelling at berths. • Oil Spill Contingency Plan. • Collision prevention procedures will be instituted.
Airborne contaminants entering water column	Loading and unloading of ships, stockpiling of materials.	Contamination of the marine environment.	Vessels will comply with the appropriate management procedures in regard to the proper loading and unloading of ships. Any stockpiles of materials stored at the PEP will be managed in accordance with the Port of Townsville's environmental management procedures, which may include ensuring stockpiles are adequately covered to prevent mobilisation of airborne contaminants.
Release of contaminants from operational areas	Spills resulting from extreme weather events, with increased wave climate and storm surge	Contamination of the marine environment.	In the event of a cyclone, undertake required actions as per the Port's, MSQ, and the operator's cyclone management plans. Account for predicted wave climate and water levels in design of marine structures (wharves, breakwaters and revetments). Limit overtopping design criteria for marine structures to capacity of associated drainage infrastructure.

B.4.5 Mitigation Measures and Residual Impacts

B.4.5.1 Overview

In terms of impact mitigation, it is noted that the Project design was developed to avoid and/or reduce impacts to the greatest practicable extent. The mitigation strategies outlined in this chapter specifically aim to further mitigate construction and operational impacts associated with the Project. The mitigation measures are detailed in previous sections.

B.4.5.2 Environmental Monitoring

Environmental monitoring forms a key strategy in the Environmental Management Plans (EMPs). POTL is committed to the implementation of environmental monitoring, with the following monitoring components relevant to water quality:

1. Baseline monitoring program.
2. Development of trigger values.
3. Construction monitoring program.

Baseline Monitoring Program (Pre-construction)

To ensure suitable trigger values are developed for the dredge monitoring program during construction, good quality baseline data is essential. The existing water quality data in Cleveland Bay comprises monthly grab samples over a number of years and continuous data logged over a few months. To ensure baseline water quality is adequately characterised, including seasonal variations, additional baseline data is required.

This data is required at locations of sensitive ecological receptors in Cleveland Bay, with data recorded over at least a 12 month period. To achieve this, water quality instruments are currently deployed off the east coast of Magnetic Island. This is the area deemed most susceptible to turbid plumes from capital dredging of Platypus and Sea channels, and is the location of sensitive ecological receptors including coral reefs and seagrass. Water quality instruments are also deployed offshore from the Strand and Cape Pallarenda to collect data for another related project, and this data will also be used for the PEP project. These instruments are collecting continuous water quality data over a 12 month period.

Development of Trigger Values

An iterative approach to setting and improving water quality trigger values will ensure that the best possible protection of environmental values is achieved. This includes continuous monitoring prior to and during the dredging campaign to ensure trigger levels and tolerance limits are realistic to ensure protection but avoid frequent and unnecessary stoppages (to ensure duration of impact is reduced) while also ensuring there are no large-scale impacts.

One method which may be used to develop trigger guideline values is to use the methodology of McArthur *et al.* (2002). The process followed is detailed below:

- The 99th percentile TSS value is adopted as the ‘Intensity Level’ or highest allowable value.
- The 95th percentile TSS value is adopted as the ‘Threshold Level’.
- Long term (i.e. at least 12 months) monitoring data is analysed to determine the distribution of all duration events during which the TSS Threshold Level was exceeded.
- The 95th percentile longest event is adopted as the ‘Duration Guideline’.

All events exceeding the TSS ‘Threshold Level’ are grouped by duration in hours, with an allowable frequency of events developed for each duration class per month. A timeframe is adopted (e.g. one month), and the 95th confidence limit is used as the total allowable frequency.

As mentioned previously, further baseline water quality monitoring data is currently being collected over a 12 month period off the east coast of Magnetic Island, the Strand and Cape Pallarenda. As this additional data becomes available, the intensity, threshold and duration trigger levels can be developed. This monitoring data may also allow a distinction between wet and dry seasons if a considerable difference in turbidity exists.

Compliance with the developed trigger values would be monitored via installation of appropriate water quality monitoring equipment to ensure dredging can be reactive in a timely manner.

Construction Monitoring Program

Once trigger values have been developed, environmental monitoring programs will be implemented for the construction period of the PEP. The following monitoring programs are relevant to water quality:

- Reactive coral and water quality monitoring program during dredging (Chapter B6 - Marine Ecology and Chapter C2.1 - Dredge Management Plan).
- Tailwater discharge quality monitoring program (Chapter C2.1 - Dredge Management Plan).
- Model validation monitoring program (see below).

Model Validation Monitoring Program

Monitoring specifically targeted at validation of the dredge plume source assumptions that underpin the water quality impact assessments is to be undertaken at the commencement of each phase of capital dredging associated with the PEP.

The methodologies associated with this monitoring component will be governed by the goal of obtaining data for the dredge plume model validation. It is likely to involve a combination of vessel-mounted ADCP (or similar) and in-situ water quality measurements and sampling for laboratory analysis, specifically targeted at characterising the dredge plume intensity and spatial dimensions on top of the ambient suspended sediment climate.

The monitoring campaigns are to occur early on during the operation of the key capital dredging equipment, namely the:

- Small TSHD dredging the outer harbour footprint.
- CSD and associated tailwater from dredging the outer harbour footprint.
- Medium TSHD dredging of the Platypus and Sea channels.

Outcomes of the monitoring will be spatial and temporal maps of the dredge plume during the validation exercise, quantification of the plume sediment characteristics and quantification of the range of plume generation source rates associated with the monitored dredging operations. These results will directly feed into water quality model simulations to validate the model configuration used in the EIS and to suggest any improvements to model input parameters (i.e. dredge plume source rates).

B.4.5.3 Environmental Management Plans (EMPs)

The Dredge Management Plan (DMP) (Chapter C2.1) contains a number of environmental elements which outline controls that will be implemented to reduce harm to marine flora and fauna and their habitats. The DMP will be refined by POTL or its dredging and construction contractors as the Port Expansion Project's design and construction methodology moves into the detailed design phase. The DMP contains the following aspects: Management Objectives, Targets, Actions, Performance Indicators, Monitoring and Reporting, Corrective Actions and Responsibilities.

Table B.4.26 Summary of commitments – Water Quality Mitigation Strategies

Statement of Commitment	Phase	Included in EIS Section
Develop a DMP which includes tailwater management to provide guidance on the mitigations measures that will be adopted to reduce impact to the receiving water quality.	Planning Construction	Section B4.4.3.4 and Section C2.1
A reactive water quality program will be developed and implemented during capital dredging. Dredging activities will be modified or suspended in the event that monitoring detects exceedance/s of trigger values.	Construction	Section B4.4.3.1 to Section C2.1
Tailor the Dredge Management Plan (DMP) to provide guidance on the mitigation measures that will be adopted to reduce impacts to both water quality and marine flora and fauna.	Planning Construction	Section B4.4.3.1 to Section B4.4.3.3

B.4.6 Cumulative Impacts

Cumulative and interactive effects described in the preceding sections have considered the interactive impacts associated with the PEP. As discussed throughout this chapter, changes in water quality will be temporary in nature and following sufficient time (usually hours to days) plumes will disperse and water quality will return to ambient conditions. The findings of this impact assessment take into consideration the impacts of other components of the study.

In broad terms, the Port Expansion Project will result in:

- Temporary water quality impacts associated with the generation of turbid plumes by construction activities and placement of dredged material to sea.
- A potential increase in pollutant loads resulting in diminished water quality, albeit temporary in the immediate vicinity of the port, once the new port facilities are operational.

Together, these key impacting processes will result in changes to ambient water quality and an increased potential, albeit minor/moderate temporary impacts to water quality in Cleveland Bay. Mitigation strategies associated with these impacting processes are summarised in Table B.4.27 and following their implementation, long-term impacts to the environmental values identified in Section B4.3 will be reduced.

Major infrastructure projects that are currently underway and that will be completed when the PEP commences include:

- The Townsville Port Access Corridor road and rail link, including the construction of a bridge across the Ross River near the port.
- The Berth 12 development adjacent to the Port Expansion Project.
- Berth 8 expansion in the inner harbour of the Port.
- Berth 10A expansion.

These projects are expected to produce similar impacting processes to the marine water quality as the PEP, albeit resulting in different intensities and extents of impacts to the water quality. While these projects are likely to be undertaken with a staged approach, the potential cumulative effects associated with future infrastructure projects could impact upon the environmental values and compliance with the annual median guideline values presented in QWQG.

It is noted that another port project, the Berth 10X project, is currently being investigated. This project is being assessed through a separate EIS where any cumulative impacts to water quality between the PEP and the B10X project will be assessed.

In the context of the cumulative impact to long-term water quality and its potential impact to achieve compliance with the environmental values and guidelines (refer to the QWQG), it is noted that the above potential future projects are located in existing operational port areas and are subject to ongoing disturbance associated with day to day port operations. The cumulative construction-related impacts on the long-term water quality of potential future developments will depend on the timing and staging of any future works, as outlined below:

1. Future development projects undertaken in parallel: The intensity of impacts associated with turbid plume generation (and associated sedimentation) and impacts to environmental values from construction-related disturbance would be greater than if construction projects be staged over a longer time period, thus potentially exceeding the QWQG value identified in an annual period. However, the duration of construction-related disturbance would be shorter, potentially reducing the overall length of time and impact upon environmental values by returning marine waters back to ambient conditions, such that compliance with the QWQG would be more likely following the works.
2. Future development projects undertaken sequentially. Compared to parallel staging (Scenario 1), the intensity of impacts associated with individual projects would be lower but duration and frequency of disturbance to the environmental values would be longer potentially increasing the non-compliance period to the QWQG.
3. Future development projects are staged but are separated by periods (measured in years). Similar to sequential staging, the intensity of impacts associated with individual projects would be lower and there would be more than recovery time to environmental values and compliance to the QWQG

more likely in any one period. Nevertheless, the environmental values would be impacted over a longer duration and longer frequency of disturbance.

These scenarios provide a general guide to the relative intensity and duration of impacts and recovery of environmental values in comparisons to the QWQG.

Based on the above, intensity of impacts could be reduced if projects are staged. It is recommended that where practicable, projects are not undertaken at similar times to aim to reduce the magnitude of impacts, and to allow sufficient time between projects to provide sensitive receptors with an opportunity for recovery.

B.4.7 Assessment Summary

Project activities that have the potential to impact on the environment are summarised in Table B.4.27.

Table B.4.27 Impact Assessment Summary – Water Quality

Primary Impacting Process	Potential Impact	Magnitude of Impact	Likelihood of Impact	Risk Rating	Mitigation Measures	Residual Risk
Dredging	Generation of turbid plumes	Local Scale: **Moderate** Dredging of the outer harbour and Sea/Platypus Channels will create turbid plumes potentially resulting in sedimentation and a temporary decrease in light penetration near sensitive habitats. Exceedances to the McArthur *et al.* (2002) guidelines will occur in the immediate vicinity of the dredge.	Likely	Medium	Dredge in approved footprint. Ensure the dredge avoids excessive overflowing. Dredge hopper to be kept watertight. Ensure the top of overflow valves are not lowered during the transport to DMPA. Loading to be to a hopper level, to ensure supernatant water is not lost over the hopper coaming during transport to the DMPA. No high pressure jets to be used on dragheads. Dredge to be fitted with 'green valve'. Dredged material placement only in specified zones in the DMPA. No washing of hopper compartment outside of DMPA. Implementation of a reactive water quality monitoring program, with management actions implemented if trigger levels are exceeded.	Low
		Broader Scale: **Minor** While turbid plumes at the dredged site are expected, the plume will disperse the further away from the impacting area and is unlikely to impact on the broader values. Exceedances to the McArthur *et al.* (2002) guidelines will be minor and largely located adjacent to Magnetic Island.	Unlikely	Low	As above	Low

Primary Impacting Process	Potential Impact	Magnitude of Impact	Likelihood of Impact	Risk Rating	Mitigation Measures	Residual Risk
	Mobilisation of contaminants into the water column	Local Scale: **Minor** Dredging of the outer harbour and Sea/Platypus Channels may mobilise nutrients/heavy metals into the water column potentially affecting water quality near sensitive habitats.	Possible	Low	Development and implementation of a Sampling and Analysis Plan (SAP)	Low
		Broader Scale: **Negligible** Unlikely to impact on the broader values.	Unlikely	Low	Nil	Low
Reclamation	Generation of turbid plumes	Local Scale: **Minor/Moderate** Discharge of tailwater will create turbid plumes potentially resulting in sedimentation and a temporary decrease in light penetration near sensitive habitats. Exceedances to the McArthur *et al.* (2002) guidelines will be minor.	Likely	Medium	Management of tailwater discharge quality through the implementation of a tailwater management plan. Use of appropriately designed sedimentation pond to reduce TSS. Implementation of best management sediment and erosion control plans.	Low
		Broader Scale: **Minor** The turbid plumes from the tailwater will disperse and be unlikely to impact on the broader values. Exceedances to the McArthur *et al.* (2002) guidelines will be unlikely to the greater Cleveland Bay area.	Unlikely	Low	As above	Low
	Mobilisation of contaminants into the water column	Local Scale: **Minor** Discharge of tailwater may mobilise nutrients/heavy metals into the water column potentially affecting water quality near sensitive habitats.	Likely	Low	Nil	Low
		Broader Scale: **Negligible** Any contaminants in plumes from the tailwater will disperse and be unlikely to impact on the broader values.	Unlikely	Low	Nil	Low
	Discharge of acidic tailwater from acid sulfate soil (ASS) in reclamation	Local Scale: **Minor** Discharge of acidic tailwater due to presence of ASS in reclamation ponds may adversely impact sensitive ecological receptors in the vicinity of the tailwater release.	Likely	Medium	Manage ASS in accordance with the ASS Management Plan. Management of tailwater discharge quality through the implementation of tailwater management plan.	Low
		Broader Scale: **Negligible**	Unlikely	Low	As above	Low

Primary Impacting Process	Potential Impact	Magnitude of Impact	Likelihood of Impact	Risk Rating	Mitigation Measures	Residual Risk
		The acidic tailwater would be diluted in the broader receiving waters and be unlikely to impact on the broader values.				
Dredged Material Placement	Generation of turbid plumes	Local Scale: **Minor/Moderate** Placement of dredged material will create turbid plumes potentially resulting in sedimentation and a temporary decrease in light penetration. Exceedances to the McArthur *et al.* (2002) guidelines will occur in the immediate vicinity of the Dredged Material Placement Area (DMPA).	Possible	Medium	Disposal in nominated DMPA Management of plumes through the implementation of a reactive water quality monitoring program.	Low
		Broader Scale: **Minor** While turbid plumes at the DMPA are expected, the plume will disperse the further away from the impacting area and is unlikely to impact on the broader values.	Unlikely	Low	As above	Low
	Mobilisation of contaminants into the water column	Local Scale: **Minor** Placement of dredged material will create turbid plumes and potential mobilisation of nutrients/heavy metals resulting to the temporary decrease in water quality in the Cleveland Bay.	Possible	Low	Development and implementation of a Sampling and Analysis Plan (SAP)	Low
		Broader Scale: **Negligible** Unlikely to impact on the broader values.	Unlikely	Low	Nil	Low

Port Expansion Project EIS

Part B

Section B5 – Marine Sediment Quality

AECOM BMT WBM

B.5 Marine Sediment Quality

B.5.1 Relevance of the Project to Marine Sediment Quality

The Townsville Port Expansion Project proposal involves capital dredging of the outer harbour area, together with deepening, widening (in the vicinity of the harbour only) and lengthening of the navigation channels, in order to facilitate access of vessels into the outer harbour. The dredging works will be undertaken in phases according to shipping requirements and demand for additional port facilities. As outlined in Part A of this EIS, it is proposed that suitable dredged material will be re-used as reclamation fill to provide for land-based port operations. However, not all dredged material has engineering qualities suitable for reclamation. It is therefore proposed that the remaining dredged material will be placed offshore, including the uppermost metre of soft and silty sediments, which are less suitable for use as reclamation fill due to their soft and compressible nature.

This chapter provides:

- Baseline information on the key environmental values of marine sediments and sediment quality in areas of potential direct disturbance for the Port Expansion Project.
- An assessment of the potential for values to be affected by the Port Expansion Project. This takes in account the construction and operation of the outer harbour and associated infrastructure, including capital and maintenance dredging works and ocean placement of dredged materials.
- The measures proposed to manage and mitigate potential impacts to marine sediment quality, such that sediment quality is maintained to nominated quantitative standards in the Project Area and surrounds, particularly where placement at sea may be required.

B.5.2 Assessment Framework and Statutory Policies

B.5.2.1 Applicable Legislation and Policies

The following policy and guidelines are relevant to the dredging and placement of marine sediment associated with the Townsville Port Expansion Project:

- ***1996 Protocol to the Convention to the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972* (as amended in 2006) (the London Protocol)** – Disposal of dredged material at sea is managed under the London Protocol, which aims to have less and cleaner waste disposal at sea. Annex 2 to the London Protocol sets out the assessment process that must be followed by countries assessing proposals for ocean disposal. These processes are reflected in Australia's regulatory framework, namely the *Environmental Protection (Sea Dumping) Act 1981* and *National Assessment Guidelines for Dredging (2009)*.
- ***Environment Protection (Sea Dumping) Act 1981*** – The Sea Dumping Act provides the framework against which the Australian Government regulates the disposal of wastes and other materials at sea. It is through the Sea Dumping Act that Australia also implements its obligations and commitments under the international London Protocol.
- **National Assessment Guidelines for Dredging (NAGD) (2009)** – These guidelines provide an approach for assessing the quality of sediments and their suitability for ocean placement (DEWHA, 2009a). They do this through a regulatory framework, which is applied to ensure the impacts of dredged material loading and disposal are adequately assessed and, when ocean placement is permitted, that impacts are managed responsibly and effectively.
- ***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)** – The EPBC Act provides for the protection of matters of national environmental significance. The Act requires a proposal must be referred to the Australian Department of the Sustainability, Environment, Water, Populations and Communities (DSEWPAC) if the Port Expansion Project has the potential to have a significant impact on matters of national environmental significance. Matters of national environmental significance triggered for this Project include world heritage properties, national heritage places, wetlands of international importance, nationally listed threatened species and communities, migratory species, Commonwealth marine areas and the Great Barrier Reef Marine Park.

- ***Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland 1998*** (Ahern, Ahern, & Powell, 1998) **-** These guidelines provide a State-wide standardised sampling and analysis regime for characterising acid sulfate soils. These guidelines are relevant to dredged sediments that will be placed in the reclamation area (i.e. land-based placement). Sediments destined for offshore placement will remain waterlogged during dredging, transport and placement, and are not considered to be of concern (note: relevant dredging considerations are also managed through the NAGD process).
- ***Environment Protection Act 1994*** – This Act and associated policies and regulations provide for sustainable resource development, while protecting ecological processes, by regulating environmentally relevant activities including dredging (ERA 16).
- ***Sustainable Planning Act 2009*** – This Act provides the framework against which the State Government regulates works undertaken in, on over or through tidal waters, including dredging of material, construction of reclamation area and breakwaters.
- ***Coastal Protection and Management Act 1995* –** This Act provides the framework against which the State Government regulates the placement of dredged material (i.e. allocation of quarry material).

B.5.2.2 Methodology

B.5.2.2.1 Assessment Approach

NAGD (DEWHA, 2009a) sets out the approach to determine the suitability of dredged material for unconfined ocean disposal. NAGD provides a decision-tree approach for assessing potential contaminants, comprised of five phases as summarised in Figure B.5.1. The present study is mainly based on an assessment of existing data, in accordance with Phase I of the NAGD assessment framework.

Further testing of sediments will be required at a later stage (as part of a detailed sediment Sampling and Analysis Plan), in accordance with the framework set out in Figure B.5.1.

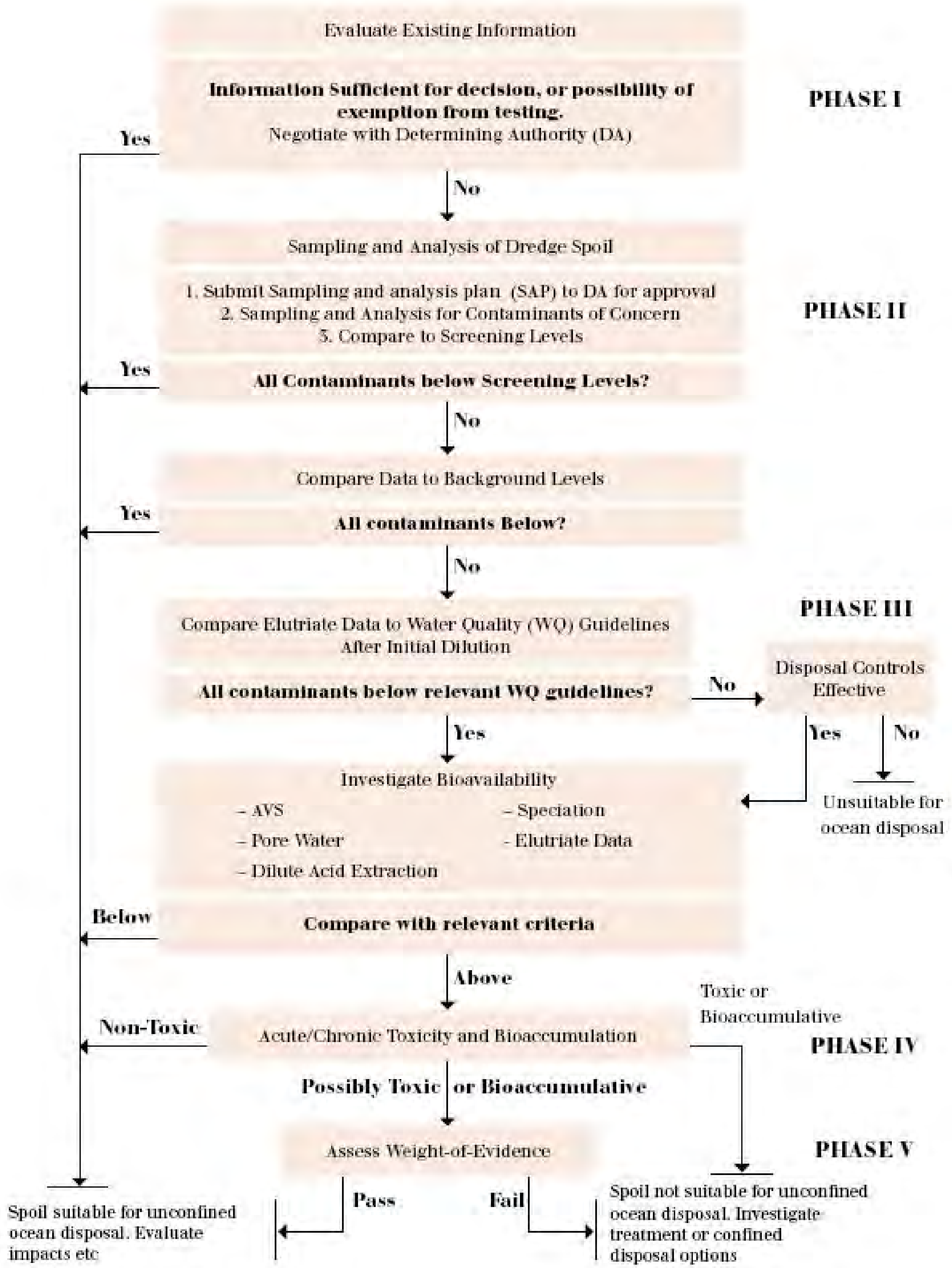


Figure B.5.1 NAGD Tiered Assessment Approach

B.5.2.2.2 Review of Existing Information

A review of relevant literature and existing data, together with targeted sampling of marine sediments, were undertaken in order to:

- Describe the physical properties of sediments in the Port Expansion Project disturbance footprints.
- Characterise the chemical properties of sediments in the Port Expansion Project disturbance footprints, in terms of current and/or known recent concentrations of trace metals/metalloids, nutrients and other analytes relevant under the applicable legislation.
- Identify contaminants of potential concern (COPC)[1] in Port Expansion Project disturbance footprints.

Key sediment quality information sources include:

- POTL sediment quality data 1995 to 2011 for sites at the Outer Harbour, Rock Wall (north-eastern rock wall in the reclamation area), Platypus Channel and Sea Channel (refer Section B5.2.2.3 below regarding data analysis).
- URS (2010) Sampling and Analysis Plan Report – 2010 Berth 12 Capital Dredging Program.
- GHD (2009d) Townsville Marine Precinct Environmental Impact Statement: Appendix J – Water and Sediment Quality Assessment.
- GHD (2008) Townsville Port Authority Long Term Dredging and Disposal Management Plan Report.
- Golder (2008b) Offshore Geotechnical Investigation and Acid Sulfate Soils Investigation.
- URS (2008) Sediment Quality Assessment – 2008 inner harbour and Berth 11 Pocket: Maintenance Dredging Program. Report to the Port of Townsville.
- Hydrobiology (2003a) Testing of Townsville inner harbour (Non-Berth Areas) Sediments for Sea Disposal Suitability – Bioavailability and Ecotoxicity Testing of Swing Basin and Silt Trench Sediment.
- Maunsell (2002) Reporting of the 2002 Sediment Sampling and Analysis Plan for the Townsville inner harbour. Volume A.

B.5.2.2.3 Surveys and Data Analysis

Data from POTL's Long Term Sediment Monitoring Program were analysed to characterise the chemical properties of sediments and identify COPCs. Furthermore, sediment porewater samples were collected from the outer harbour and Platypus Channel to inform water quality assessments described in Section B5.3.6. The analysis approach is described below.

Sediment Quality

Marine sediment sampling has been undertaken by POTL on a quarterly basis since 1995. The following investigations areas are located in or directly adjacent to disturbance areas for the Port Expansion Project (see Figure B.5.2 for locations), and were therefore considered in this assessment:

- *Outer Harbour* – 39 sites occur in this area.
- *Berth 11* – This includes 12 sites in a section of the outer harbour dredge area adjacent to Berth 11 operations. This area was specifically delineated due to the proposed removal of surficial sediment from this area as part of Berth 11 maintenance dredging prior to the Port Expansion Project.
- *Platypus Channel* – This section of the navigation channel contains 24 sites.
- *Sea Channel* – This section of the shipping channel contains 18 sites.
- *Rock Wall* – Four sites within the outer harbour along the existing north-eastern rock wall occur in the reclamation area and would therefore be disturbed by the Project.

[1] In accordance with NAGD, COPCs are those contaminants that exceed the background concentrations and the Screening Level (or elevated concentrations of contaminants for which guidelines do not exist). COCs are those contaminants which exceed the background concentrations and the Screening Level and for which the bioavailability, bioaccumulation or toxicity assessments indicate that significant effects from the contaminants are likely. For COCs, definite actions are required. For COPCs, no immediate action may be required.

Trace metals/metalloids considered in the long-term monitoring program included antimony, arsenic, cadmium, chromium, copper, nickel, silver, lead and zinc.

The long-term dataset (1995-2011) was analysed to determine general trends in metal/metalloid concentrations over time.

Under the NAGD assessment framework, existing sediment quality data for Phase I assessments has a currency of five years. Therefore, data for the period January 2007 – April 2011 were used to determine the contaminant status of surface sediments. The Upper 95% confidence limit (95%UCL) was calculated for all trace metals/metalloids at each of the five investigation areas described above[2]. The analysis method used to calculate the 95%UCL depends on the statistical distribution of the data. Goodness-of-fit (GOF) tests for normal and lognormal distributed data sets were calculated using the software program ProUCL version 4.0. Consistent with NAGD, the following decision rules were adopted in the selection of statistical tests for the calculations of the 95%UCL:

- the geometric mean was used where data followed a log-normal distribution; or
- if data did not follow a log-normal distribution, the arithmetic mean was adopted.

The 95%UCL for each trace metal/metalloid were compared against screening levels outlined in Table B.5.1. Trace metals/metalloids that had a 95%UCL that exceeded the screening level were classified as contaminants of potential concern (COPCs). To assist with the identification of potential 'hot spots' where future sediment quality investigations may focus, the above statistical analyses were repeated at the level of distinct sites.

Note that only surficial sediment quality data was available for use in this assessment, therefore further assessments will be required to characterise the sediment quality of the total extent and volume of the capital dredging area (Section B5.5).

Porewater and Elutriate Analysis of Nutrients

Sediment samples were collected from the outer harbour and Platypus Channel for porewater analysis in November 2010. Sediment samples were collected using a grab sampler at six sites (labelled 103 through 108) as shown in Figure B.5.3. Whole samples (not homogenised) were immediately placed into zip-lock plastic bags and were transported on ice to the laboratory in 24 hours of sample collection.

Porewaters were extracted from sediments by a NATA accredited laboratory (Advance Analytical Australia), and then analysed for the following nutrients:

- Ammonia as N
- Nitrite + Nitrate as N
- Total Nitrogen as N
- Reactive Phosphorus as P
- Total Phosphorus as P

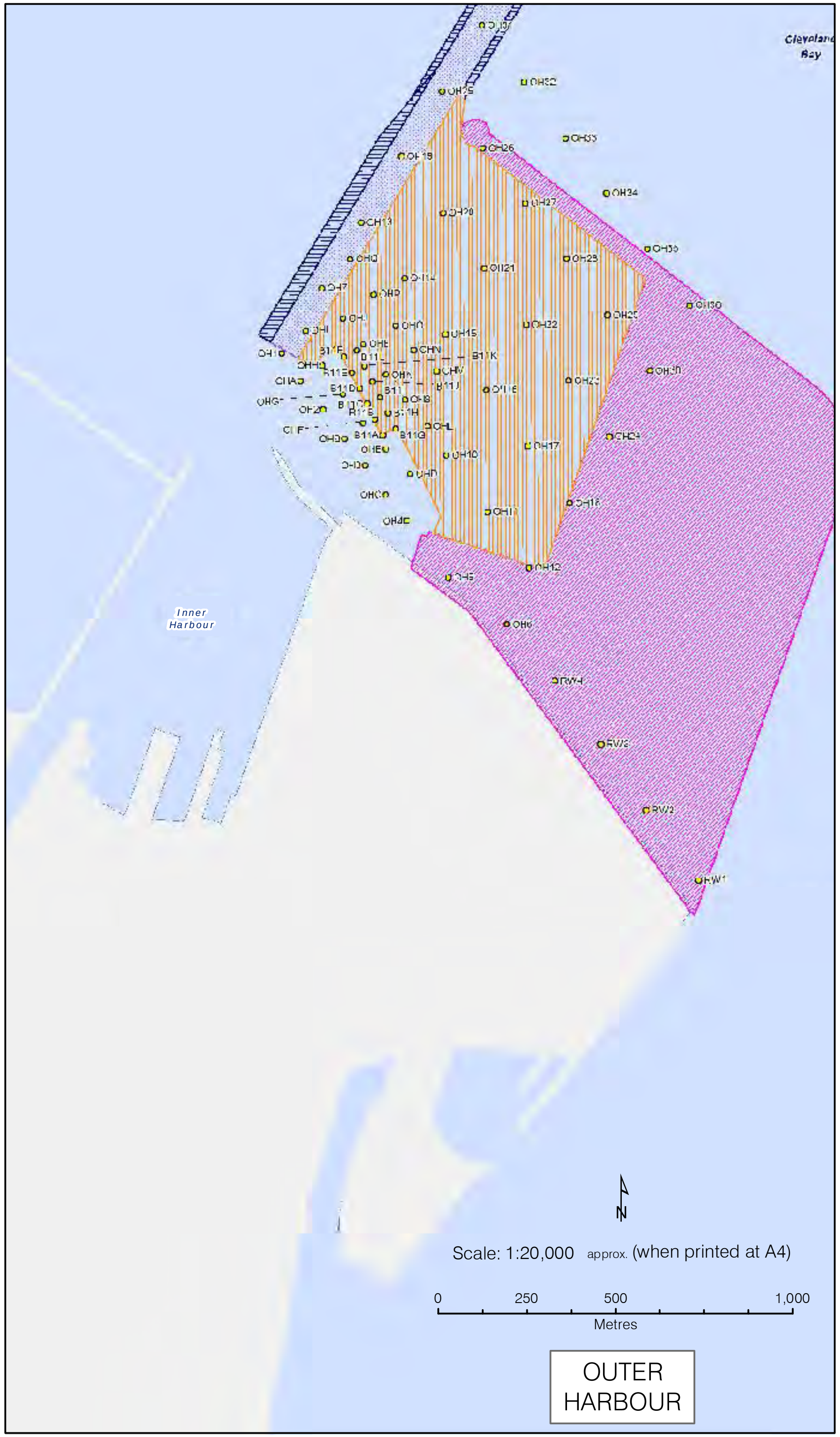
Sediment particle size distribution analysis was also performed on the sediments. In addition, a seawater sample was collected for elutriate analysis. Seawater sample collection, handling and transport were undertaken in accordance with standard methods (DERM, 2009c). The seawater sample was supplied to a NATA accredited laboratory (Advance Analytical Australia) for elutriate analysis of the nutrients listed above.

[2] A value of half the detection limit was adopted where concentrations were below the laboratory detection limit (DEWHA, 2009a)

PORT EXPANSION PROJECT
EIS

Location of POTL Long Term
Sediment Monitoring Program
Sediment Sampling Sites

Figure B.5.2



Legend

- Outer Harbour Sampling Point
- Platypus Channel Sampling Point
- Sea Channel Sampling Point
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_048

Data Source:
Long Term Sediment Monitoring Programme Sampling Sites (POTL), Figure 1.1 - BMT WBM 2012.

PORT EXPANSION PROJECT
EIS

Sediment Porewater Sampling Sites, November 2010 (BMT - WBM)

Figure B.5.3

Legend

- Sampling Site
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

N

Scale: 1:25,000 approx. (when printed at A4)

0 250 500 1,000
Metres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_049

Data Source:
Sediment Porewater Sampling Sites, November 2010 (BMT - WBM), Figure 1.2 - BMT WBM 2012.

B.5.2.2.4 Assessment of Potential Impacts and Mitigation

The assessment of potential impacts considered three broad disturbance categories:

- Construction phase dredging (capital dredging) and sediment disturbance in the dredging footprint.
- Construction phase dredged material placement, both in the offshore Dredged Material Placement Area (DMPA) and reclamation area.
- Operational phase effects as a result of either maintenance dredging or other operational activities.

For each of these categories, the assessment primarily focused on the trace metals/metalloids listed above in Section B5.2.2.3 as these are the key contaminants of concern in the context of the Port Expansion Project. Other potential contaminants such as nutrients and potential acid sulfate soils were also considered.

The recommended mitigation measures were developed in accordance with the NAGD framework (DEWHA, 2009a).

A Sea Dumping Permit, under the *Environment Protection (Sea Dumping) Act 1981*, will not be sought as part of this EIS. Furthermore, state approvals will be required under the *Sustainable Planning Act 2009* and the *Environmental Protection Act 1994.* Future detailed marine sediment investigations will need to be undertaken in accordance with NAGD (DEWHA, 2009a) as part of such permit applications. However, this EIS characterises sediments and discusses the potential of sediment contamination, noting that ocean disposal is a key strategy for the Port Expansion Project.

B.5.3 Existing Values, Uses and Characteristics

B.5.3.1 Background

The Port of Townsville is located in Cleveland Bay, which is the receiving waters of catchment sediments from the Burdekin, Ross, Bohle and Rivers, and numerous small creeks (including Ross Creek). Catchment derived sediments dispersed into Cleveland Bay during flow events. These sediments come under the influence of wave-induced longshore drift, and are transported northwards along the shoreline. During floods, suspended mud and finer sands are directed onto the inner shelf, where they either accumulate at depths out to 20m, or are advected back to tidal systems along the coastline (refer Chapter B3 - Coastal Processes).

Maintenance dredging of port areas has been undertaken in Cleveland Bay for over 100 years in order to maintain navigable shipping channels, berths and vessel manoeuvring areas (GHD, 2008). Capital dredging works have also been required from time to time as a result of expansion of Port of Townsville infrastructure (Pringle, 1989). The present offshore DMPA has a long history of use, as has an inshore DMPA which is no longer in use. Therefore, marine sediments in Cleveland Bay, particularly in the vicinity of port infrastructure, harbours, shipping channels and the DMPA (i.e. the Port Expansion Project footprint) have a long history of regular disturbance from dredging and disposal activities (Pringle, 1989).

Catchment land use, coastal industry, shipping and related activities over the years have resulted in elevated levels of nutrients and other contaminants in places, particularly in Ross River and Creek and nearshore areas of Cleveland Bay. Based on estimates of sediment deposition in the outer harbour over the last 100 years, URS (2009) estimated that the upper one metre of surface sediments in the outer harbour area has the potential for anthropogenic influence. Areas below one metre in the outer harbour area are therefore considered in this assessment as ‘probably clean’ in accordance with nomenclature of NAGD (DEWHA, 2009a).

Coastal sediments throughout the Cleveland Bay also have the potential for acid generation when exposed to the air because of their natural sulphur content (i.e. potential acid sulfate soils).

B.5.3.2 Physical Characteristics of Marine Sediments

Marine sediments in the reclamation area, outer harbour, Platypus and Sea channels were broadly characterised by two strata, described by Golder (2008) as follows:

1) The surface layer of recent seabed sediments generally consisted of approximately 60 to 70% silts and clays with some sand zones (i.e. a mixture of soft silty clay to clayey silt, with loose sand, silty sand and clayey sand also present). Shell fragments and organic materials commonly occurred in

this layer. The seabed sediments were readily identified by their dark hue and very soft and very loose nature. The surface materials represented potential acid sulfate sediments and, also due to their soft and compressible nature, were considered unsuitable for use as reclamation fill or as the foundation support material for marine structures. This surface layer had a thickness of approximately 1 to 1.5m on the seabed in the outer harbour and reclamation areas. In the Platypus and Sea channels this surface layer was usually thinner, in the order of 0.5 to 1.0m due to regular maintenance dredging by POTL.

2) Beneath the surface layer was a subsurface layer of harder sandy clays and sands (i.e. a mixture of stiff to hard clays and sandy clays, with dense clayey sands and sands also present). These materials were lighter in colour than the surface layer. With the exception of sediments to an approximate depth of 2.5m, the subsurface layer has not been identified as potential acid sulfate sediments and was generally considered suitable as reclamation fill (Section B5.3.4).

Appendix J1 of the EIS contains a description of the sediment strata and their physical characteristics. These include sediment stratigraphy depth profiles from the Golder (2008) geotechnical investigation for four representative bores in the outer harbour area, along with subsurface cross sections for bores along two transects across this area.

Seabed mapping undertaken as part of this EIS (refer Appendix J2) provides a map of surface sediment types throughout the nearshore section of the Study Area (i.e. outer harbour and adjacent section of Platypus and Sea channels) and the DMPA. Consistent with Golder (2008), these data indicate that most of the sediment surface in the outer harbour was comprised of a relatively homogenous mix of loose silt and fine sand. The exception to this was the channel and the vessel manoeuvring areas at Berth 11, where previous dredging has exposed coarser sand, gravel and consolidated clays.

B.5.3.3 Sediment Quality Guidelines

Table B.5.1 shows NAGD screening levels (DEWHA, 2009a) adopted in the present assessment. Land contamination guideline values identified in the Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland (EPA, 1998) are also presented in the context of assessing the suitability of placing dredged sediments onshore.

Table B.5.1 NAGD Sediment Quality Guidelines (DEWHA, 2009a), ANZECC Sediment Quality Guidelines (ISQG Values) and Queensland land contamination guideline values (EPA, 1998)

Contaminant	Screening Level (ISQG Trigger Value)	High Value (ISQG High)	QLD Contaminated Land (EIL)
Metals and Metalloids (mg/kg=ppm)			
Antimony	2	25	20
Arsenic	20	70	20
Cadmium	1.5	10	3
Chromium	80	370	
Copper	65	270	60
Lead	50	220	300
Manganese			500
Mercury	0.15	1.0	1
Nickel	21	52	60
Silver	1.0	3.7	
Zinc	200	410	200
Organics (µg/kg=ppb)			
Total PCBs	23	-	1,000
DDD	2	20	
DDE	2.2	27	
Total DDT	1.6	46	
DDT+DDE+DDD			200
Dieldrin	280	270 e / 620	
Aldrin + Dieldrin			200
Chlordane	0.5	6	
Lindane	0.32	1.0	
Endrin	10	120 e / 220	
Benz(a)pyrene			1,000
Total PAHs	10,000	50,000	20,000
Total petroleum hydrocarbons	550 mg/kg	NA	^
Tributyltin (as Sn)	9 µg Sn/kg	70	

^ Variable according to fraction, refer EPA (1998)

B.5.3.4 Review of Recent Sediment Quality Studies

Key findings of the other previous sediment quality studies carried out at the Port are summarised in this section. Most previous marine sediment quality sampling and studies at the Port have focused on the inner harbour area, which is located adjacent to the Port Expansion Project footprint. Note that studies prior to the release of the NAGD (DEWHA, 2009a) were assessed against the National Ocean Disposal Guidelines for Dredged Material screening levels (Environment Australia, 2002), which are mostly consistent with NAGD screening levels. Analysis of data from POTL's Long Term Sediment Monitoring Program are described in Section B5.3.5.

As outlined in Part A of the EIS, the Port Expansion Project includes extending the Sea Channel a further 2.7km seaward (as a result of channel deepening). No sediment quality data are currently available for this channel extension area, but will be acquired during further assessment as part of the detailed sediment Sampling and Analysis Plan (SAP) that will be executed prior to the application for sea disposal and the commencement of works. Considering the offshore location of this channel extension area and its distance from port operations, it is highly unlikely that any contaminated materials occur here.

Trace Metals/Metalloid – Regional Context and Background Concentrations

Limited existing background/ambient trace metal concentration data exists for Cleveland Bay. Reichelt and Jones (1994) sampled a range of trace metals throughout Cleveland Bay, including sites located remote from the DMPA. Nickel concentrations ranged from 3 to 178 mg/kg (mean = 49mg/kg). Elevated nickel concentrations were recorded in the Port area (46 to 139mg/kg), but also at sites remote from port and dredging activities. For example, their Site 26 located approximately eight kilometres east of the DMPA at Cape Cleveland had a nickel concentration of 62mg/kg. When data from sites clearly affected by dredging were removed from the dataset (i.e. Radical Bay, Middle Reef and the DMPA), the average nickel concentration for Cleveland Bay sites was 30mg/kg, which was above the screening level.

Ward and Larcombe (1996) found that high concentrations of nickel and other trace metals occur in the silt and clay fractions of the modern and early Holocene mangrove sediments, noting that the Holocene mangrove sediments presently represent subsurface sediments in offshore, central and nearshore Cleveland Bay. However, Port of Townsville (1998), Cruz Motta (2000), Doherty (2000) and Doherty *et al.* (2000) all found that nickel concentrations in Cleveland Bay sediments were low, below the present (DEWHA, 2009a) screening level. For example, sampling undertaken in 1995 by then Townsville Port Authority (1998) aimed to determine background heavy metal concentrations in the marine sediments of Cleveland Bay. This baseline study found low metal concentrations throughout Cleveland Bay, except for manganese which was elevated. Further, metals concentrations of sediment in Cleveland Bay were lower than those at the adjacent Halifax Bay and Bowling Green Bay. Similarly, Doherty (2000) and Doherty *et al.* (2000) found no evidence of trace metals derived from anthropogenic sources in the sediments of central Cleveland Bay, with an average nickel concentration of 9mg/kg. Sampling throughout northern Cleveland Bay, in the vicinity of the offshore DMPA, in 1998 and 1999 (Cruz Motta, 2000) found nickel concentrations below screening levels, with the highest nickel concentration being 20mg/kg.

Notwithstanding differences in analysis methods and findings of these studies, it is apparent that nickel concentrations in Cleveland Bay can exceed NAGD screening levels, including areas well away from Port activities. Although there are too few data to calculate a meaningful background (e.g. 80th percentile) nickel value, these data report nickel concentrations at sites remote from dredging affected areas can have levels above screening levels and similar to concentrations recorded in the dredge areas.

Trace Metals/Metalloids – Recent Studies in the Port Area

Golder (2008b) measured trace metal/metalloid concentrations (arsenic, cadmium, chromium, copper, mercury, lead, nickel, zinc) in boreholes taken from the outer harbour area. Eight of these boreholes were collected from the area of the Port Expansion dredging footprint, and trace metal concentrations were measured through the sediment column down to at least 0.7m sediment depth and to a maximum depth of 8.5m (26 samples analysed in total).

Golder (2008b) found that cadmium and mercury concentrations were below laboratory detection limits (and screening levels) in all samples. In the outer harbour area, all other tested metals/metalloids were recorded above laboratory detection limits, but generally below relevant screening levels. The exception to this was zinc, which had elevated concentrations (382mg/kg) in one bore at the 0.6 to 0.7m depth interval.

URS (2008) measured trace metal/metalloid concentrations in 10 cores (maximum depth to 17m) collected at Berth 11, adjacent to Townsville outer harbour. The 95%UCL for all trace metals/metalloids were below screening levels, and generally similar to concentrations recorded by Golder (2008b). Despite concentrations falling below screening levels, elutriate tests were undertaken by URS (2008) as were dilute acid extraction (DAE) tests, which provide an estimate of the bio-availability of trace metals and form part of the suite of tests in Phase III assessments in the NAGD framework (Figure B.5.1). DAE tests indicated that trace metals/metalloids were mostly not in a bio-available form, with all samples having trace metals/metalloids below relevant screening levels.

Sediment quality investigations carried out elsewhere in the Port suggest that while trace metals/metalloid concentrations can exceed screening levels in places, these trace metals/metalloids are typically not in a bio-available form. For example, Hydrobiology (2003a) carried out Phase III investigations into the bioavailability of metals (barium, cobalt, copper, lead, manganese, mercury, nickel and zinc) in samples from the inner harbour. They found that all samples had concentrations below screening levels.

Overall, the results of previous investigations indicate that there are no metals/metalloids representing COCs and therefore do not pose a constraint to ocean placement of dredged sediments from the outer harbour area.

Tributyltin

Tributyltin was measured in 2008 from sediment and porewater at Berth 11 in the outer harbour area (URS, 2008). Concentrations of tributyltin in the sediment at Berth 11 were below the detection limit (0.5µg Sn/kg) and tributyltin concentrations (normalised to 1% total organic carbon - TOC) were below the NAGD screening level in all samples. Concentrations of tributyltin in the porewater were also found to below the detection limit (0.005 g Sn/L) and below the ANZECC/ARMCANZ (2000) 95% trigger values for marine water. URS (2008) found that tributyltin concentrations in the wider port area (i.e. inner harbour) were below the screening level and that porewater tributyltin concentrations were below the detection limit and the ANZECC/ARMCANZ (2000) trigger values (95% protection of species) for marine waters (URS, 2008).

URS (2010) undertook further sampling of the outer harbour sediments, and found that tributyltin concentrations were uniformly low throughout most of the outer harbour dredged basin. However, an isolated area in the proposed Berth 12 area had TBT concentrations above the NAGD Screening Level of 9µgSn/kg. Additional sampling was carried out in this area, and four of seven core sample locations had tributyltin concentrations (ranging from 59.3 to 221.6µgSn/kg) above the NAGD screening level in sediments. Phase III investigations (elutriate testing) suggested that this localised area of Berth 12 sediments was unsuitable for ocean placement. The area containing high tributyltin concentrations was located outside the Port Expansion Project dredging and construction footprint, as shown in Figure B.5.4, and will be excavated and disposed to land as part of the Berth 12 project.

Based on data collected from the outer harbour area (URS, 2008), tributyltin was not considered to represent a COPC in the context of this Project. Notwithstanding this, further more detailed investigations will be required to validate the initial findings of (URS, 2008).

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons were analysed in 44 samples from the inner harbour by Maunsell (2002). PAH concentrations were generally at or below the detection limit, with the analytical laboratory's detection limit below the respective guideline screening levels. The exception was one sample that had an acenaphtylene concentration above the screening level. Phase III elutriate testing on this sample demonstrated that all PAH concentrations were below the laboratory detection limit and ANZECC/ARMCANZ (2000) water quality guideline levels (9%% protection of species). Therefore, polycyclic aromatic hydrocarbons were not considered to be a contaminant of concern for the Townsville inner harbour (Maunsell, 2002).

No measurements of polycyclic aromatic hydrocarbons are available for the outer harbour area sediments. However, given the absence of polycyclic aromatic hydrocarbons sources adjacent to the outer harbour area, it is expected that polycyclic aromatic hydrocarbons concentrations in such sediments would, like inner harbour sediments, be below relevant screening levels. Further sampling will be undertaken prior to project commencement to validate this conclusion.

Pesticides/Herbicides

Hydrobiology (2003a) analysed a wide range of organochlorine/organophosphate pesticides, herbicides and fungicides in porewater and sediments from one site in the inner harbour. All 40 pesticides and herbicides measured in this study were below laboratory levels of reporting, which were below respective screening levels. No data for pesticides/herbicides are available for the outer harbour area. However, given that there are no additional sources of these contaminants in or adjacent to the outer harbour area, their concentrations in these sediments are likewise expected to be below screening levels. It is considered highly unlikely that pesticides and herbicides represent COPC in the Port.

Acid Sulfate Soils

Golder (2008) conducted field screening tests and Chromium Suite tests to determine concentrations of actual acid sulfate sediments and potential acid sulfate sediments at seven locations in the outer harbour (cores to 6 m sediment depth). Field screening tests indicated that no actual acid sulfate sediments were present in this area. A generally low interpreted acid sulfate potential was inferred from the field screening tests, although some samples showed medium to high interpreted potential acid sulfate sediments. Golder (2008b) noted that field tests in saturated sediments from estuarine areas generally provide a poor indication of the presence of potential acid sulfate sediments because of the buffering capacity of saltwater in the soil.

Laboratory measurements of low existing titratable acidity confirmed that the sediments in the outer harbour were not actual acid sulfate sediments. However, Chromium Reducible Sulfur concentrations indicated that sediments down to 2.5 m depth were potential acid sulfate sediments.

Summary

The studies described above provide a basis for describing sediment quality in the outer harbour area. From the available data, only TBT concentrations exceed NAGD screening levels in a small localised area outside the bounds of the Port Expansion Project development footprint. This hot spot is likely to be removed prior to the construction of the Port Expansion project. The high zinc concentration in a single sample in the outer harbour (Golder Associates, 2008b) would not be expected to trigger NAGD screening levels when assessed following recommended NAGD procedures (i.e. 95%UCL of a minimum of seven samples). Therefore, in accordance with the approach outlined in NAGD, the concentrations of contaminants in the overall dredged material were well below screening values, and would not pose a constraint to future offshore placement of those dredged materials.

Further sampling and development of a Sampling and Analysis Plan (SAP) will be required prior to application for dredged material placement (ocean and land placement).

PORT EXPANSION PROJECT
EIS

Location of Sediments that Exceed NAGD Screening Levels for TBT (URS 2010)

Figure B.5.4

Legend

- Approximate Excised Area (2,937m^2)
- New Channel Area to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

Normalised TBT in Sediment (ng Sn/g)

- >20
- 9 to 19.9

N

Scale: 1:25,000 approx. (when printed at A4)

0 250 500 1,000
Metres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_050

Data Source:
Location of Sediments that Exceed NAGD Screening Levels for TBT (URS 2010), Figure 1.3 - BMT WBM 2012.

B.5.3.5 Current Condition of Sediment Quality – Metals/Metalloids

Temporal Trends

The trends discussed in this section are informed by POTL's Long Term Sediment Monitoring Program, which has been undertaken since 1995. Sediment analyses have focused on trace metal/metalloid concentrations, namely: antimony, arsenic, barium, cadmium, cobalt, chromium, copper, manganese, molybdenum, nickel, lead, tin, silver and zinc. Mercury is not considered a contaminant of concern for the Port of Townsville (GHD, 2008) and therefore is not part of this monitoring program. This is supported by bioavailability and ecotoxicity testing of sediment by Hydrobiology (2003a), which found that mercury concentrations were below screening levels in all samples. Mercury was also below the limit of detection in all 23 boreholes taken from the Townsville outer harbour (Golder Associates, 2008b). Most recently, sediment samples have only been analysed for POTL's nine key metal/metalloid contaminants of concern (antimony, arsenic, cadmium, chromium, copper, nickel, lead, silver and zinc) because all others had previously been found to be consistently below the limits of detection.

For the sole purpose of determining temporal trends in metal/metalloid concentrations, annual mean concentrations were derived from the POTL sediment quality data. Assessment of these annual mean concentrations indicated that concentrations of nickel, copper and arsenic show a slight increase in time across some of the investigation areas after 2008, particularly at the Berth 11 area (Table B.5.2). Other contaminants showed no long term trend (e.g. zinc, chromium, cadmium, lead).

The results are consistent with previous assessments in the Port (GHD, 2008) which show that metal/metalloid concentrations change over time. These temporal trends are expected to be partly a consequence of the following:

1) Periods of above average rainfall and associated catchment/stormwater runoff. The years 2000 to 2011 had above average annual rainfall, particularly 2009 to 2010 which had almost double the average annual rainfall. The period January and February 2009, rainfall was 2.5 to 3.5 times greater than the historical monthly average (Chapter B4 - Water Quality). The Project Area is a depositional environment that may have accumulated sediment loads associated with high rainfall events.

2) Loads via stormwater runoff or wind dispersal from the existing ore unloading and material loading associated operations at the Port. The current nickel ore stockpile and unloading facility (Berth 2) are located adjacent to Berth 11 and the outer harbour area.

Table B.5.2 Annual mean concentrations of nickel, copper and arsenic - 1996-2011 (mg/kg)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Nickel (mg/kg)																
Outer Harbour	10.0	11.7	10.8	10.8	10.4	11.4	17.1	10.7	11.0	11.0	11.8	12.2	14.0	15.4	16.0	14.3
Berth 11	-	-	11.9	16.2	13.5	15.6	18.4	13.7	14.7	16.0	14.2	16.5	21.8	25.5	49.1	42.0
Rock Wall	4.3	4.4	4.9	5.9	4.2	4.7	5.8	4.4	5.7	5.0	5.9	6.0	5.5	9.4	6.8	5.0
Sea Channel	9.9	8.6	10.7	10.6	9.3	9.7	12.6	9.1	10.6	11.0	13.4	13.0	12.0	15.9	26.5	15.7
Platypus Channel	11.1	11.6	12.1	12.6	11.5	11.4	14.6	11.2	13.9	14.5	14.1	13.5	14.4	19.3	20.9	12.6
Copper (mg/kg)																
Outer Harbour	11.0	8.6	9.2	9.6	10.1	11.9	10.1	9.2	9.2	9.2	10.1	11.8	10.4	12.8	11.6	14.4
Berth 11	-	-	12.7	15.3	13.8	15.3	16.8	13.2	16.0	15.8	14.3	17.6	19.4	22.1	21.2	20.6
Rock Wall	4.5	2.5	2.8	3.4	2.3	2.4	3.0	2.3	2.7	2.9	2.9	3.3	2.8	3.8	2.5	3.3
Sea Channel	10.4	12.0	7.7	7.6	7.7	7.3	8.2	7.1	7.5	8.0	9.8	9.0	7.1	11.2	9.6	12.5
Platypus Channel	13.0	12.5	12.2	13.9	13.4	11.7	13.9	11.2	12.3	13.2	13.4	14.5	11.9	14.7	12.3	14.1
Arsenic (mg/kg)																
Outer Harbour	7.5	8.1	7.5	8.5	8.4	8.5	9.0	9.3	9.6	9.6	10.1	10.6	9.9	10.0	11.7	11.6
Berth 11	-	-	8.9	11.6	9.5	10.2	12.3	11.4	12.2	11.7	11.4	12.1	12.5	12.7	17.0	14.4
Rock Wall	6.8	2.9	4.7	5.8	5.1	5.3	6.2	5.6	6.6	6.3	7.4	7.4	6.1	6.6	6.7	5.8
Sea Channel	8.9	6.6	7.1	7.8	6.8	7.1	7.8	7.8	8.3	8.5	10.1	9.0	7.8	9.2	10.0	10.5
Platypus Channel	8.5	8.3	7.6	8.3	8.1	7.8	8.4	8.3	9.7	9.7	10.0	9.7	9.0	5.6	11.0	10.0

Contaminants of Potential Concern (COPC)

The 95%UCL for trace metals/metalloids for each the five investigation areas are shown in Table B.5.3. Nickel and lead had 95%UCL above the NAGD screening level at the Berth 11 investigation area, and were therefore considered to represent COPCs in the context of this Project. However, it is noted that concentrations above NAGD screening levels only triggers further testing to determine suitability for ocean disposal (i.e. Phase III assessments as per Figure B.5.1), and does not necessarily mean that sediment is contaminated and unsuitable for ocean disposal.

Furthermore, the Berth 11 surficial sediment will likely be removed as part of maintenance dredging prior to the Port Expansion Project commencing, and is therefore subject to separate approvals. As such, further Phase III testing has recently been undertaken in the Berth 11 area as part of the maintenance dredging approvals process, and at the time of writing the results were being reviewed by DSEWPAC and DEHP.

As the Berth 11 area (along with other areas) will be deepened as part of capital dredging for the Port Expansion Project, the in situ consolidated sediment below the surficial sediment to be maintenance dredged is still required to be characterised. This will be undertaken as part of the sediment Sampling and Analysis Plan (SAP), however as these sediments are below the zone of contemporary contamination (typically >1 m), it is expected that they are not likely to be contaminated.

The 95%UCL for all trace metals/metalloids were below screening levels at the other investigation areas.

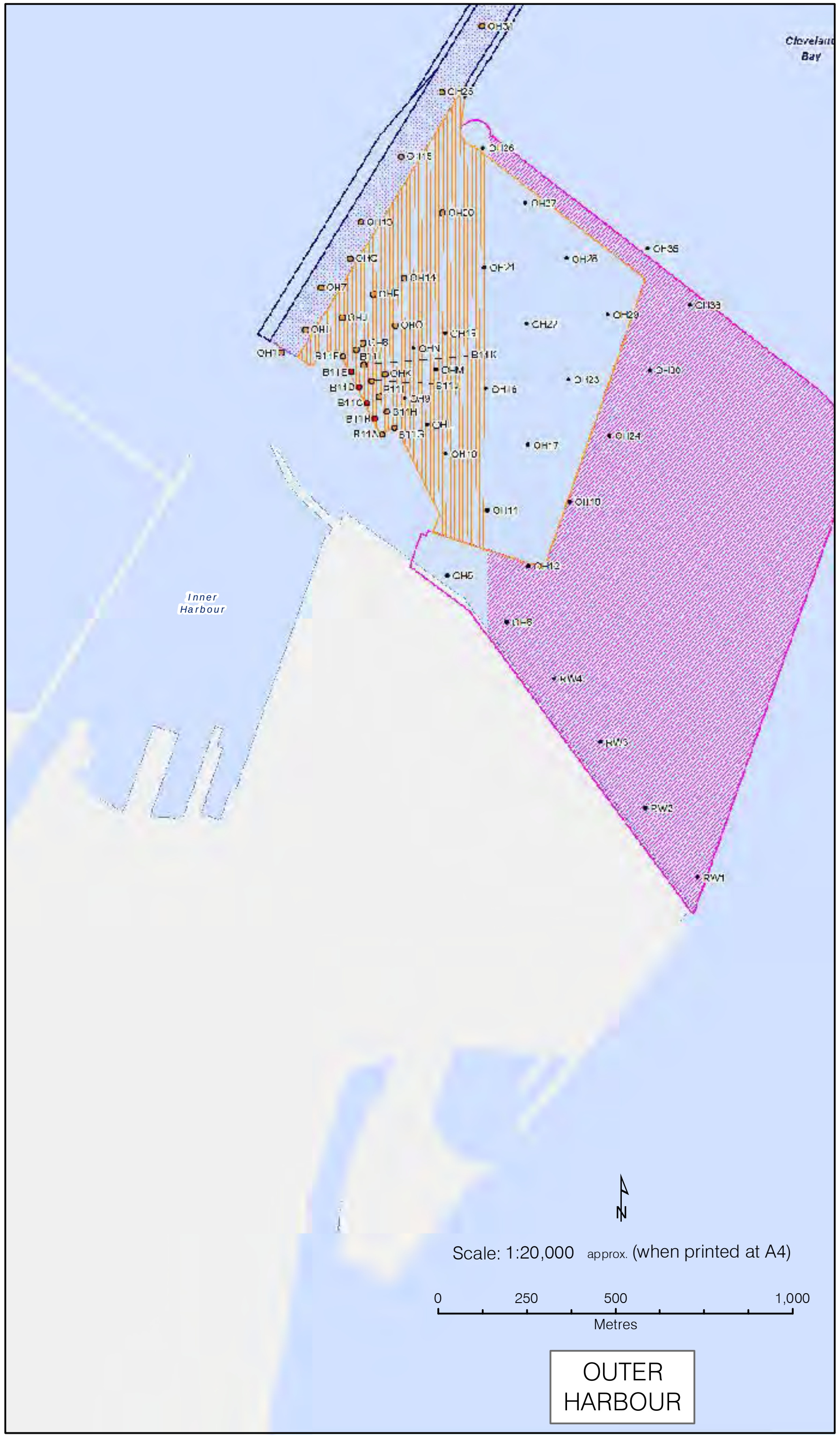
Table B.5.3 95%UCL of metal/metalloid concentrations (mg/kg) for each broad dredge area (data 2007-2011)

Area	Antimony	Arsenic	Cadmium	Chromium	Copper	Nickel	Lead	Silver	Zinc
Screening level (mg/kg)	2	20	1.5	80	65	21	50	1	200
Outer Harbour	<0.5	10.92	0.06	23.92	13.69	15.47	16.72	0.28	63.91
Berth 11	<0.5	14.16	0.17	37.17	20.93	44.92	78.41	0.65	79.88
Rock Wall	<0.5	6.89	<0.1	11.17	3.41	7.43	7.91	0.45	27.81
Sea Channel	<0.5	9.68	0.15	23.14	10.46	14.93	17.49	0.42	39.19
Platypus Channel	<0.5	10.16	0.12	24.26	15.43	17.46	18.39	0.41	48.96

Figure B.5.5 to Figure B.5.7 show the concentrations of trace metals in surface sediments at individual monitoring sites. These figures show that there were instances where localised areas had concentrations above screening levels. However, as discussed above, when assessed in accordance with the NAGD assessment process, the overall 95%UCL for most trace metal/metalloids concentrations were below screening levels.

Further testing (as part of the sediment Sampling and Analysis Plan) will be undertaken to refine the preliminary assessment above, as set out in Section B5.5. Depending on the results from implementation of the Sampling and Analysis Plan, further assessment as per Phase III of the NAGD assessment framework may be required. Phase III involves both elutriate and bioavailability testing to determine if a bioavailable fraction is present that would affect marine life (DEWHA, 2009a). Pending the results of these Phase III assessments, toxicity and bioaccumulation testing (Phase IV) may also be required to further determine the potential of sediment-borne contamination as a result of dredging and placement works.

These results provide a preliminary indication that surface sediments throughout the outer harbour area should be suitable for ocean placement. In the event that further assessments indicate that any localised areas of sediment are not suitable for ocean placement, appropriate land-based disposal will be utilised (Section B5.5.2).



PORT EXPANSION PROJECT EIS

Locations of Distinct Sites Exceeding NAGD Screening Levels for Nickel Concentrations, Data Pooled 2007-2011 (95%UCL mg/kg)

Figure B.5.5

Legend

- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

Sediment Nickel Concentration (95%UCL mg/kg)

- Greater than or equal to 52
- 21 to 51
- Less than 21

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

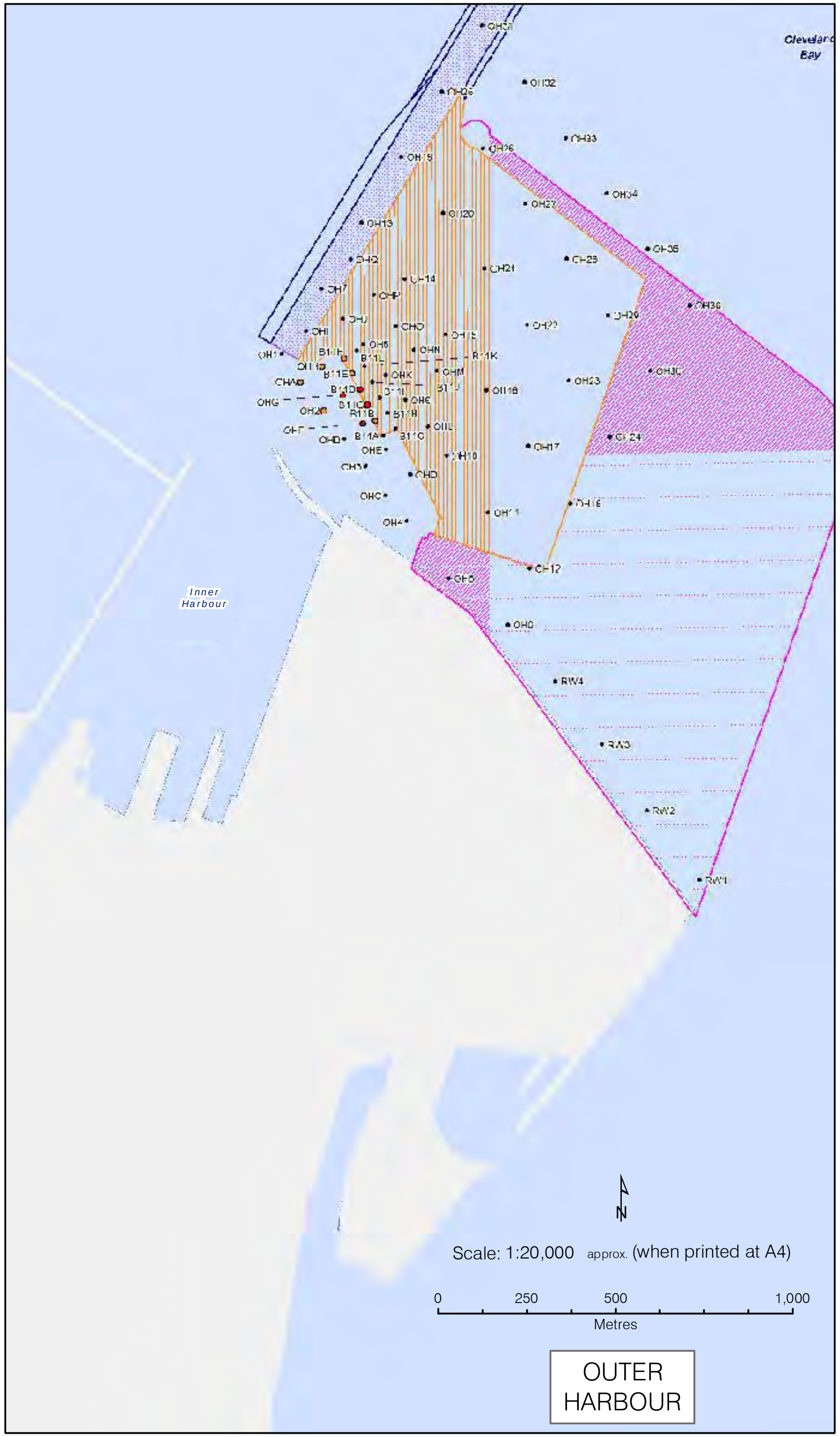
FILE NAME 60161996_PLN_051

Data Source:
Location of Sediments where Nickel Concentrations Exceed NAGD Screening Levels, 2007-2011 (95% UCL mg/kg), Figure 1.4 - BMT WBM 2012.

PORT EXPANSION PROJECT
EIS

Locations of Distinct Sites Exceeding NAGD Screening Levels for Lead Concentrations, Data Pooled 2007-2011 (95%UCL mg/kg)

Figure B.5.6



Legend

Channel to be Dredged
Existing Channel to be Deepened
Harbour Basin
Reclamation Area

Sediment Lead Concentration (95%UCL mg/kg)

Greater than or equal to 220
50 to 219
Less than 50

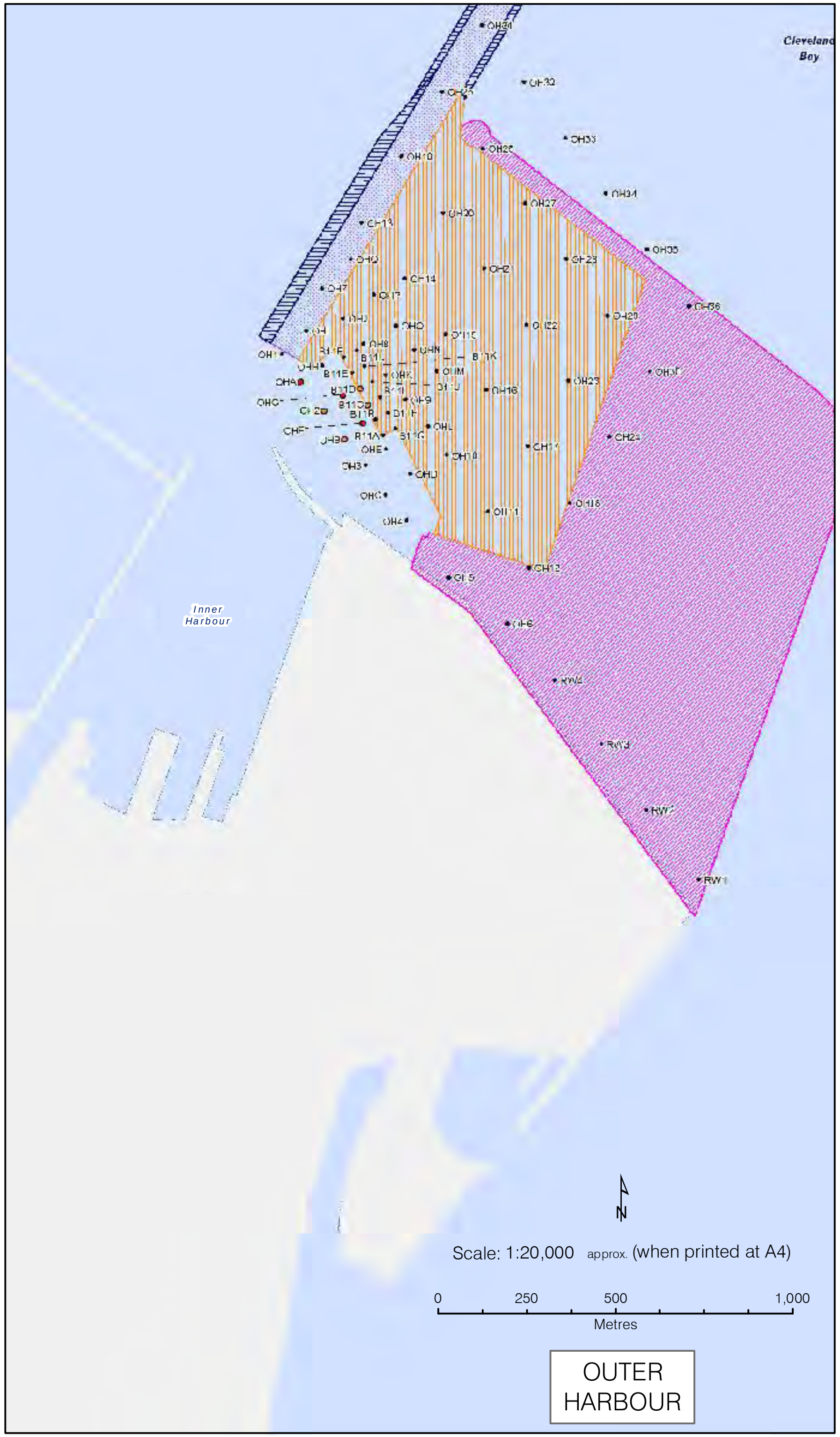
PROJECT ID 60161996
LAST MODIFIED CFS 16-Oct-2012
FILE NAME 60161996_PLN_052

Data Source:
Location of Sediments where Lead Concentrations Exceed NAGD Screening Levels, 2007-2011 (95% UCL mg/kg), Figure 1.5 - BMT WBM 2012.

PORT EXPANSION PROJECT
EIS

Locations of Distinct Sites Exceeding NAGD Screening Levels for Silver Concentrations, Data Pooled 2007-2011 (95%UCL mg/kg)

Figure B.5.7



Legend

- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

Sediment Silver Concentration (95%UCL mg/kg)

- Greater than or equal to 3.7
- 1.0 to 3.6
- Less than 1.0

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_053

Data Source:
Location of Sediments where Silver Concentrations Exceed NAGD Screening Levels, 2007-2011 (95% UCL mg/kg), Figure 1.6 - BMT WBM 2012.

B.5.3.6 Sediment Porewater Quality - Nutrients

Results of sediment porewater and elutriate analyses from samples collected in the outer harbour area and Platypus Channel are provided in Table B.5.4 and Table B.5.5. Samples were collected from surface sediments, to a maximum depth of 150mm below the sediment surface (i.e. from soft to very soft sandy clays and clays). Porewater samples from the outer harbour area were characterised by low nutrient concentrations, while porewater samples from Platypus Channel have higher nutrient concentrations.

Table B.5.4 Surface sediment porewater results (mg/L, November 2010)

Site	Location	Ammonia	NO_x	TN	PO_4	TP
103	Platypus Channel	6.88	0.016	6.63	0.017	0.451
104	Platypus Channel	6.85	0.011	7.56	0.012	0.426
105	Platypus Channel	3.92	0.008	5.18	0.012	0.523
106	Outer Harbour	1.05	0.016	2.09	0.021	0.218
107	Outer Harbour	0.95	0.011	1.17	0.032	0.094
108	Outer Harbour	7.10	0.094	7.26	0.010	0.138

(Ammonia as N, Nitrite + Nitrate (NO_X) as N, Total Nitrogen (TN) as N, Reactive Phosphorus (PO_4) as P, Total Phosphorus (TP) as P.)

Table B.5.5 Surface sediment elutriate results (mg/L, November 2010)

Site	Location	Ammonia	NO_x	TN	PO_4	TP
103	Platypus Channel	1.70	0.011	1.93	0.009	0.035
104	Platypus Channel	2.07	0.008	2.35	0.011	0.044
105	Platypus Channel	1.33	0.008	1.50	0.009	0.036
106	Outer Harbour	0.24	0.008	0.36	0.022	0.023
107	Outer Harbour	0.19	0.010	0.30	0.027	0.030
108	Outer Harbour	1.73	0.003	2.00	0.007	0.034

(Ammonia as N, Nitrite + Nitrate (NO_X) as N, Total Nitrogen (TN) as N, Reactive Phosphorus (PO_4) as P, Total Phosphorus (TP) as P.)

Of particular relevance are the relationships of the elutriate results to relevant water quality objectives and/or toxicity limits. This is because the elutriate tests attempt to measure resultant water column concentrations following some degree of dilution (a ratio of four parts seawater to one part porewater) as a highly conservative replication of mixing associated with dredge activities.

There are no set water quality objectives for sediment porewater; however, previous dredging-related assessments elsewhere (BMT WBM, 2008) have been required to compare porewater (and elutriate) concentrations with acute toxicity trigger values associated with water column water as outlined in the National Water Quality Guidelines (ANZECC & ARMCANZ, 2000). In the case of the analytes examined here, the key species of interest are ammonia and nitrogen oxides (NO_X), which have listed toxicity trigger values.

The toxicity trigger value for nitrate, which forms the main form of oxidised nitrogen, is 13mg/L assuming 95% protection of species. Therefore the oxidised nitrogen concentrations recorded in both the outer harbour and Platypus Channel areas pose negligible threat.

For ammonia the toxicity trigger value varies according to pH. Given the typical pH of 8.0 and adopting a 95% protection of species for slightly to moderately disturbed systems, the toxicity trigger value for ammonia is 0.91mg/L (ANZECC & ARMCANZ, 2000). Although elutriate tests for sites in or nearest to Platypus Channel exceeded this value (i.e. Sites 103, 104, 105 and 108) ammonia concentrations reported were consistent with those found previously by others at separate locations in and around the port (for example, (Hydrobiology, 2003a)). These previous studies also found that ammonia levels were naturally elevated in the area. Importantly, those previous studies conducted detailed and extensive risk assessments associated with these levels of porewater ammonia, and were able to show that toxicity risks were minimal.

B.5.4 Assessment of Potential Impacts

Construction works will involve the capital dredging and the placement of the dredged material and armour rock into the marine environment. Ongoing maintenance dredging and dredged material placement will also be required throughout the life of the Project. Dredging, placement and other disturbances to marine sediments, such as pile driving, can alter the physical and/or chemical characteristics of the existing marine sediment environment, potentially resulting in adverse effects to marine ecological values.

A risk-based approach was adopted to characterise potential impacts, based on the approach described in this EIS. Table B.5.6 and Table B.5.7 provide a summary of the categories assigned to the various levels of potential impacts in this assessment, as well as the anticipated likelihood for potential impacts to occur in the absence of the proposed mitigation. Based on these consequence and likelihood categories, Section B5.7 provides a tabulated summary of the sediment quality issues addressed by the marine sediment quality impact assessment, including the results of the risk assessment for each issue, the relevant mitigation measures and the resultant residual risk.

Table B.5.6 Guide to the expected consequence of level of potential impact

Impact Magnitude	Description of Consequences
Very High	The impact is considered critical to the decision-making process due to its significance/importance at a national or international scale. Impacts tend to be permanent or irreversible or otherwise long term and can occur over large-scale areas.
High	The effects of the impact are likely to be important to decision-making due to its state significance/importance. Impacts tend to be permanent or irreversible or otherwise long term and can occur over large or medium scale areas.
Moderate	While important at a regional or local scale, these impacts are not likely to be key decision making issues. Impacts tend to be medium or short term and/or occur over a medium to small (local) scale.
Low	Impacts are recognisable/detectable but acceptable. These impacts are unlikely to be of importance in the decision making process. Nevertheless, they are relevant in the consideration of standard mitigation measures. Impacts tend to be short term or temporary and/or occur at local scale.
Negligible	Minimal change to the existing situation. This could include for example impacts which are beneath levels of detection, impacts that are within the normal bounds of variation or impacts that are within the margin of forecasting error.
Beneficial	Any beneficial impacts as a result of the Project such as for example, the improvement of habitat.

Table B.5.7 Guide to the anticipated likelihood of potential impacts

Likelihood of Impacts	
Highly Unlikely/Rare	Highly unlikely to occur but theoretically possible
Unlikely	May occur during construction/life of the Project but probability well below 50%; unlikely but not negligible
Possible	Less likely than not but still appreciable; probability of about 50%
Likely	Likely to occur during construction or during a 12 month timeframe; probability greater than 50%
Almost Certain	Very likely to occur as a result of the project construction and/or operations; could occur multiple times during relevant impacting period

B.5.4.1 Construction Phase Dredging and Sediment Disturbance

Capital dredging during the construction phases of the Port Expansion Project will result in the removal of approximately 10 million m^3 of sediments during the development of the outer harbour, as well as the deepening of the Platypus and Sea channels, and minor widening of Platypus Channel at the entrance to the outer harbour. A break-down of the estimated dredge volumes (for each sediment type) for each capital dredging stage is provided in Table B.5.6. Note that it is estimated that approximately 43% (~4.3 million m^3) of the combined three firm/stiff/dense sediments will be required for use as reclamation fill.

The excess from these sediment categories, together with the soft surface sediments, results in a balance of approximately 5.7 million m^3 that is planned for offshore placement.

Table B.5.8 Estimated capital dredging sediment volumes (m^3)

	Soft surface sediments	Firm and stiff sandy clays	Very stiff and hard sandy clays	Medium dense clayey sand	Total
Stage A (Harbour and Channel)	1,941,569	1,932,875	696,220	830,445	5,401,110
Stage B (Harbour)	90,264	351,028	366,072	100,294	907,659
Stage C (Harbour and Channel)	604,410	1,878,326	858,521	319,177	3,660,434
Stage D	*Other works – no dredging required during this stage.*				
Grand Total					**9,969,203**

After the completion of capital dredging works, the physical characteristics of the new surficial sediments will initially be different to the original soft sandy clays, more closely reflecting the characteristics of the deeper subsurface sediments (i.e. stiff hard sandy clays and sands). This will gradually change over time as coastal processes deposit finer materials over these facies.

Marine sediments may be mobilised at the dredge site via the following mechanisms:

- Overflow dredging – where excess water from the dredged material is drained from the hopper and released back into the water column releasing suspended sediment.
- Sediment directly disturbed at the dredge site by the dredge head.
- Spills from the mechanical dredger – during the process of transferring sediment from the sea floor to the hopper.
- Leaking hoppers for example, due to hopper overloading.

Disturbance and mobilisation of marine sediments may also occur as a result of other construction activities, particularly the following:

- Placement of the rock armour enclosing the reclamation area (i.e. construction of new breakwaters and revetments).
- Pile driving activities associated with the construction of new shipping berths.

This chapter is principally concerned about the disturbance of sediments during dredging and construction that could release sediment contaminants. The potential impacts of increased suspended sediments and turbid plumes to water quality and marine ecology values are discussed separately in Chapter B3 (Coastal Processes) and Chapter B6 (Marine Ecology).

As discussed in Section B5.3, marine sediments in the Port Expansion Project dredging areas typically contain elements (potential contaminants) at concentrations (95%UCL) that are below NAGD screening levels, and therefore do not pose a toxicity threat. The only exception to this is the surficial sediments recently detected near Berth 11 containing elevated nickel and lead concentrations. However, the Berth 11 area will be dredged as part of maintenance dredging prior to the Port Expansion Project, and further assessment of these sediments has been undertaken as part of the maintenance dredging approval process. Consequently, it is unlikely that residual contaminated sediments will remain or accumulate in this section of the of the outer harbour area prior to construction of the Port Expansion Project. Still, testing will be undertaken to confirm this and, in the event that localised areas of probable contamination are identified, this chapter provides guidance for handling and managing these sediments.

Further testing will accurately map the distribution of contaminants in areas to be dredged, in accordance with NAGD. Where contaminants are found in concentrations above trigger values, additional testing will also be undertaken in accordance with NAGD to confirm suitability for ocean placement. In the event that any 'hot-spots' are identified, mitigation measures will be implemented to reduce the risk of sediments being released from the dredger into other locations. For example, identified hot spots will be excised and disposed to land (refer mitigation measures in Section B5.5). This further testing will also advise the likely areas and volumes (if any) that should be treated as contaminated sediment during dredging and disposal. If further testing confirms the presence of some localised areas of material that are unsuitable for ocean disposal, it is expected that these volumes will be small, particularly in the context of the overall dredging program proposed for this Project.

Changes in pH due to disturbance and exposure of acid sulfate soils to the atmosphere can also lead to water quality impacts. As discussed in Section B5.3.4, no areas of actual acid sulfate sediments are known to occur in the outer harbour area, although areas of high acid sulfate potential are present in the upper 2.5m of surface Holocence sediments (Golder Associates, 2008). Being in the upper, soft surface layer, the bulk of potential acid sulfate sediments will be placed at sea so will not pose a water quality risk (i.e. will remain waterlogged during dredging and placement process).

B.5.4.2 Construction Phase Dredged Material Placement

Offshore DMPA

Dredged material to be placed at the offshore DMPA includes stiff clays and fine silty sediments that are unsuitable for use in reclamation fill, as well as sands that are either excess above that required for fill or dispersed throughout the finer sediment layer (Golder Associates, 2008). This dredged material has different physical characteristics (e.g. grain size, compaction and compressibility) to that now present at the DMPA. Therefore, the placement of dredged sediments at the DMPA is expected to result in an initial smothering with finer sediments at placement sites, eventually leading to a mosaic of patches with different disturbance histories, which may result in changes to resident benthic fauna communities (Chapter B6 - Marine Ecology).

Further assessment as part of the Sampling and Analysis Plan will confirm whether these sediments are suitable for ocean disposal, and only sediments that are acceptable for ocean disposal will be placed at the offshore DMPA. Subsequently, dredged sediments placed at the offshore DMPA will not lead to toxic effects to resident benthic communities or nearby marine communities.

Reclamation Area

Marine sediments from the subsurface layers of the dredging footprint are suitable to be used as fill in the proposed reclamation area.

Most of the potential acid sulfate sediments are located in the upper surface layer of sediment to a depth of approximately 2.5m (Section B5.3.4). Much of this, especially the first 1 m of sediment, has already be deemed unsuitable as reclamation fill for structural reasons and will be destined for offshore placement at the DMPA. These sediments will remain wetted during the dredging and disposal process, avoiding oxidisation and associated water quality effects. If potential acid sulfate sediments from deeper sediments (i.e. those 1 to 2.5 m depth) are required as reclamation fill, they will be strategically placed at the bottom of the reclamation area below the permanent water table and/or will be treated appropriately to ensure neutralisation. Additional management procedures will also be implemented, as described in Chapter B1 (Land), so that no adverse effects occur from the disturbance or placement of potential acid sulfate sediments.

B.5.4.3 Operational Phase

Maintenance Dredging and Placement

Maintenance dredging of the outer harbour and the shipping channels is usually undertaken at least annually, with volumes varying over time. Maintenance dredging and dredged material placement will be undertaken in accordance with NAGD or future versions of these guidelines, and only acceptable sediments will be placed at sea. Consequently, neither a build-up or entrainment of contaminants at the DMPA would be expected to occur as a result of the placement of maintenance dredged material.

Operational Impacts to Future Sediment Quality

Once operational, it is forecast that shipping (and associated export/import activity) will increase by approximately 60% in the 20 years from 2010 to 2030. The increase in shipping and import/export activity may increase the potential for shipping related contaminants (e.g. hydrocarbons), trade products and industrial run-off (e.g. metals, polycyclic aromatic hydrocarbons etc.) to enter the marine environment with an effect on sediment quality. Stormwater and product handling and storage management procedures will need to be developed and implemented to reduce the risk of significant loads of contaminants entering the marine environment. POTL long term sediment quality monitoring program will also continue with expansion of the program to accommodate new berths and areas that could also be affected by the Port Expansion Project.

B.5.5 Mitigation Measures and Residual Impacts

B.5.5.1 Identification of Sediments Unsuitable for Ocean Disposal

The present study represents a Phase I level investigation in accordance with NAGD (see Figure B.5.1). The study identifies preliminary Contaminants of Potential Concern of relevance to the Project in surface sediments adjacent to the Project area, and areas requiring further investigation in accordance with NAGD. These further studies will particularly focus on the identification of any material that is unsuitable for ocean disposal.

A strategy will be developed and implemented to inform dredging and disposal activities, ensuring that relevant sediments are adequately identified and appropriately managed. One key technical input to further investigations will be a Sampling and Analysis Plan (SAP), which will be prepared in accordance with NAGD (DEWHA, 2009a), following a decision on the EIS, in order to properly characterise the total extent and volume of capital dredged sediments. Additionally, an assessment of the acid sulfate potential of subsurface sediments to be placed in the reclamation area will be carried out in accordance with the *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland* (Ahern, Ahern, & Powell, 1998).

Sampling will be undertaken to support the Sea Dumping Application and State Government approvals for the dredging and dredged material disposal components of the Port Expansion Project. Any dredge areas that are unsuitable for ocean disposal will be placed on land, as described in Section B5.5.2.

B.5.5.2 Handling and Disposal of Sediments Unsuitable for Ocean Disposal

In accordance with the NAGD process, the detailed sediment sampling program described above will be used to identify any sediment that is unsuitable for ocean placement. Any such sediment will be handled separately and disposed to land (i.e. will not be placed at DMPA). It is proposed that the following mitigation measures and dredging and disposal processes will be implemented as part of the Dredge Management Plan (refer to Chapter C2.1) for the Port Expansion Project to manage the potential impact of contaminant mobilisation during proposed dredging works:

- A mechanical grab dredge will be used to reduce environmental disturbance when excavating sediments unsuitable for ocean disposal. This type of dredge is preferred as it does not create as much disturbance to the sea bed as other dredging techniques, reducing the potential for contaminant mobilisation. It also does not require fluidisation of the dredged material, reducing the requirement for overflow dredging techniques and associated impacts. For the excavation of clean sediments elsewhere, trailing suction hopper dredges will be used.
- A sediment volume greater than that known to be unsuitable for ocean disposal will be removed for onshore disposal to ensure that all unsuitable sediment is removed, resulting in negligible risk of unsuitable material being disposed at DMPA.
- Once excavated and placed on the barge, material unsuitable for ocean disposal will be pumped onshore to a dedicated onshore area for drying and dewatering, including monitoring of decant waters.
- Residual traces of contaminated sediment would be removed prior to dredging of the remaining clean sediment. This methodology would reduce slumping of material into ‘clean’ areas as may happen if the dredging order were reversed.
- Appropriate dredge management procedures will be implemented. For example, ensuring the hopper is not overloaded to the point that there is a risk of materials unsuitable for ocean disposal spilling over the sides of the vessel.
- Silt curtains will be used to prevent migration of turbid plumes when practicable. These silt curtains could only used when favourable conditions permit as they would be ineffective when high waves, currents or considerable tidal variation occurs, as is commonly the case in dredge footprint areas in Townsville.

- Dredge operators will ensure hopper seals are in good condition and not compromised by obstructions, so that sediment laden water is prevented from discharging back into the water.

Land based treatment and disposal of materials unsuitable for ocean disposal will be in accordance with State Government approvals and guidelines relating to the assessment and management of contaminated land in Queensland (EPA, 1998). For onshore treatment of material unsuitable for ocean disposal, a dewatering monitoring program (monitoring metal/metalloid contaminants of concern and pH) will be developed and implemented to reduce the risk of contaminated dewatering discharges entering the marine environment.

As discussed above, there is a likelihood that potential acid sulfate sediments will be placed in the reclamation area. As detailed in Chapter B1 (Land), appropriate procedures will be in place to ensure that the disturbance and placement of potential acid sulfate sediments does not adversely affect water quality.

B.5.5.3 Monitoring

Sediment quality sampling in the abovementioned SAP (Section B5.5.1) will be undertaken as a singular exercise prior to the capital dredging works and submission of the Sea Dumping Permit Application and relevant State Government approvals. In accordance with the current POTL Long Term Sediment Monitoring Program, quarterly monitoring of sediment trace metal/metalloid concentrations will continue to occur. No additional ongoing marine sediment quality monitoring is proposed specifically as part of the Port Expansion Project.

Appropriate water quality monitoring of dewatering discharges and any seepage, runoff or decant waters to be discharge from the reclamation area are spoil dewatering or treatment areas will be undertaken on a regular basis before waters are treated, if required, and discharged to the marine environment.

B.5.5.4 Long Term Dredging and Disposal Management Plans

The Port of Townsville Long Term Dredging and Disposal Management Plan will provide the long term spoil disposal strategy for the design life of the Port Expansion Project (i.e. > 20 years). This Long Term Dredging and Disposal Management Plan will continue to be regularly reviewed and updated as required. In particular, the plan will be revised in order to incorporate relevant conditions and requirements and the approvals obtained for the Port Expansion Project when it becomes operational.

In summary, the plan currently describes the following:

- Relevant past, current and proposed dredging activities in the port.
- Disposal options, considerations and justification.
- Environmental values in the port limits and wider Cleveland Bay, including sediment quality, water quality, and sensitive habitats and biological receptors.
- Procedures for maintenance dredging and dredged material management, particularly with respect to minimising dredging, minimising ocean disposal, associated environmental impacts and other environmental risks.
- Legislative, policy and stakeholder considerations.

B.5.6 Cumulative Impacts

The assessment of potential sediment quality impacts has thus far considered likely impacting processes and mechanisms that may result from either the construction or operation of the Port Expansion Project. A number of other concurrent and future projects are also proposed in the Port of Townsville. Each of these projects comprise significant marine sediment disturbance components, especially in relation to dredging. Of particular relevance to the consideration of cumulative impacts here are the:

- Marine Precinct development (Stage 1 now complete).
- Construction of Berth 12 and associated vessel manoeuvring areas.
- Minor channel improvement works.

Dredging and dredged material placement components of other existing/concurrent and future proposals will be undertaken in accordance with NAGD and the Long Term Dredging and Disposal Management

Plan, or any relevant future versions of these documents. Therefore, similar to the current proposal, the likelihood of these other proposals mobilising potential contaminants into the water column during loading or placement is low.

A key matter, especially in the context of dredging for future projects, is consideration of the capacity of the onshore spoil dewatering and disposal facilities to accommodate combined dredged material volumes of contaminated sediments. In the event that further contaminated marine sediments which are unsuitable for ocean placement are encountered, consideration will need to be given to the capacity of the current land-based dewatering and storage/disposal facilities to accommodate volumes of contaminated marine sediments from multiple proposals. POTL operate a purpose-built drying and dewatering area for contaminated sediments that are excavated. This is an isolated bunded area in the eastern reclamation area. It is proposed that this area will continue to be used for these purposes for all existing and concurrent proposals, given the relatively small volumes that are expected to require land-based disposal. In the unlikely event the capacity of this dewatering facility is exceeded, a similar facility will be constructed and operated in the Port Expansion Project reclamation area.

As outlined in Part A of the EIS, a preliminary analysis of the capacity of the offshore DMPA has recently been undertaken confirming that the offshore DMPA is predicted to have sufficient capacity to accommodate dredged sediment from the Port Expansion Project, in addition to other planned port developments and maintenance dredging.

Other construction-related disturbances to marine sediments (e.g. pile driving) during concurrent and future projects will have appropriate management measures applied in order to avoid disturbing any latent contaminants in marine sediments. For example, using appropriate procedures to remove contaminated sediments prior to the commencement of relevant construction works. Therefore the cumulative risks associated with construction-related disturbance to marine sediments should be low (refer risk assessment summary – Section B5.7).

In terms of operational impacts to sediment quality, the assessment of the current project noted the potential for sediment quality to reduce over time, particularly in the new outer harbour, as a result of increased shipping, product loading/handling and industrial runoff. While these affects will be relatively localised for the Port Expansion Project, similar mechanisms will be underway elsewhere as a result of other projects (e.g. Marine Precinct, Berth 12). Therefore, the cumulative impacts of future operations to sediment quality will likely result in reduced sediment quality across a broader spatial scale, albeit still largely limited to areas in or adjacent to product storage or handling areas, berths and ship movement areas. This is under the premise that all other concurrent and future proposals will also have contemporary stormwater, product handling and storage management procedures, thereby reducing this risk.

B.5.7 Assessment Summary

Table B.5.9 Impact Assessment Summary – Sediment Quality

Element	Description of Impact				Summary of key mitigation measures	Residual Risk
	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact	Risk Rating (before mitigation)		
Disturbance and mobilisation of contaminated sediments during construction	Dredging in the outer harbour area	Moderate	Possible	Medium	Identify materials suitable for ocean disposal, and sediments unsuitable for ocean disposal, in accordance with NAGD assessment process. Identify any contaminated areas that are to be avoided by the dredger If contaminated sediments are detected, use a mechanical grab dredge (with silt curtains) for detected contaminated materials, excavate an area larger than that probably contaminated, dispose contaminated material onshore in accordance with appropriate procedures.	Low
	Dredging in Platypus and Sea channels, and Channel Extension area	Moderate	Unlikely	Low	See above for Dredging in the outer harbour area	Low
	Placement of dredged material unsuitable for ocean disposal at the DMPA	Moderate	Possible	Medium	Identify materials suitable for ocean disposal, and sediments unsuitable for ocean disposal, in accordance with NAGD assessment process. Undertake ocean disposal in accordance with NAGD and any Sea Dumping Approval and DEHP conditions.	Low
Placement of material in reclamation	Acid sulfate soil oxidation and release	Moderate	Possible	Medium	ASS management practices – refer to ASS report.	Low
On-shore placement of material unsuitable for ocean disposal	Dewatering of contaminated material	Moderate	Possible	Medium	Contaminated material will be placed in a separate bund with quality of tailwater tested prior to release. Monitor and manage dewatering, seepage or runoff waters if they occur (see EMP).	Low

Element	Description of Impact				Summary of key mitigation measures	Residual Risk
Operational impacts to future marine sediment quality	Potential decline in sediment quality, in or adjacent to project footprint, as a result of increased trade product handling and storage	Low	Possible	Low	Continue to implement appropriate environmental procedures for product handling and storage. Continue quarterly sediment quality monitoring. Ensure updates of long term Sea Dumping Permit and DEHP approvals, in accordance with NAGD.	Low

Port Expansion Project EIS

Part B

Section B6 – Marine Ecology and Conservation

AECOM BMT WBM

B.6 Marine Ecology and Conservation

B.6.1 Relevance of Project to Marine Ecology and its Values

This section addresses potential environmental issues and impacts to marine ecology associated with the Port Expansion Project, specifically in relation to the construction and operation of the new port facilities including the dredging and ocean placement of dredged material. This report section specifically describes:

- The main features of the existing environment in the Study Area, focusing on important or sensitive ecological resources and the integrity of coastal ecosystems;
- Potential impacts on the marine environment from the construction and operation of the port facilities; and
- Options for managing, mitigating or offsetting identified impacts.

In terms of impact mitigation, it is noted that the Port Expansion Project design has been developed and refined over a four year period to avoid and/or reduce impacts to the greatest practicable extent. The mitigation strategies outlined in this chapter specifically aim to mitigate construction and operational impacts associated with the Port Expansion Project.

B.6.2 Assessment Framework and Statutory Policies

B.6.2.1 Applicable Legislation to Policies

The following is a summary of Commonwealth and State legislation that is relevant to marine ecological aspects of the Port Expansion Project.

Federal:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which provides for the protection of matters of national environmental significance (MNES). MNES of relevance to the Port Expansion Project include:
  - World Heritage Sites and National Heritage Places (i.e. Great Barrier Reef World Heritage Area);
  - Wetlands of international importance (i.e. Bowling Green Bay Ramsar site occurs adjacent to Cleveland Bay);
  - Nationally threatened species and ecological communities (including marine turtles and whales);
  - Migratory species (including dugong, whale shark and several threatened marine megafauna species);
  - Commonwealth marine area; and
  - Great Barrier Reef Marine Park.
- *Great Barrier Reef Marine Park Act 1975 (GBRMP Act*) - relevant to the protection of marine ecological values within the boundaries of the marine park that may be affected by the Port Expansion Project).

State:

- *Nature Conservation Act 1992* (NC Act), which provides for the protection of state listed threatened and near threatened flora and fauna species, which in terms of this Project includes marine turtles, whales, dolphins and dugong.
- *Fisheries Act 1994* provides for the use, conservation and enhancement of the community's fisheries resources and fish habitats. Of particular relevance to the Port Expansion Project is the management of Fish Habitat Areas (including Cleveland Bay Fish Habitat Area) and the protection of fisheries habitats such as seagrass, mangroves and saltmarsh, and protection of fish stocks.
- *Environment Protection Act 1994* (EP Act) provides for sustainable resource development while protecting ecological processes. The EP Act regulates environmentally relevant activities, including

petroleum activities. The *Environmental Protection (Water) Policy 2009* aims to achieve the object of the EP Act in Queensland waters by establishing environmental values and water quality objectives.

- *Queensland Coastal Plan* (Coastal Plan) describes how the coastal zone is to be managed. The Coastal Plan identifies areas of high ecological significance (HES) and general ecological significance (GES), which includes wetlands adjacent to the Port Expansion Project.

B.6.2.2 Methodology

B.6.2.2.1 Nomenclature and Terminology

For the purpose of this EIS the following terminology has been adopted:

- The term Study Area refers to waters in Cleveland Bay. The Study Area includes the following project areas (Figure B.6.1):
  - *Port Expansion Project Area* – refers to the construction footprint and immediate surrounds and includes two components: the harbour basin and the reclamation area;
  - *Offshore dredged material placement area* (DMPA), refers to the existing offshore disposal site or DMPA;
  - *Dredged channel* refers to the existing Platypus and Sea channels that will be subject to capital dredging as part of this Project; and
  - *Channel extension project area* refers to the seaward extension of the Sea Channel along the existing alignment by approximately 2.7 km that will be created as a result of deepening of the Sea Channel from capital dredging.
- The *surrounding area* refers to the intertidal and subtidal waters of Cleveland Bay, including the foreshore of the mainland and Magnetic Island, as shown in Figure B.6.1.

B.6.2.2.2 Assessment Approach

Flora and fauna species, communities and habitats in the Study Area and surrounds were defined through searches of relevant databases, a review of previous studies, and where there was inadequate existing information, through supplementary site surveys. Searches were undertaken of the EPBC Protected Matters Search Tool (31 March 2011) (DSEWPC, 2012a) and Department of Environment and Heritage Protection Wildlife Online database (7 June 2012) (DERM, 2012e).

Information gaps were identified in the initial stages of the impact assessment process, hence supplementary surveys were undertaken to fill these gaps. The following assessments were undertaken by BMT WBM between 2010 and 2012 (refer to Figure B.6.2 for locations of survey sites and transects):

- Breakwater habitats. Video-based surveys were undertaken at three subtidal sites located off the existing breakwaters adjacent to the Port Expansion Project Area in November 2010. The relative abundance of epibenthic taxa was enumerated on each video transect based on standard methods. This survey complements surveys carried out by GHD (2011c) of intertidal and subtidal section of the existing rock walls.
- Reef community assessment. There is a large body of literature describing the reefs communities of Cleveland Bay, however no broad-scale reef surveys had been carried following Cyclone Yasi. A survey was carried out in March 2012 to characterise existing reef communities at seven sites: Five Beach Bay, Horseshoe Bay, Florence Bay, Nelly Bay, Geoffrey Bay, Cockle Bay and Middle Reef. Three replicate photo transects (30 m in length) were sampled by scuba divers at both reef slope and reef crest areas in each site. Photo transects were conducted using wide-angle, high-definition cameras taking stills every two seconds. Coral Point Count (CPCe 4.1) was used to process imagery from a selection of 30 photos from each transect. The percentage cover of benthic groups (coral and algae genera, high levels for other taxa, bare substrate and bleached coral) was then calculated.
- Soft sediment habitat types and epifauna communities. Soft sediment habitats in and adjacent to the DMPA, Port Expansion Project Area, existing dredged channel and channel extension project areas were mapped using acoustic techniques (refer to Figure B.6.3 for acoustic survey lines). Single beam sonar data were analysed using Quester Tangent Corporation (QTC) software packages and a preliminary acoustic habitat class map was derived. Ground-truthing was then

carried out to assess the sediment types in each acoustic habitat class, and to characterise epibenthic communities in each habitat class. Sediment was collected using a van Veen grab and subsequently subject to sieve analysis to determine particle grain size distribution. Epibenthic communities were sampled using a towed underwater video, which was deployed at a total of 94 sites. Sampling of the DMPA, Port Expansion Project Area, existing dredged channel was carried out in November 2010, and the channel extension project area was sampled in November 2011. The relative abundance of taxa recorded on each standardised four minute transect line was calculated, and spatial patterns were determine using a range of statistical analysis techniques.

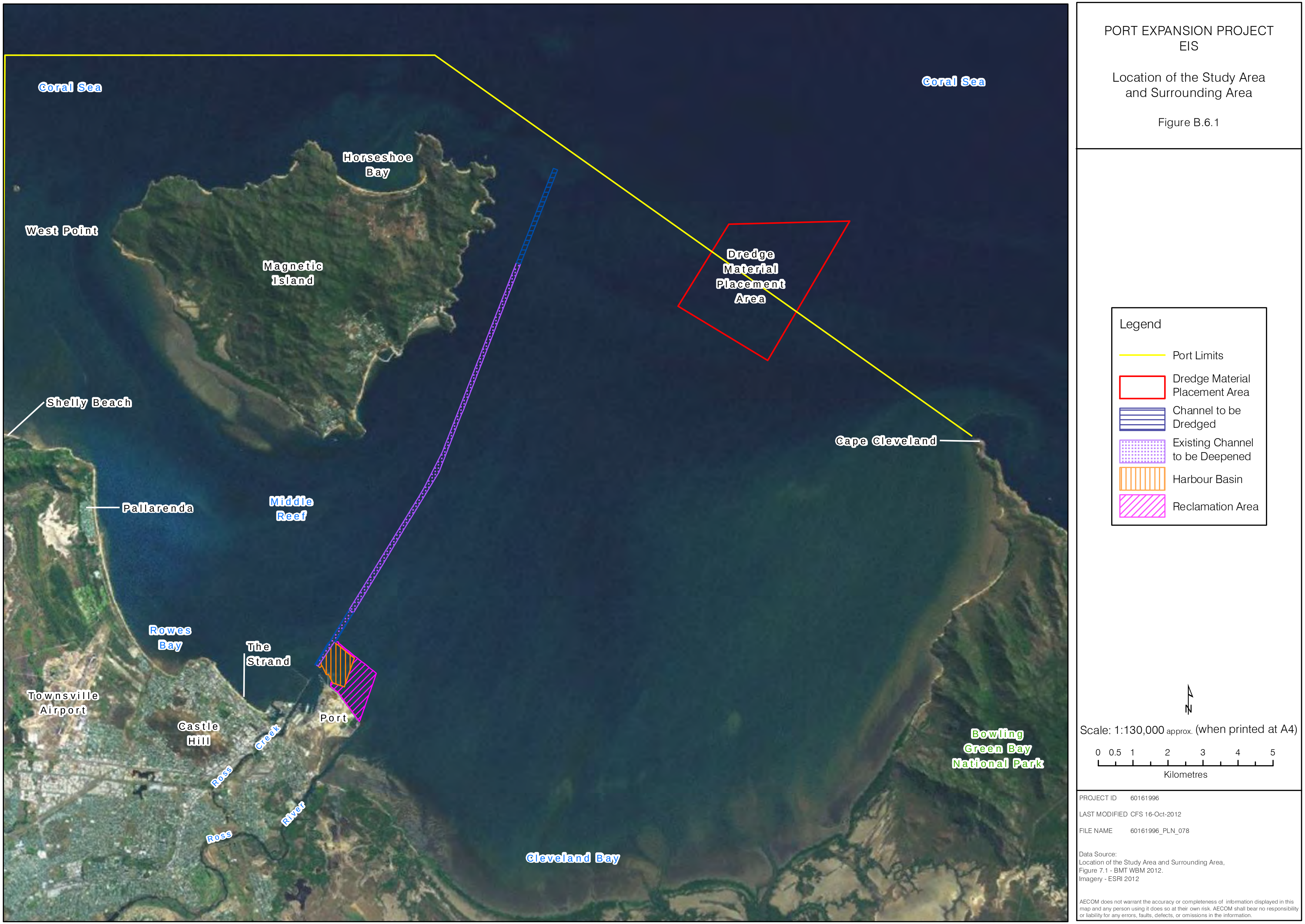
- Macrobenthic (infauna) fauna communities. A total of 38 sites were sampled at representative areas in the proposed disturbance footprint (i.e. Port Expansion Project Area, existing navigation channels, DMPA, channel extension) and 'control' areas outside the disturbance footprint. Sampling of the DMPA, Port Expansion Project Area and existing dredged channel was carried out in November 2010, and the channel extension project area was sampled in November 2011. Four replicate 0.028 m^2 van Veen grab samples were collected at each site, sieved through a 1 mm screen and preserved in 10% formalin solution. Samples were sent to James Cook University for identification and enumeration of each taxa. Summary statistics for abundance and taxa richness were derived, and multivariate statistical analysis was used to explore spatial patterns in community structure. This survey complements surveys carried out by GHD (2011c) of benthic fauna communities of the Study Area and surrounds in November 2010 and March 2011.

A description of sampling and analysis methods, including maps of sampling locations, is provided in Appendix K2 (Marine Ecology Baseline Report).

PORT EXPANSION PROJECT
EIS

Location of the Study Area and Surrounding Area

Figure B.6.1

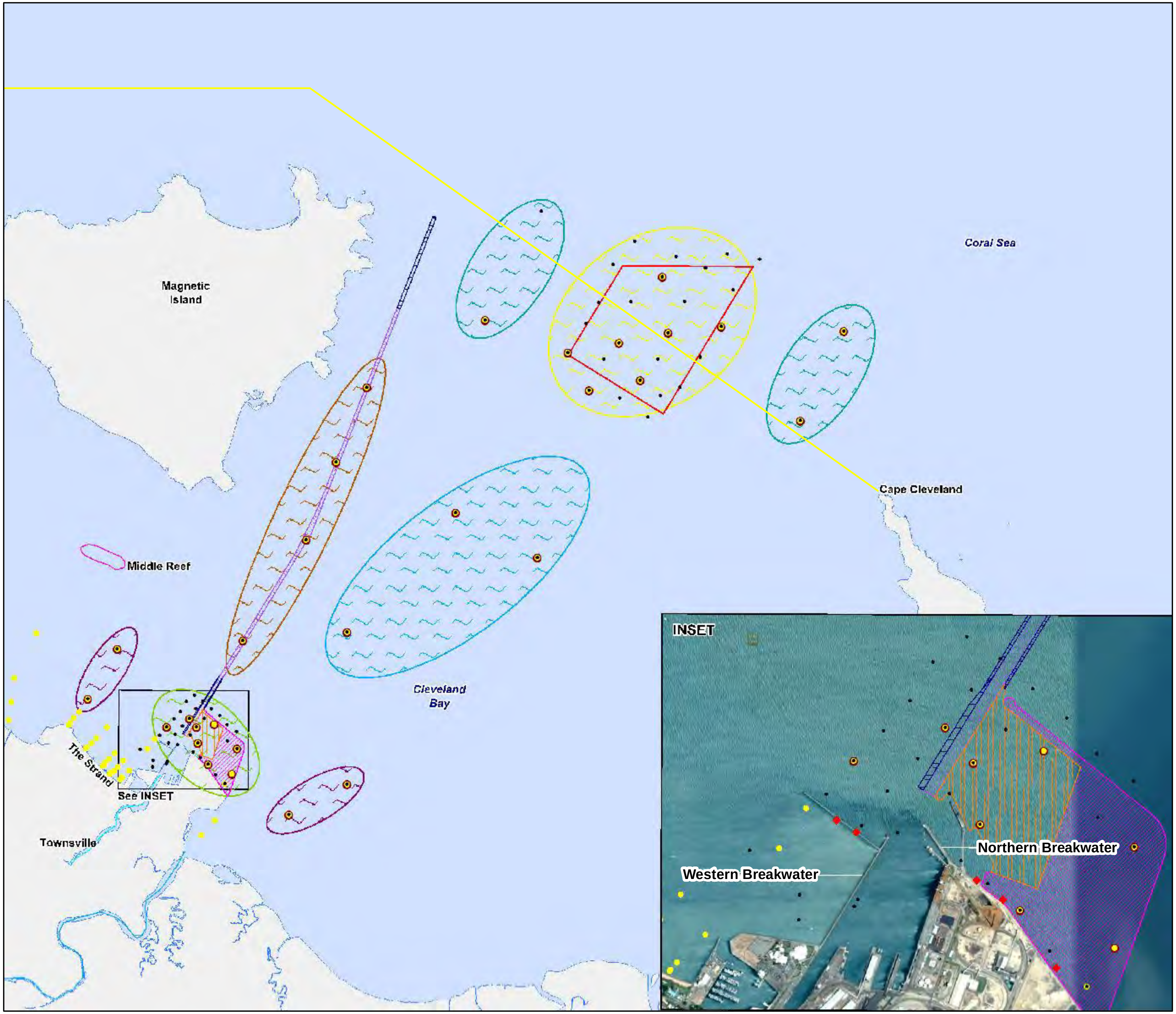


PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_078

Data Source:
Location of the Study Area and Surrounding Area,
Figure 7.1 - BMT WBM 2012.
Imagery - ESRI 2012



PORT EXPANSION PROJECT EIS

Locations of Video Transects, Diver Surveys, and Infauna and PSD Sampling at the Outer Harbour Project Area, DMPA, Dredged Channel and Surrounds (2010)

Figure B.6.2

Legend

- Video Sites
- PSD Sites
- Infauna Sites
- Diver Transects
- Ross River
- Ross Creek
- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- Construction Footprint
- Nearshore Control
- Channel
- Midshore Control
- Offshore Control
- Dredge Material Placement Area

N

Scale: 1:135,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5

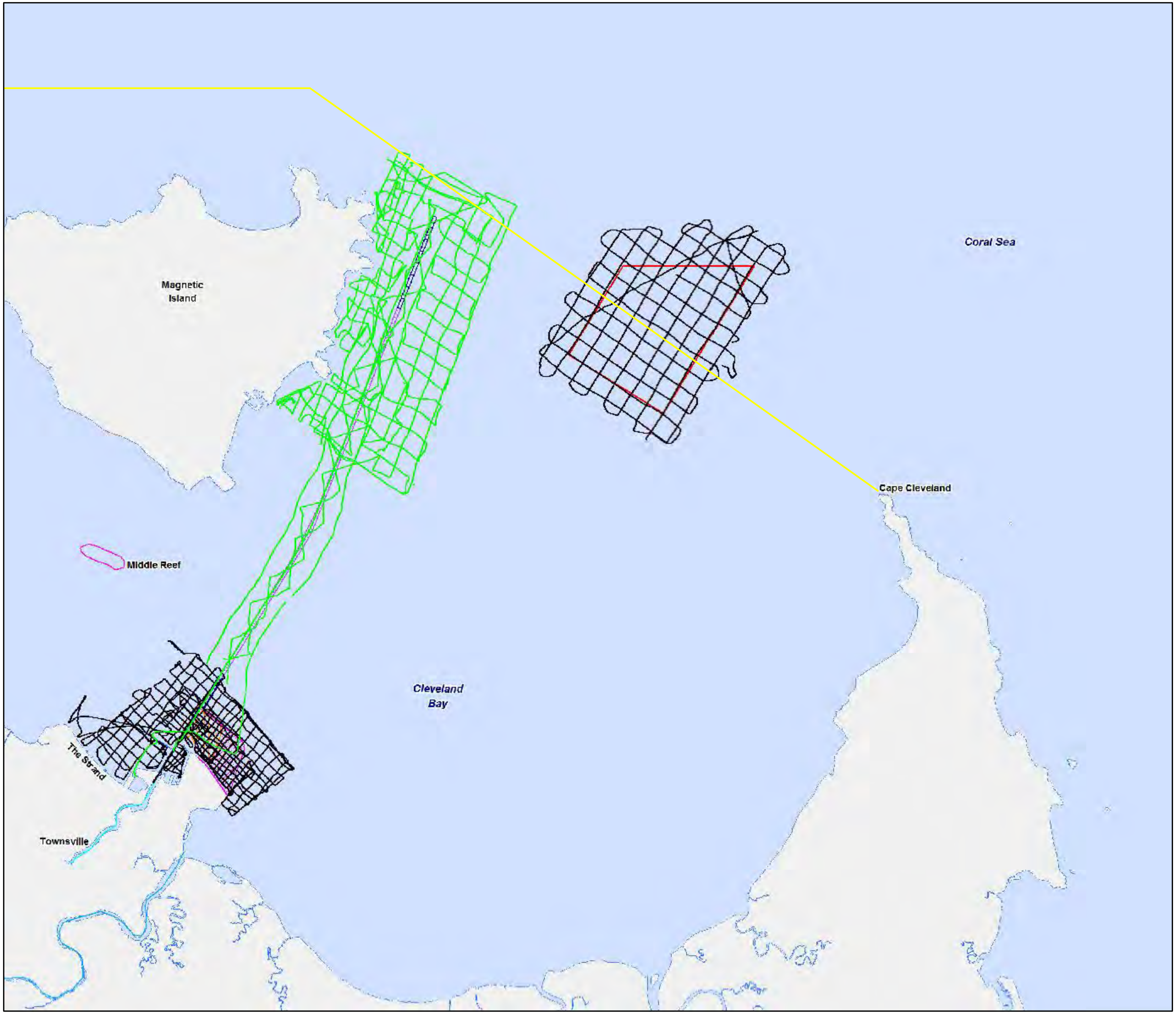
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_044

Data Source:
Locations of Video Transects, Diver Surveys, and Infauna and PSD Sampling at the Outer Harbour Project Area, DMPA, Dredged Channel and Surrounds (2010), Figure 7.2 - BMT WBM 2012.



PORT EXPANSION PROJECT
EIS

Acoustic Survey Lines
2010 and 2011

Figure B.6.3

Legend

- 2010 Acoustic Survey Sites
- 2011 Acoustic Survey Sites
- Ross River
- Ross Creek
- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

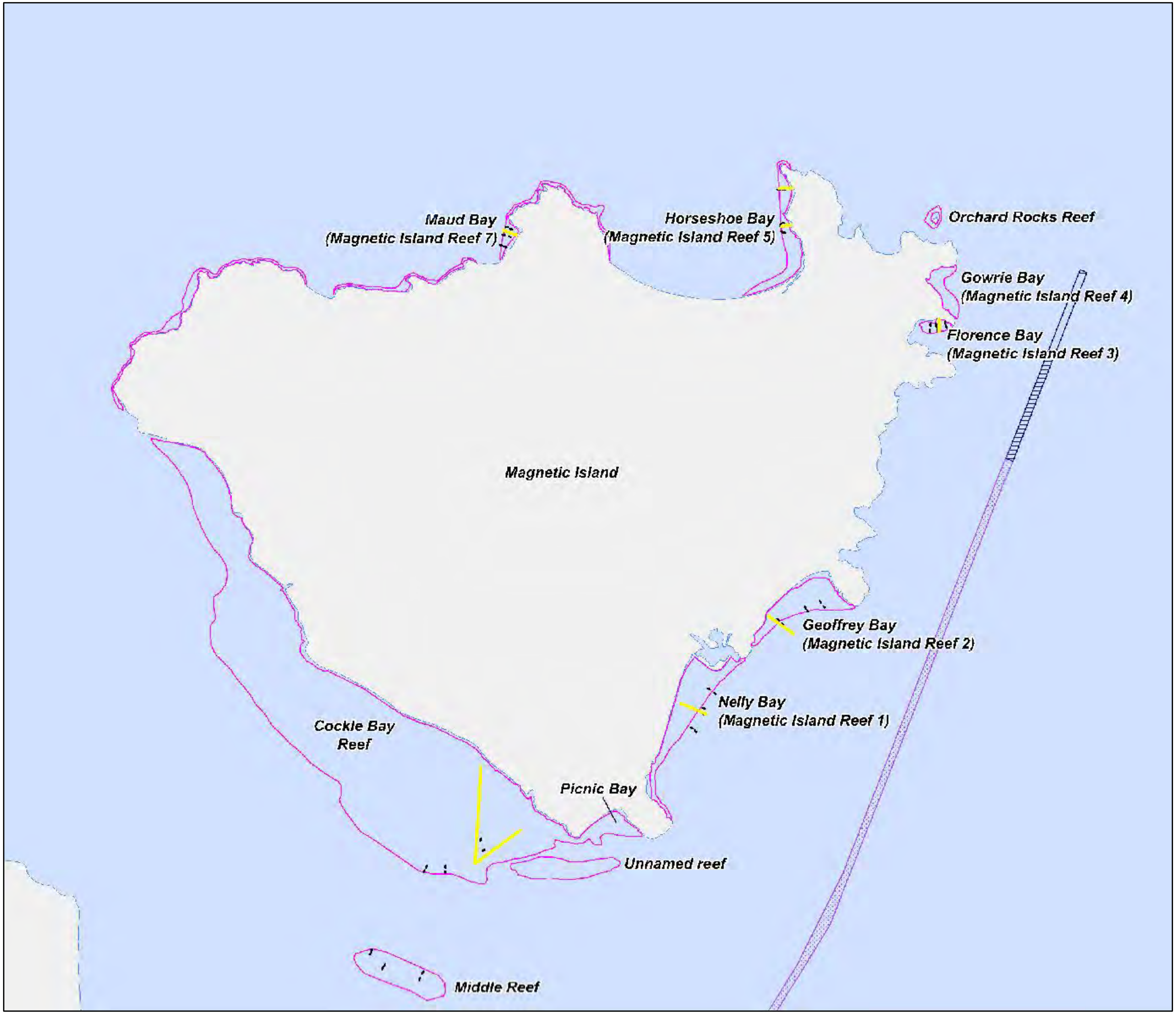
N

Scale: 1:135,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5
Kilometres

PROJECT ID 60161996
LAST MODIFIED CFS 16-Oct-2012
FILE NAME 60161996_PLN_045

Data Source:
Acoustic Survey Lines- 2010 and 201, Figure 7.3 - BMT WBM 2012.



PORT EXPANSION PROJECT
EIS

Locations of Snorkel and Photo Transects Surrounding Eastern Magnetic Island and Middle Reef

Figure B.6.4

Legend

- Snorkel Transects
- Photo Transects
- Coral Reefs (GBRMPA Gazetteer)
- Channel to be Dredged
- Existing Channel to be Deepened

N

Scale: 1:65,000 approx. (when printed at A4)

0 250 500 1,000 1,500 2,000 2,500

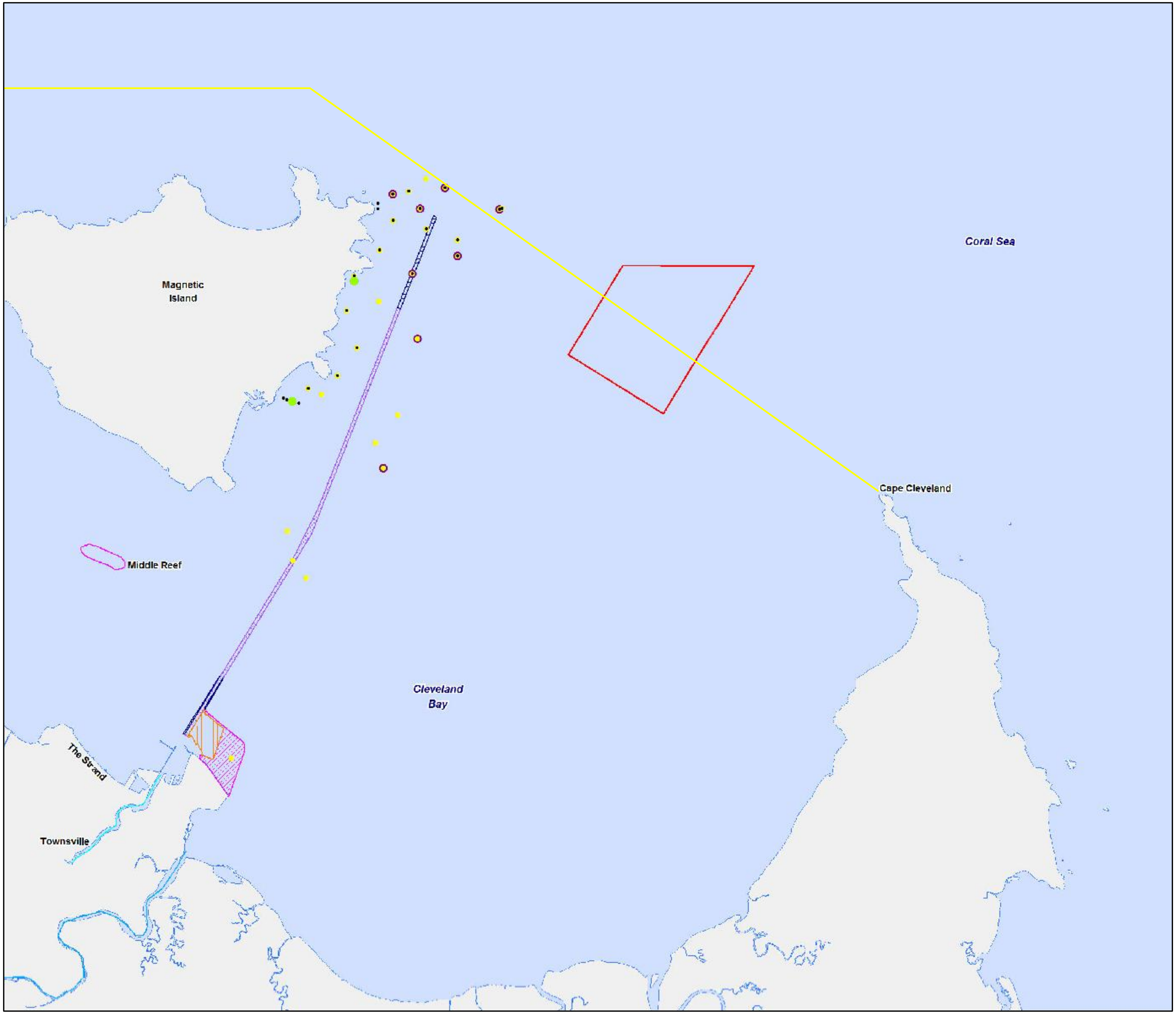
Metres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_035

Data Source:
Locations of Snorkel and Photo Transects Surrounding Eastern Magnetic Island and Middle Reef, Figure 7.4 - BMT WBM 2012.



PORT EXPANSION PROJECT
EIS

Locations of Video Transects, Epifauna and Infauna Sampling Sites (2012)

Figure B.6.5

Legend

- Video Sites
- PSD Sites
- Infauna Sites - Inshore Magnetic Island
- Infauna Sites - Channel Extension Project Area and Surrounds
- Ross River
- Ross Creek
- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

N

Scale: 1:135,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5
Kilometres

PROJECT ID 60161996
LAST MODIFIED CFS 16-Oct-2012
FILE NAME 60161996_PLN_036

Data Source:
Locations of Video Transects, Epifauna and Infauna Sampling Sites (2012) Figure 7.5 - BMT WBM 2012.

B.6.3 Existing Values, Uses and Characteristics

B.6.3.1 Background

Cleveland Bay is a natural embayment located adjacent to Townsville. The general environmental and ecological characteristics of Cleveland Bay are well known and described. Furthermore, there is a large body of work describing the known or possible effects of port operations, including dredging, on marine ecological environmental values (e.g. (Benson, Goldsworthy, Butler, & Oliver, 1994; Kettle B, 2002; Anderson, et al., 2002; Pringle, 1989; Rasheed & Taylor, Port of Townsville Seagrass Baseline Survey Report Cairns Harbour and Trinity Inlet – September 2011, 2008).

Despite significant changes to Townsville's coastal zone as a result of urban (Scheltinga & Heydon, 2005) and port development (Anderson, et al., 2002), Cleveland Bay supports a broad range of significant marine ecological values and functions. Particularly notable marine ecological values supported by Cleveland Bay include:

- A wide diversity of marine habitat types including intertidal beaches, mangrove forests, saltmarshes, intertidal shoals, subtidal soft sediment habitats, rock walls, coral reefs and rocky shores;
- One of the largest seagrass meadows in the broader region (Rasheed & Taylor, Port of Townsville Seagrass Baseline Survey Report Cairns Harbour and Trinity Inlet – September 2011, 2008);
- Coral communities of high biodiversity significance, particularly those around Magnetic Island. Despite being subject to periods of high turbidity and macroalgae blooms, these reefs support high coral cover;
- Habitats for a wide range of fish and shellfish species of direct economic significance;
- Significant feeding areas for marine turtles, dugongs and dolphins, which are listed as threatened or migratory under Commonwealth and/or state legislation; and
- Habitat for a range of other threatened or otherwise listed marine megafauna species, including whales and sharks protected under the EPBC Act.

This EIS section describes these environmental values and the condition/integrity of underpinning marine habitats (including benthic primary producer habitats such as seagrass, corals, mangroves and communities) in the Study Area and surrounds.

B.6.3.2 Marine Protected Areas

Protected areas represented in the Study Area include (Figure B.6.6):

- Great Barrier Reef World Heritage Area;
- Great Barrier Reef Marine Park;
- Cleveland Bay Dugong Protection Area;
- Cleveland Bay Fish Habitat Area; and
- Bowling Green Bay Ramsar site.

B.6.3.2.1 Great Barrier Reef World Heritage Area

Natural Values

Waters in Cleveland Bay, including the Port Expansion Project Area, channels, wider port area and DMPA, are located within the GBRWHA. Cleveland Bay represents a small proportion of the overall area of the GBRWHA (approximately 0.07%; (C&R Consulting, 2007b).

The nomination document for the GBRWHA was a broad general description of the GBR and how it meets the WHA nomination area. The document primarily focuses on coral reef ecosystems, with little attention given to other marine and terrestrial components. The nomination document does not provide a discussion on specific values (e.g. components, processes and ecosystems services/benefits) supported in different parts or habitats of the GBRWHA.

The *Magnetic Island EPBC Policy Statement 5.1* (DSEWPC, 2011a) describes the World Heritage Area values of the Great Barrier Reef identified in the GBRWHA nomination document, and the contribution of

Magnetic Island to these values. DSEWPAC (2011a) suggested that Magnetic Island supported almost all of the values outlined in the nomination document. On the basis of DSEWPC (2011a), together the findings of the Marine Ecology Baseline Report (Appendix K2), are considered the following list of attributes supported by Cleveland Bay and Magnetic Island natural values are considered to contribute to the 'outstanding universal value' of the GBRWHA:

- Largest and most complex expanse of living corals;
- Unique forms of marine life;
- A diversity of environmental assets such as forests, coral reefs, seagrass beds and mangroves (DSEWPC, 2011a), as well as inter-reefal and lagoonal benthos; and
- Great diversity of life-forms, including many species of coral, macroalgae, crustaceans, polychaetes, molluscs, phytoplankton, fish, seabirds, mammals and reptiles.
- Natural and near-natural areas occur in Cleveland Bay (particularly eastern and northern Cleveland Bay) which meets the conditions of integrity required for World Heritage Area nomination. However, the developed coastal strip around Townsville and Cape Pallarenda is a slightly to moderately modified condition, as are Ross River, Ross Creek and the existing dredged channels in Cleveland Bay.

The marine ecological features underpinning these values are summarised in the following sections and the Marine Ecology Baseline Report (Appendix K2). This includes consideration of each of the world heritage values supported at Magnetic Island (as relevant to marine ecology issues), as set out in the *Magnetic Island EPBC Policy Statement 5.1* (DSEWPC, 2011a). Potential impacts to GBRWHA are considered in Section B.6.4.13, specifically with reference to MNES Significant Impact Guidelines 1.1 (DEWHA, 2009b).

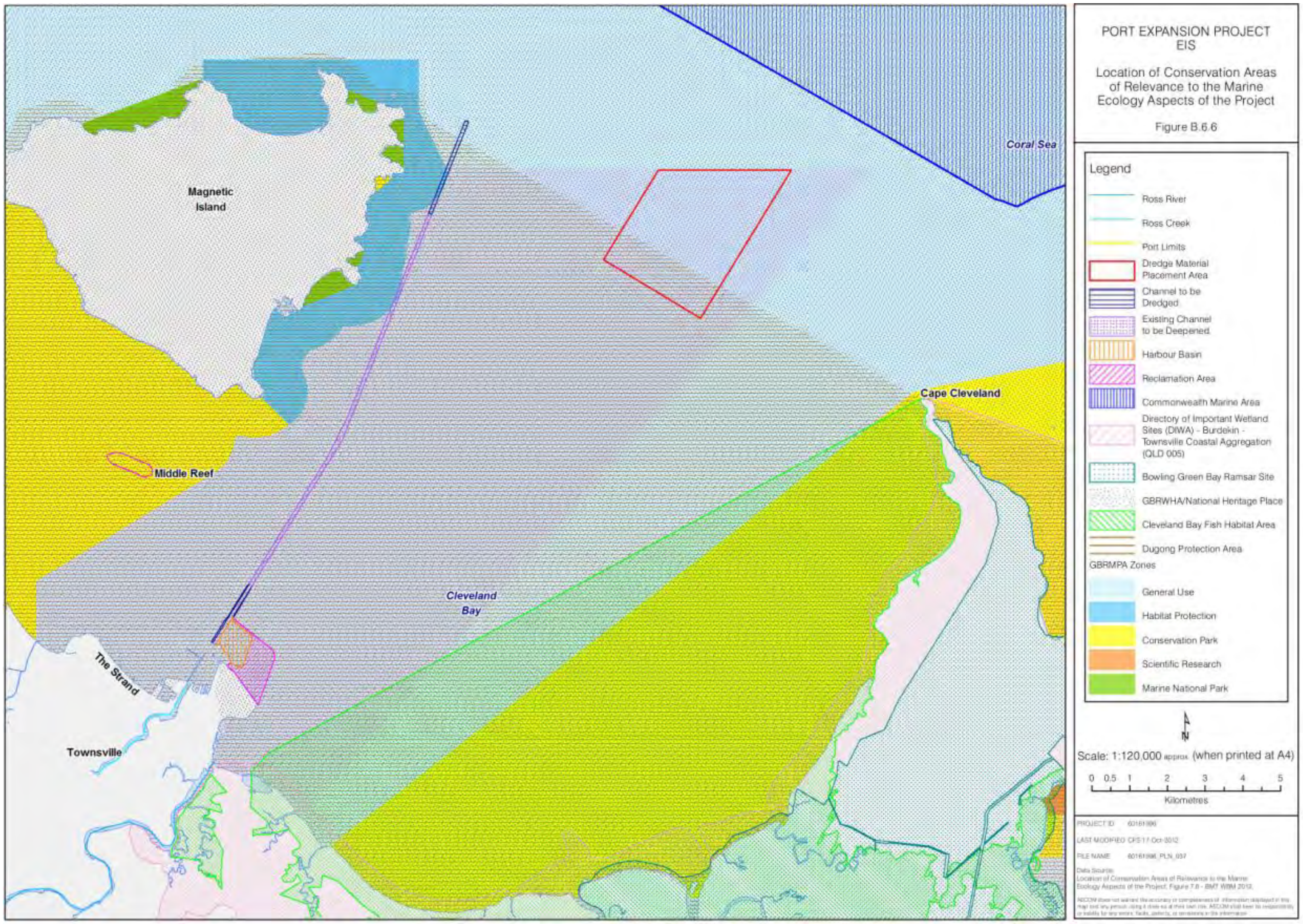


Figure B.6.6 **Location of conservation areas of relevance to the marine ecology aspects of the Project**

GBRWHA Management and Threats

The primary management objectives for World Heritage properties are part of Australia's general obligations under the World Heritage Convention, which are:

- *to protect, conserve and present the World Heritage values of the property;*
- *to integrate the protection of the area into a comprehensive planning program;*
- *to give the property a function in the life of the Australian community;*
- *to strengthen appreciation and respect of the property's World Heritage values, particularly through educational and information programs;*
- *to keep the community broadly informed about the condition of the World Heritage values of the property; and*
- *to take appropriate scientific, technical, legal, administrative and financial measures necessary for achieving the foregoing objectives.*

The 25 Year Strategic Plan (GBRMPA, 1994) sets out the management approach for the GBRWHA. This plan sets out a 25 year vision for the GBRWHA, and short (5 years) and long-term (25 year) management objectives to achieve the vision. The most relevant long term objectives relevant to the management of biodiversity values are:

- Conservation : *To ensure the persistence of the Great Barrier Reef World Heritage Area as a diverse, resilient, and productive ecological system, while retaining opportunity for a diverse range of experiences and uses consistent with Australia's obligations under the World Heritage Convention*.
- Resource management: *To facilitate the sustainable multiple use of the resources of the Great Barrier Reef World Heritage Area, through integrated management systems which are complementary with the management of the adjacent regions. This should be done in a manner consistent with the maintenance of World Heritage, ecological, social and economic values, recognising that the economic viability of many activities relies on the maintenance of the ecosystem.*

The primary tool used to manage the GBRWHA is zoning (for sections of the GBRWHA contained within the Great Barrier Reef Marine Park). Specific management objectives are set out for different zones within the Marine Park, which are outlined below. The objectives set out above and for the GBRMP provide a basis for the conservation management objectives adopted for the Port Expansion Project.

The Great Barrier Reef Outlook Report (GBRMPA, 2009) provides an assessment of the overall condition, pressures and management responses for the GBRWHA. The following sections describe the condition and integrity of marine habitats, communities and species in Cleveland Bay, as identified in the 2009 Outlook Report and other relevant publications (including the Reef Rescue Monitoring Program).

In terms of pressures, the 2009 Outlook Report identifies a range of climate change processes as the dominant future threats to the GBR. The report also identified a range of other key pressures including declining water quality from catchment sources, loss of coastal habitats from coastal development, and impacts from fishing and poaching as key issues in terms of the long-term management of the GBR. The 2009 Outlook Report also identifies proposed port expansions, increased shipping activity, coastal and catchment development, marine debris and extreme weather events as emerging issues.

The 2009 Outlook Report noted that the response of the GBR to climate change and other future threats will depend on the resilience of the GBR ecosystem, key taxa and habitats to such changes. The GBRMPA (2009) assessment grades are shown in Figure B.6.7 below. The description of existing marine ecological components presented below and in the Marine Ecology Baseline Report describes both the resistance of ecological components to change, and the resilience of ecological components should changes occur.

Assessment component	Summary	Very good	Good	Poor	Very poor
Mangroves	The Great Barrier Reef is maintaining strong mangrove biodiversity with local fluctuations, mainly along the developed coast.	●			
Seagrass	The Great Barrier Reef is maintaining seagrass biodiversity with local fluctuations in inshore waters.		●		
Macroalgae	The biodiversity of macroalgae is being maintained but there is little information about its condition.		?		
Benthic microalgae	Benthic microalgae are little studied, but they are believed to be in good condition.	?			
Corals	There are more than 500 species of corals, with localised declines in some hard corals and limited information about soft corals, sea pens and sea fans.		●		
Other invertebrates	Little is known about most non-commercial invertebrate species.	?			
Plankton and microbes	Little is known about the status of plankton or microbes on the Great Barrier Reef.	?			
Bony fish	Of the more than 1600 bony fish species, only a few are known to have locally depleted populations.		?		
Sharks and rays	There is concern about declines in populations of some of the 134 shark and ray species.			?	
Marine turtles	Five of the six species of marine turtle on the Great Barrier Reef have declined; the loggerhead, flatback and green turtle nesting populations appear to have stabilised or are now increasing.			○	
Sea snakes	There are 14 species of sea snake on the Great Barrier Reef and there are serious concerns about the status of some species.			?	
Estuarine crocodiles	Numbers of estuarine crocodiles are recovering following protection of the species.		●		
Seabirds	Twenty-two species of seabird breed on the Great Barrier Reef with serious declines in some populations.			○	
Whales	Most whales appear to be maintaining intact populations. Humpback whales are recovering strongly after being decimated by whaling.		●		
Dolphins	There is limited information about most dolphin populations; but two inshore dolphin species are known to be at risk.		?		

Figure B.6.7 Current assessment grade of key populations of species and groups of species (after GBRMPA, 2009; section 2.4.2)

Great Barrier Reef Marine Park (GBRMP)

The Great Barrier Reef Marine Park (GBRMP) is managed under the GBRMP Act, and is also a MNES. Under the existing GBRMP zoning plan, Cleveland Bay contains Habitat Protection (the north-eastern and eastern coast of Magnetic Island), Conservation Park (coastal areas between Cape Pallarenda and Magnetic Island, and the eastern section of Cleveland Bay), Marine National Park (several embayments around Magnetic Island) and General Use zones.

The Port of Townsville, which includes the Port Expansion Project Area and DMPA, is located outside the GBRMP. However, a small proportion of the existing Sea Channel (adjacent to Bremner Point) intersects the GBRMP in an area zoned as Habitat Protection. The Port Expansion Project will require the deepening of the portion of the Sea Channel in the GBRMP (Habitat Protection zone), as well as the lengthening of the Sea Channel into the General Use zone.

The management objectives for GBRMP zones are set out in the Great Barrier Reef Marine Park Zoning Plan (GBRMPA, 2003). Objectives of GBRMP zones in and adjacent to the Study Area are (GBRMPA, 2003):

- *General Use Zone* - to provide for the conservation of areas of the Marine Park, while providing opportunities for reasonable use.
- *Habitat Protection Zone*:
  - (a) to provide for the conservation of areas of the Marine Park through the protection and management of sensitive habitats, generally free from potentially damaging activities; and
  - (b) subject to the objective mentioned in paragraph (a), to provide opportunities for reasonable use.

Potential impacts to GBRMP are considered in Section B.6.4.14, specifically with reference to MNES Significant Impact Guidelines 1.1 (DEWHA, 2009b).

Bowling Green Bay Ramsar Site

Wetlands of international importance are listed as a MNES under sections 16 and 17B of the EPBC Act. Such wetlands are commonly referred to as Ramsar wetlands, and are considered to represent wetlands of international significance.

Bowling Green Bay Ramsar site is the closest Ramsar site to the study area. Ramsar sites are protected under international agreements (e.g. Ramsar Convention) and National legislation (EPBC Act). This Ramsar site is largely situated to the east of Cape Cleveland, and extends partly along the southeast coastline of Cleveland Bay.

At the time of the EIS report preparation there was no Ecological Character Description for this site. However, the most up to date published Ramsar Information Sheet for the site (Blackman 1999) indicates that the key values of the site are based on habitat provisioning for migratory and resident waterbirds, marine megafauna (turtles, dugong) and a range of other natural resource values supported by the diversity and extent of wetland types. Based on Blackman (1999), the following components, processes and services are likely to be critical in the context of maintaining the ecological character of the site:

- Diversity of wetland types – the site supports a diverse complex of wetland types. A total of 14 different wetland types were identified by Blackman (1999), with the largest by area being Tidal mud flats (Ramsar Wetland Type G), Mangrove/tidal forest (Ramsar Wetland Type I) and saltmarsh/saltpan (Ramsar Wetland Type H). The site includes terrestrial areas, as well as freshwater and marine environments. Extensive areas of forest and woodland are present in elevated areas (mountainous and coastal sand dunes), before giving way to brackish and freshwater communities on the low lying coastal plain (including both stream and palustrine marsh habitats). Saltmarsh and saltpans occur landward of mangrove forests, before giving way to intertidal flats associated with the prograding spit of Cape Bowling Green.
- Hydrological conditions - the site is drained by the Haughton River, together with several major creeks (Barramundi, Barratta and Sheep Station creeks) and smaller drainages. Groundwater is stored in two main aquifers that are recharged mostly by stream flows. These hydrological processes ultimately control freshwater ecosystems within the site, as well as representing a key control on marine communities during significant flow events.

- Provision of feeding grounds for threatened marine megafauna species. Blackman (1999) found that the intertidal and subtidal seagrass meadows of the site, together with those at nearby Cleveland Bay outside the site, provide an important food resource for dugongs and green turtles.
- Provision of nursery areas for species of economic importance. The mosaic of habitat types present within close proximity to each other, together with the presence of extensive seagrass meadows, mangrove forest, saltmarsh and freshwater marshes, represent high quality fisheries habitat. Key fisheries groups include prawns, crabs (including the mud crab *Scylla serrata*), baitfish and finfish (including barramundi *Lates calcarifer*) species. Blackman (1999) notes that these habitats are used by a wide variety of life-stages for species of economic importance, particularly as a nursery habitat.
- Provision of breeding and feeding areas for waterbirds. Blackman (1999) notes that the site is particularly important for post breeding groups of brolga, magpie geese and various other species of Anatidae (ducks, geese and swans). The brolga and magpie geese are mainly associated with shallow sedge swamps and marine plains of the site, where they undertake breeding during late summer. The site also supports a wide range of migratory shorebirds, with approximately 50% of the species listed under JAMBA and CAMBA recorded in the site. Little tern can reach high numbers (1000 individuals), and is known to breed on Bowling Green Bay spit. At least 103 birds (including terrestrial birds) are known to breed within the site.
- The site also supports a range of ecosystem services/benefits including sediment trapping, control of coastal erosion, and maintenance of water quality.

The Port Expansion Project Area is located >9 km from the Bowling Green Bay Ramsar site. Potential impacts to Ramsar wetland values are considered in Section B.6.4.14, specifically with reference to MNES Significant Impact Guidelines 1.1 (DEWHA, 2009b).

Commonwealth Marine Area

The Commonwealth marine area is any part of the sea within Australia's exclusive economic zone and/or over the continental shelf of Australia outside State or Northern Territory waters. The Commonwealth marine area stretches from three to 200 nautical miles from the coast. The Commonwealth marine area is a MNES under Sections 23 & 24A of the EPBC Act.

The Port Expansion Project Area, offshore DMPA and navigation channels are located wholly within Queensland State waters. The closest portion of the Commonwealth marine area to Cleveland Bay is located approximately six kilometres north-east of the north-eastern tip of Magnetic Island, and approximately three kilometres from the nearest portion of the Sea Channel extension area.

The sections of the Commonwealth marine area (CMA) located directly adjacent to proposed Project disturbance areas (i.e. the Sea Channel extension near Magnetic Island and the offshore DMPA) have the following environmental characteristics.

The CMA is more exposed to swell and local seas originating from the south-east than the Cleveland Bay. However, as the CMA is located in deep waters, there is typically little re-suspension of bed sediments under typical conditions, as indicated by the low bed sheer stress predicted by hydrodynamic modelling (see Chapter B3 – Coastal Processes). During higher winds periods and extreme events (such as cyclones), resuspension would occur throughout Cleveland Bay and the adjacent CMA.

The sediments of the CMA and offshore waters of Cleveland Bay reflect these hydraulic conditions. Grab samples collected by BMT WBM (February 2012) from two sites within the CMA, together with samples collected from within and adjacent to the DMPA and channel extension project area, were found to be composed of fine silty upper layer underlain by sandy muds (i.e. similar parts of sand and mud). This sediment type was found to be relatively uniform at two locations within the CMA, and similar to those of the existing DMPA and channel extension area.

These sediment conditions control the composition and structure of benthic communities. The benthic flora and fauna assemblages between outer Cleveland Bay and the deeper parts of the inner continental shelf between Magnetic Island and John Brewer Reef can be characterised and differentiated along depth and sediment gradients (e.g. Birtles and Arnold 1983; 1989). Surveys by Birtles and Arnold (1989) found that the inner shelf zone (<22 m depth contour, which included both Cleveland Bay and the adjacent CMA) had distinctly different habitats and epifauna echinoderm and molluscs communities (composition and lower abundance) than those further offshore (26-41 m). They suggested that these differences mostly reflected changes in habitat conditions, including sediment types.

Surveys were carried out in March 2012 to qualitatively assess the habitat and epifauna community characteristics at two representative locations within the CMA. Four minute video recordings and benthic grabs were taken from four stations within two locations (locations A and B). The survey found that the epibenthic communities at both locations were very sparse, similar to that found in the adjacent DMPA. Occasional sea pens and sea cucumbers were observed at location A, but in low abundance (<10 individuals per four minute transect. Burrows (bioturbation) were abundant at both locations, as also occurs in the offshore sections of Cleveland Bay (see Section B.6.3.6).

No reefs or similar hard substrates were found at either location in this survey. This is consistent with Great Barrier Reef Gazetteer, which does not identify any reefs within the section of the CMA adjacent to Magnetic Island or the offshore DMPA. Furthermore, there was no evidence of deepwater seagrass or algal/sponge beds within the two locations. It is likely that low light conditions would prevent the development of extensive seagrass meadows in this area, however like the offshore waters of Cleveland Bay, sparse transient seagrass meadows could occur in this area from time to time.

Overall, the seabed habitat characteristics of the CMA appear to be similar to those found within the offshore sections of Cleveland Bay. No seabed features of outstanding biodiversity significance are known or likely to occur within the CMA. As discussed in Section B.6.3.7, the offshore waters of Cleveland Bay and the CMA are occasionally visited by offshore, marine megafauna species, such as humpback whales and a range of marine turtles and dolphin species. Areas to the north of Magnetic Island are known to represent important trawling grounds compared to Cleveland Bay and other sections of the CMA (Section B.6.3.9).

Cleveland Bay Dugong Protection Area and Fish Habitat Area

The entire area of Cleveland Bay is located in the Cleveland Bay Dugong Protection Area, which is a Zone 'A' Dugong Protection Area. As such, the Port Expansion Project Area, channels and DMPA are located in the Protected Area (see Section B.6.4.2). Dugong Protection Areas are declared in legislation under the Queensland NC Act and as special management areas under the *Great Barrier Reef Marine Park Zoning Plan 2003*, and fishing activities in Dugong Protection Areas are managed under the Queensland *Fisheries Act 1994*. Certain forms of netting are prohibited in Dugong Protection Areas, however there are no restrictions on port related activities.

Fish Habitat Areas, which are managed under the Queensland *Fisheries Act 1994*, represents a form of multiple use marine protected area that limits certain activities that may affect fisheries habitat values. The closest Fish Habitat Area to the Project Area is the Cleveland Bay Fish Habitat Area, which extends across the eastern half of Cleveland Bay. The closest Project works area to the Cleveland Bay Fish Habitat Area is the Port Expansion Project Area, which is located approximately one kilometre to the west of the Fish Habitat Area.

Potential impacts to Dugong Protected Areas and Fish Habitat Areas are considered in Section B.6.4.14, specifically with reference to MNES Significant Impact Guidelines 1.1 (DEWHA, 2009b).

Directory of Important Wetlands (DIWA)

Several nationally important wetlands listed in the DIWA occur in or adjacent to the Study Area, namely: Burdekin - Townsville Coastal Aggregation (QLD005) and Great Barrier Reef Marine Park (QLD100). The Great Barrier Reef Mark Park is considered above.

Burdekin - Townsville Coastal Aggregation (BTCA) is a coastal wetland aggregation that covers an area of 113,947 ha. The BTCA includes the coastal plain from the southern bank of the lower Ross River estuary to the Burdekin Delta, and includes Bowling Green Ramsar site. The BTCA forms a continuous, complex wetland aggregation that includes shallow marine waters comprised of seagrass meadows, 'unvegetated' sediments and intertidal wetlands, extensive beach ridge systems, palustrine and lacustrine wetlands, and numerous drainages (including the Haughton River). The seagrass meadows represent important feeding and nursery habitat for species of commercial significance, as well as feeding areas for turtles and dugongs. The BTCA is also an important habitat for vegetation and fauna of conservation significance, and wader birds (Spain & Blackman, 1995).

B.6.3.3 Mangroves and Saltmarsh

Mangroves and saltmarsh communities represent benthic primary producer habitats[1]. There are no mangrove and saltmarsh areas in the Port Expansion Project Area, dredging areas or dredged material placement area (Figure B.6.8). These habitats occur adjacent to the Port Expansion Project Area at the mouth of Ross River, but are located outside the likely zone of impact of the Project.

B.6.3.4 Seagrass Meadows

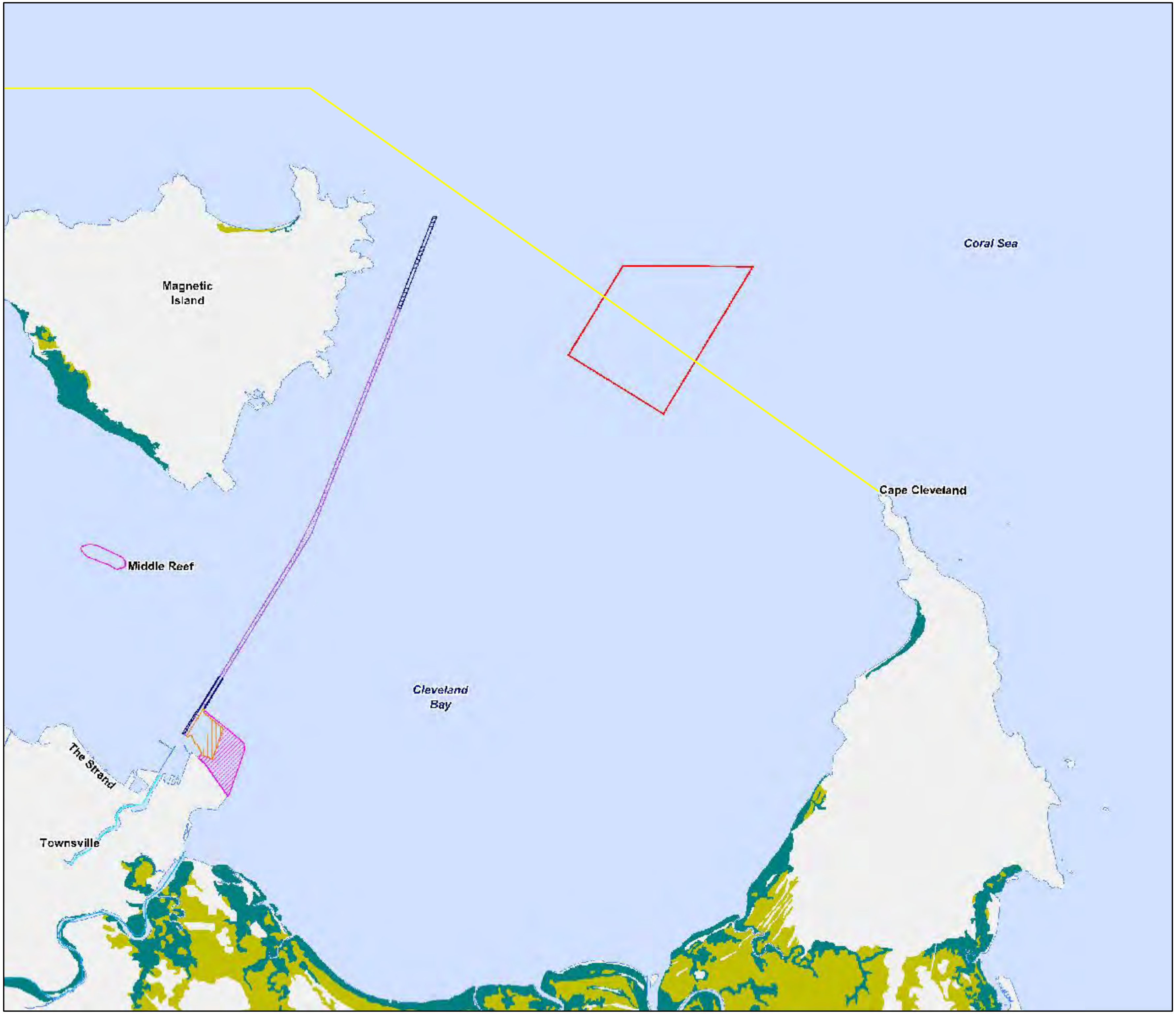
B.6.3.4.1 Spatial Patterns

Seagrasses are benthic primary producer habitats that provide a range of functions in the maintenance of coastal/estuarine ecosystem, including provision of food resources for dugong, green turtles and certain invertebrate species; provision of habitat for adult and juvenile stages of many fish and invertebrate species of fisheries significance; and assisting in the stabilization of sediments and sediment nutrient cycling (Larkum, McComb, & Shepherd, 1989). Because of these ecological values, seagrass and other marine plants are protected under the *Fisheries Act 1994* and a permit is required for their disturbance and/or removal.

Cleveland Bay contains some of the most extensive and diverse seagrass meadows in north Queensland. A range of studies have investigated the seagrass communities of Cleveland Bay. Eight species of seagrass have been recorded in Cleveland Bay (Rasheed & Taylor, 2008), namely *Zostera muelleri*, *Halodule uninervis*, *Syringodium isoetifolium*, *Cymodocea serrulata, Halophila spinulosa*, *Halophila ovalis*, *Halophila decipiens* and *Thalassia hemprichii*.

---

[1] Seagrass, mangroves, saltmarsh, benthic algae, together with corals, represent benthic primary producer habitat (BPPH). BPPH play an important role in maintaining coastal ecosystems and associated ecological services, including the provision of food and habitat resources for species of fisheries and conservation significance.



PORT EXPANSION PROJECT
EIS

Mangrove and Saltmarsh Vegetation in Cleveland Bay

Figure B.6.8

Legend

- Ross River
- Ross Creek
- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- Mangroves
- Saltmarsh

N

Scale: 1:135,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_038

Data Source:
Mangrove and Saltmarsh Vegetation in Cleveland Bay, Figure 7.7 - BMT WBM 2012.

The Queensland Department of Agriculture, Fisheries and Forestry (DAFF, formerly DEEDI) has undertaken seagrass meadow surveys since 2007, which included sites located in the Study Area and surrounds (Rasheed & Taylor, 2008; Taylor & Rasheed, 2009; Unsworth, Taylor, & Rasheed, 2009; McKenna & Rasheed, 2011). For impact assessment purposes (see Section B.6.4.4.2), the maximum extent of seagrass as shown in Figure B.6.9 has been conservatively adopted as the baseline potential seagrass habitat extent.

Meadows tend to be denser, more structurally complex and more temporally persistent in the intertidal and shallow subtidal areas than those in deeper offshore waters (Rasheed & Taylor, 2008). Shallow waters favour the growth of larger growing species such as *Zostera muelleri*, *Cymodocea serrulata* and *Halodule uninervis* (wide leaf form), and is a consistent pattern of most seagrass areas in north Queensland (Lee Long, Mellors, & Coles, 1993). The most well developed shallow water meadows are located between the mainland (the Strand, Rowes Bay and Pallarenda) and south-western embayments of Magnetic Island (Cockle Bay, Picnic Bay), and adjacent to Cape Cleveland in the vicinity of Alligator Creek and Crocodile Creek (Rasheed & Taylor, 2008).

Cleveland Bay has also historically contained extensive deepwater seagrass beds (Rasheed & Taylor, 2008). These deepwater meadows are typically patchy (non-contiguous, fragmented beds) with a sparse cover, and low species richness (dominated by *Halophila decipiens*). Sparse deepwater seagrass assemblages have occurred offshore of the Port Expansion Project Area, including areas in the vicinity of the offshore DMPA. However, deepwater seagrass has not been recorded in this area since 2007 (Figure B.6.9). No seagrass is known to occur in the Port's inner or proposed outer harbour areas, although shallow water and intertidal seagrass beds occur nearby (e.g. near the Ross River mouth and Townsville waterfront).

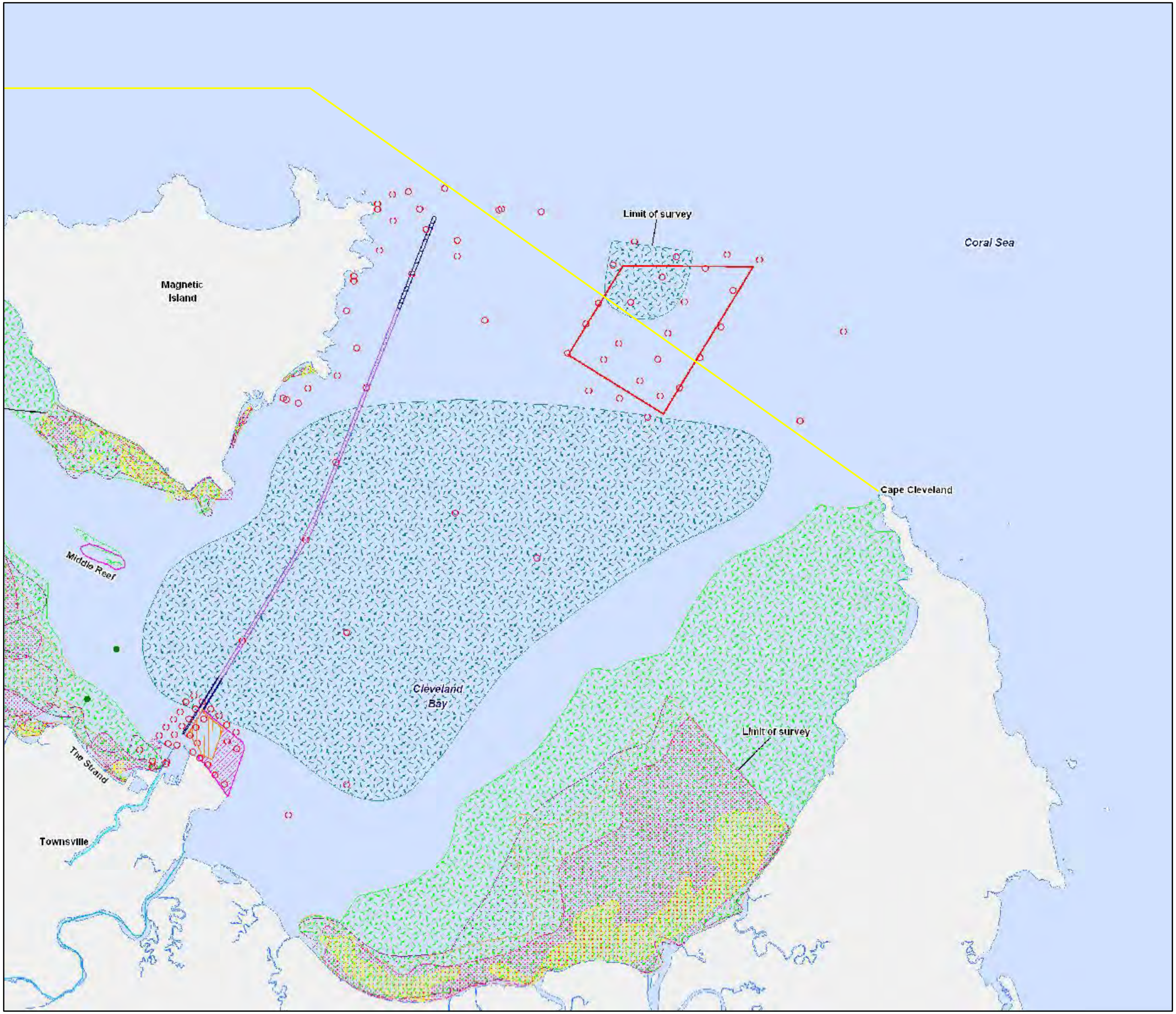
B.6.3.4.2 Temporal Patterns

The results of monitoring studies indicate that the distribution, extent and density of seagrass assemblages in the Study Area and surrounds can show great variation over a range of temporal scales. At seasonal scales, there is a typically a seasonal growth cycle in intertidal and shallow subtidal seagrass meadows (Waycott, Longstaff, & Mellors, 2005), with higher percentage cover of seagrass in late spring-summer than winter (Johnson, et al., 2011). This is the typical seasonal pattern of seagrass meadows in nearshore waters of the Great Barrier Reef region (Waycott, Longstaff, & Mellors, 2005; Unsworth, Taylor, & Rasheed, 2009), with higher water temperatures during summer periods promoting seagrass growth rates e.g. (Collier & Waycott, 2010).

PORT EXPANSION PROJECT
EIS

Distribution and Extent of Seagrasses within Cleveland Bay (Source: McKenna and Rasheed 2012)

Figure B.6.9



Legend

- Video Site - No Seagrass Observed
- Video Site - Seagrass Observed
- Ross River
- Ross Creek
- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- 2007 Coastal Seagrass (Permanent and Semi-permanent Meadows)
- 2007 Deepwater Seagrass (Sparse Ephemeral Meadows)

Monitoring Meadows
(McKenna and Rasheed 2012)

- 2008
- 2009
- 2010
- 2011

N

Scale: 1:135,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5
Kilometres

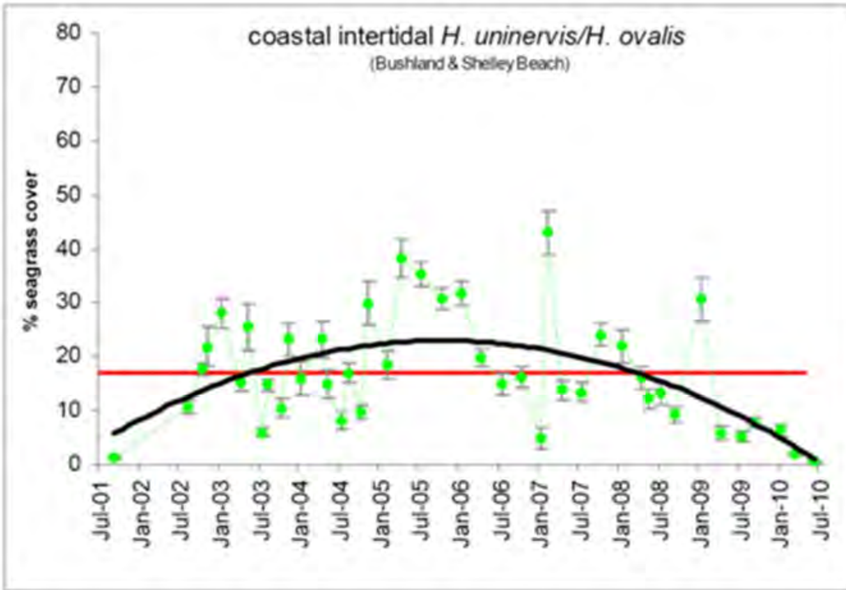
PROJECT ID 60161996
LAST MODIFIED CFS 16-Oct-2012
FILE NAME 60161996_PLN_039

Data Source:
Distribution and Extent of Seagrasses within Cleveland Bay (Source: McKenna and Rasheed 2012), Figure 7.8 - BMT WBM 2012.

Superimposed on these general seasonal growth patterns are longer term (inter-annual) cyclic changes in seagrass meadows due to climate-driven disturbance and subsequent periods of recovery. Large inter-annual changes in seagrass meadow extent and community structure resulting from climate-driven disturbance have been documented in the Port's annual seagrass monitoring program (McKenna & Rasheed, 2011). In particular, a major reduction in seagrass above-ground biomass and extent (at the deepest boundaries of the meadows) was recorded in Cleveland Bay between 2007 and 2011. Accompanying these overall declines was a change in species composition and community structure, with higher relative cover of primary colonist species (*Halodule uninervis* and *Halophila*), and a reduction in the canopy height of *Zostera muelleri*. Similar declines in seagrass cover were recorded by Seagrass Watch at Cape Pallarenda and Magnetic Island over the measurement period (Figure B.6.10). Johnson *et al*. (2011) found that there was declining trends in seagrass cover at the mainland sites (i.e. Cape Pallarenda) since 2005 whereas those around Magnetic Island only began to decline in 2008. Light limitation is a key driver of spatial and temporal patterns in seagrass distribution and abundance, and is thought to be a key driver of the observed long term temporal patterns in seagrass. Periods of high suspended sediment concentrations in Cleveland Bay are controlled mainly by wave driven bed sediment remobilisation, and inputs of terrigenous sediments in flood waters from the Burdekin and the coastal drainages that enter Cleveland Bay (Chapter B4 - Marine Water Quality). Conversely, when local climate conditions are in a drought-like state, subtidal seagrasses can thrive due to higher light levels reaching the seabed.

As shown in Figure B.6.11, all years in the period 2007-2011 had above average rainfall, with 2010 and 2011 almost double the annual average rainfall. As described in Chapter B4 (Marine Water Quality), water quality monitoring during this period found that photosynthetic active radiation (PAR) levels at the edge of seagrass meadows and coral reefs in Cleveland Bay were very low, particularly when significant rainfall and/or moderate-high winds occurred. Subtidal corals and seagrass were likely to be at or approaching their tolerance limits in terms of light deprivation for most of this measurement period.

The Port's seagrass monitoring program undertaken by DEEDI (now DAFF) commenced in November 2007, which was the beginning of this wet period. The previous six year period (2001-2006) were drought years, with three of these six years having less than half the annual average rainfall. The subtidal seagrass extent measured in 2007 is therefore likely to reflect optimal growing conditions. Coincident with these drought years, mean annual solar radiation and mean annual daily temperature was typically well above the long term average values (Taylor & Rasheed, 2009). In contrast to subtidal seagrass, intertidal seagrass mapped in 2007 may not be representative of a period of optimal growing conditions.



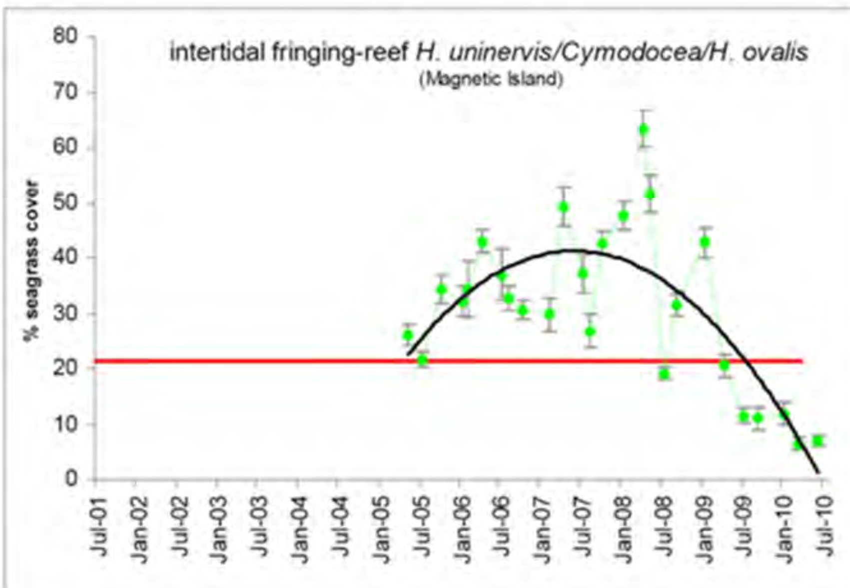


Figure B.6.10 Change in seagrass abundance (percentage cover) at intertidal meadows on fringing reef platforms from 2001 to 2010 at Bushland and Shelly Beach (east of Cape Pallarenda) and Magnetic Island sites. Red line = GBR long-term average for reef habitats (average of all sites pooled) Source: (Seagrass Watch, 2012)

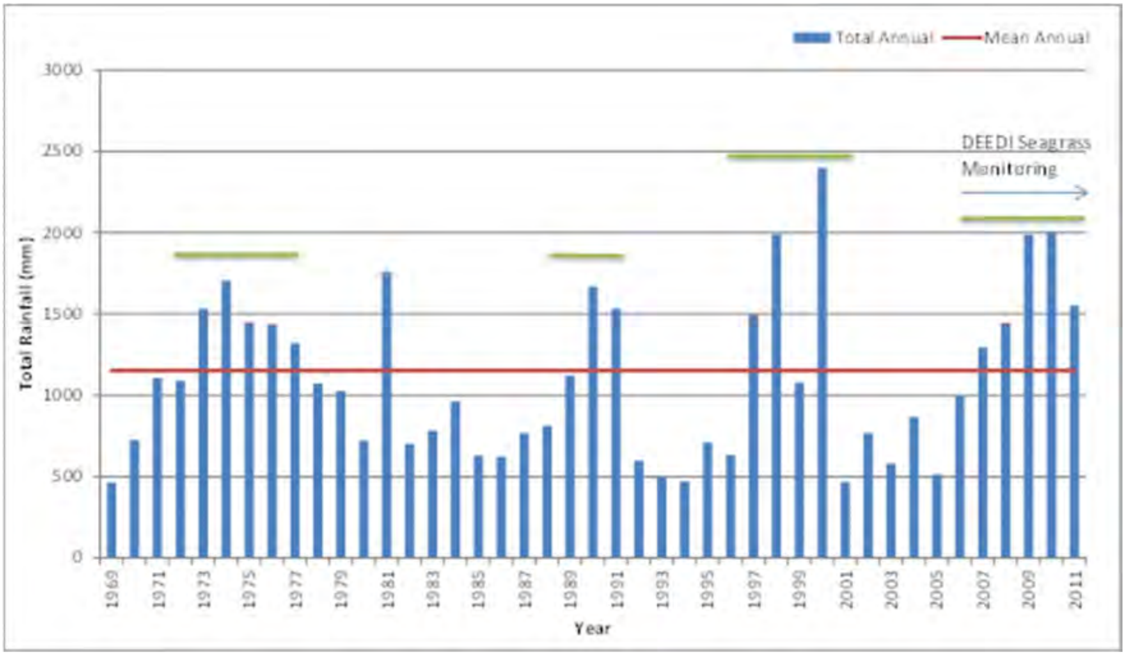


Figure B.6.11 Long term average annual rainfall (1940-2011) and total annual rainfall for the period 1969-2011 (BOM, 2012a) Green lines show periods when three out of four years were at or above average annual rainfall

B.6.3.4.3 Seagrass Resistance, Resilience and Condition

Seagrass species differ in their sensitivity to disturbance (i.e. resistance) and capacity to recover following disturbance (i.e. resilience). The degree of resistance and resilience of seagrass depends on a number of often interactive factors (Kenworthy, 2000; Taylor & Rasheed, 2009). In general, small species such as *Halodule* and *Halophila* tend to have low carbohydrate reserves compared to larger species, and are hence the most sensitive species to low light conditions (i.e. low resistance). However, *Halodule* and *Halophila* species also have adaptations that allow rapid recovery, including high reproductive output, rapid growth rates and the production of long lived seeds that can live in sediments for many years (i.e. high resilience). Larger species such as *Zostera muelleri* and *Cymodocea serrulata* have higher carbohydrate reserves and can endure unfavourable periods for longer than small-bodied species (i.e. high resilience). These larger bodied species are slower to recover should they be lost (Rasheed, 2004). Most species found in Cleveland Bay (except *H. decipiens* and *H. spinulosa*) are also capable of vegetative growth following disturbance, which increases the capacity of meadows to recover following disturbance.

The capacity to recover following disturbance also depends on seagrass condition, which is a function of the previous disturbance history (magnitude, and spatial and temporal scale of disturbance). Successive periods of disturbance (i.e. multiple wet years) can deplete seagrass energy sores, seed banks and standing crop (i.e. seagrass condition), which greatly decrease the capacity for seagrasses to recover following disturbance.

The Reef Rescue Marine Monitoring Program (Johnson, et al., 2011) assessed the condition of seagrass meadows, and found that seagrass meadows of the Burdekin-Townsville region were classified as being in a ‘poor state’ throughout the 2009/10 monitoring period (Johnson, et al., 2011). In terms of reproductive effort (and capacity to recover), Johnson *et al*. (2011) suggested that there was a decline in seed banks across the Burdekin-Townsville region over the monitoring period, with most mainland sites in the region having peak seed densities in 2007, and lower densities in the periods before and after 2007. Magnetic Island sites had consistently low seed densities throughout the measurement period, with no apparent temporal trend. The consistently low seagrass seed densities at the two Magnetic Island sites suggest that these meadows may have limited capacity to recover from disturbance (Johnson, et al., 2011).

Overall, these results indicate that the successive wet periods since 2007 have reduced the condition of seagrass meadows and their capacity to recover from disturbance. This is particularly the case of seagrass meadows around Magnetic Island, with mainland meadows displaying a higher capacity to recover from disturbance.

B.6.3.5 Reefs and Rock Wall Habitats

B.6.3.5.1 Reef Habitats and Biodiversity

Coral reefs form a benthic primary producer habitat. Cleveland Bay supports a network of near-shore reefs, which have different levels of inter-connectivity, habitat structure and are regulated by different water quality processes. At broader spatial scales, Cleveland Bay reefs form part of an extensive system of nearshore reefs within the *Coastal Central Reefs Bioregion* (GBRMPA, 2012c). Nearby nearshore reef systems include Herald Island, Bramble Rock Reef, Cordelia Rocks Reef, Acheron Reef and the Palm Island group to the north-west of Cleveland Bay, and Salamander, Bray and Bald Reefs around Point Cleveland.

Based on mapping from the GBRMPA Gazetteer, the total area of reef habitat in Cleveland Bay is approximately 987 hectares. Reef habitats in Cleveland Bay include shallow fringing reefs and rocky shores around Magnetic Island; the well-developed reef platform of Middle Reef; and smaller, less developed reef areas between the mainland and Magnetic Island (e.g. Virago Shoal) (Figure B.6.12).

At least 258 species of hard corals were recorded on reefs in Cleveland Bay and surrounds by Stafford-Smith and Veron (1992). This represents over half of the total number of hard coral species recorded in the Great Barrier Reef (405 hard coral species; see Fabricius (2009)). On a GBR wide scale, the species richness recorded on Cleveland Bay reefs was considered to be moderate (e.g. c.f. (DeVantier, De'ath, Done, Turak, & Fabricius, 2006). This level of biodiversity is remarkable given the frequent disturbance from floods and bleaching events, and the close proximity of reefs to the major urban centre of Townsville.

B.6.3.5.2 Spatial Patterns

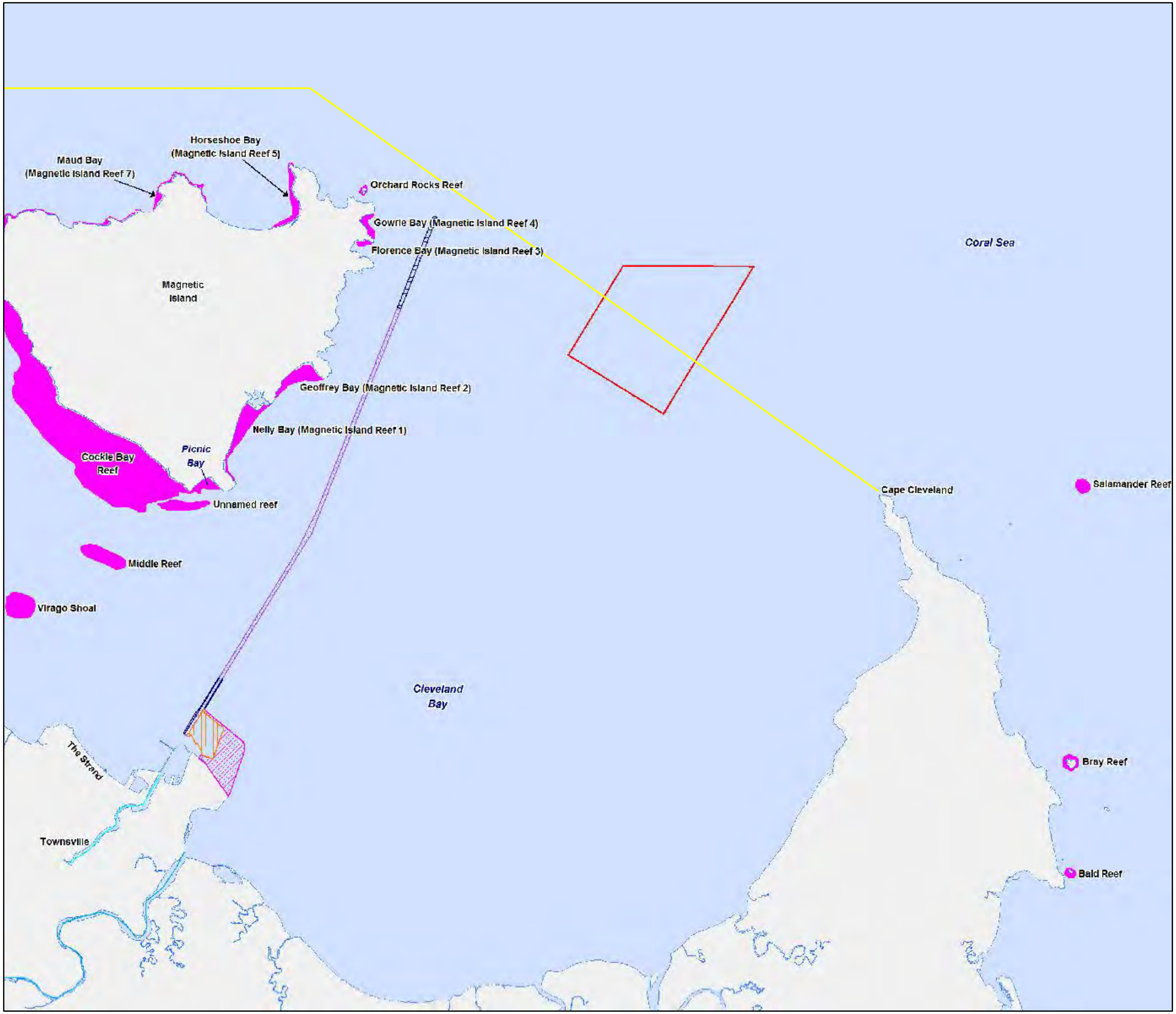
Background data describing coral and reef communities have been collected by researchers and consultants during environmental impact assessments. Previous studies suggest that hard coral cover is generally highest at Middle Reef, where cover averages around 50%, and varied between 19 and 84% over different parts of the reef. The fringing reefs of Magnetic Island typically have the highest hard coral cover along the reef slopes, whereas the reef flats are colonised by macroalgae and seagrass (particularly at Cockle Bay Reef). C and R Consulting (2007b) classified reefs into the following based on the relative cover of hard corals and macroalgae:

- Middle Reef, Nelly Bay West and Arthur Bay with very high live coral cover and low algal cover;
- Nelly Bay East and Florence Bay with lower live coral cover and relatively low algal cover; and
- Picnic Bay, Geoffrey West and Geoffrey East, where live coral cover was relatively low and similar to algal cover at the surveyed sites.

A coral and reef benthos survey was undertaken as part of the present study, which included sites at Middle Reef and around Magnetic Island. Figure B.6.13 shows the mean number of taxa/benthic categories recorded at each site in this 2012 survey. Cockle Bay and Horseshoe Bay had slightly greater mean numbers of taxa/benthic categories than other sites. Figure B.6.14 and Figure B.6.15, respectively, show the total and average percentage cover of corals, algae and all taxa recorded in 2012. These results indicate that patterns in the numerical dominance of hard coral families varied among locations, as summarised below:

- Acroporidae numerically dominated at Middle Reef, and Florence, Geoffrey and Horseshoe Bays. *Acropora* was the numerically dominant hard coral genus at Horseshoe. Confamiliar *Montipora* was the numerically dominant coral genus at Middle Reef, Florence and Geoffrey Bays, and was sub-dominant to *Acropora* at Horseshoe Bay.
- Faviidae was co-dominant with Dendrophyllidae (mostly *Turbinaria*) at Cockle Bay, and Poritidae and Acroporidae at Florence Bay, and was also abundant at Middle Reef.
- Dendrophyllidae (almost exclusively *Turbinaria*) was the dominant hard coral at Nelly Bay, and was abundant at Cockle Bay and Middle Reef.

- Soft corals were a minor part of the benthos at most locations, the exception being Horseshoe Bay and to a lesser extent Five Beach Bay.



PORT EXPANSION PROJECT
EIS

Distribution and Extent of Reefs within Cleveland Bay as Mapped in the GBRMPA Gazetteer

Figure B.6.12

Legend

- Ross River
- Ross Creek
- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- Coral Reefs

N

Scale: 1:135,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_040

Data Source:
Distribution and Extent of Reefs within Cleveland Bay as Mapped in the GBRMPA Gazetteer, Figure 7.11 - BMT WBM 2012.

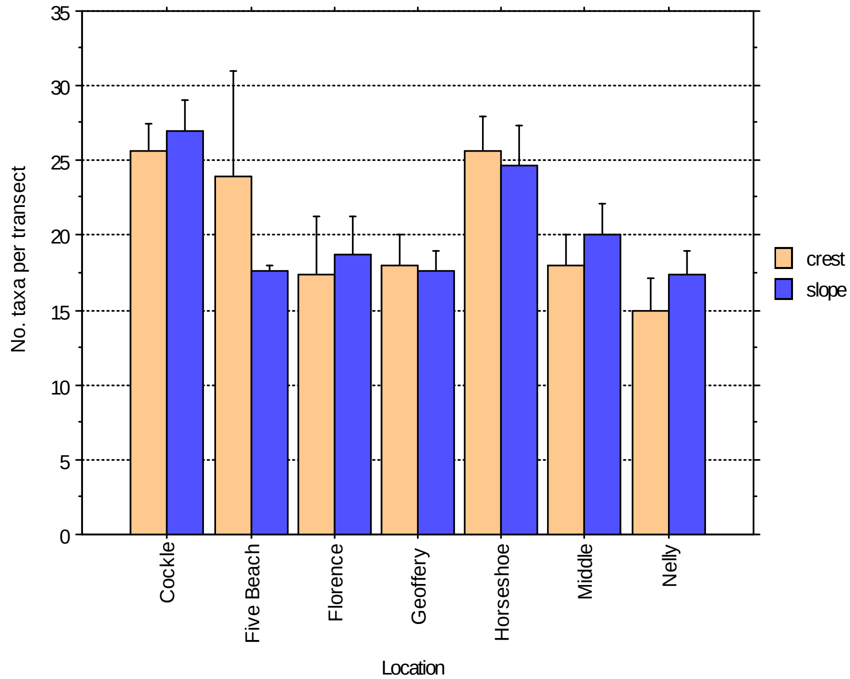


Figure B.6.13 Mean (error bars ± S.E.) number of hard coral genera (upper plot) and all reef taxa (lower plot) recorded on 30 m transects at each strata and location – 2012

The numerical dominance of the Acropora, Monitpora and (to a lesser extent) Turbinaria in Cleveland Bay coral assemblages has been reported by others (e.g. (Kaly, Mapstone, Ayling, & Choat, 1993; Mapstone, Choat, Cumming, & Oxley, 1989; C&R Consulting, 2007b; AIMS, 2010; Browne, Smithers, & Perry, 2010). While differences in sampling methods, site placement etc. prevents direct comparisons between studies, the following broad comparisons can be drawn from studies undertaken at three representative reef locations:

- Geoffrey Bay - Patterns in the relative abundance of corals at Geoffrey Bay were relatively similar between the present study and previous studies by Kaly *et al*. (1993), Thompson *et al*. (2011) and C and R Consulting (2007b). All studies recorded a dominance of Acroporidae, with Faviidae, Poritidae and other corals less common. The percentage cover of hard corals recorded at Geoffrey Bay in 2012 was in the range recorded previously.
- Nelly Bay - Kaly *et al*. (1993) found that mean hard coral cover at Nelly Bay was approximately 42% ± 5 (S.E). The mean percentage cover of coral recorded by C and R Consulting (2007b) ranged from approximately 65% ± 8 (S.E.) at Nelly Bay West and approximately 50% ± 8 (S.E.) at Nelly Bay East. These results indicate that there is great variability in hard coral cover at scales measured in 100's of metres. In the present study, mean hard coral cover was 13% ± 6 (S.E) at the reef crest, and 10% ± 0.7 (S.E) at the reef slope. These values were far lower than recorded previously at this location. All studies demonstrate that the cover of most massive corals was consistently low, whereas there were great differences among studies in *Turbinaria* and Acroporidae coral cover. Acroporidae coral cover can show great variation over time, being sensitive to physical disturbance, but also capable of high growth rates and capacity to recover following disturbance (see temporal patterns discussion below). *Turbinaria* is a moderately fast growing coral, but can be susceptible to physical disturbance during major storms and cyclones. While it is possible that there was a large increase in *Turbiniaria* and decrease in Acroporidae cover between the C and R Consulting (2007b) and the present study, it is also likely that differences in the position of transects accounted for some of the differences between studies.
- Middle Reef - Middle Reef is known to support highly abundant hard coral communities. Kaly *et al*. (1993) recorded a mean hard coral cover of approximately 62%, similarly C and R Consulting

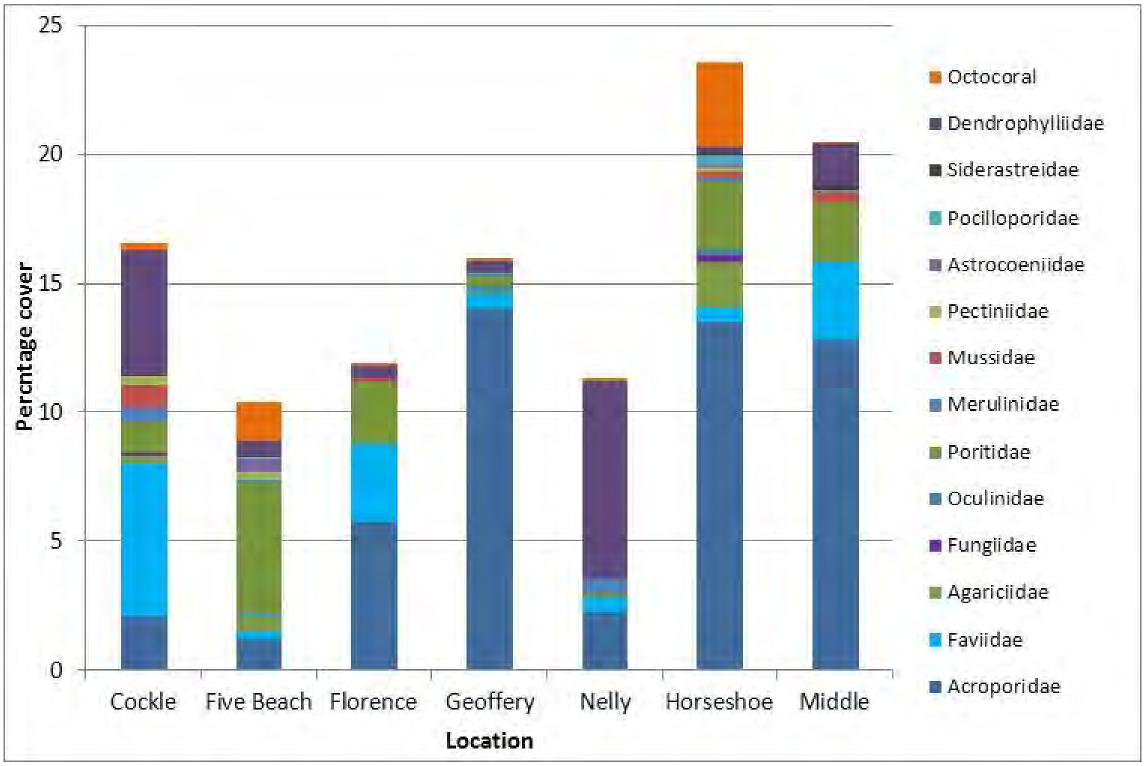
(2007b) recorded a mean hard coral cover of approximately 78% ± 11% (S.E.). In the period 2005-2011, Thompson *et al*. (2011) found that hard coral cover was between approximately 45% and 52% at the permanent transect located at the 2 m depth stratum. There are distinctly different reef community types at Middle Reef (Browne *et al*. 2010), and it would appear that Kaly *et al*. (1993) and C and R Consulting (2007b) sampled the particularly abundant coral community type (possibly Browne *et al*.'s (2010) Type 1 community, found on exposed windward slope of Middle Reef). The present study sampled sections of Middle Reef containing Browne *et al*.'s (2010) Type 2 and 3 (semi-protected slope) and 4 to 6 (reef flat and inner basin slopes) communities. The mean hard coral cover values recorded in the present study (19-21%) was consistent with Browne *et al*. (2010) for these community types. Patterns in the relative abundance of corals at Middle Reef were relatively similar between the present study and previous studies by Kaly *et al*. (1993), Thompson *et al*. (2011) and C and R Consulting (2007b). All studies recorded a dominance of Acroporidae, with Faviidae, Poritidae and other corals less common.

Macroalgae and turfing algae were also abundant at all surveyed locations (Figure B.6.15; Figure B.6.14). *Sargassum* was particularly abundant at east coast reefs (Florence 45%; Geoffrey 47%; Nelly 26%), but less so at the northern reefs (8 to 10%) and the southern reefs (Cockle 10%; Middle <1%). Turf algae were less abundant at east coast reefs (5 to 15%) than northern reefs (19 to 21%), and the southern reefs (Cockle 22%; Middle Reef 39%). *Laurencia* and *Lobophora* were found in moderate abundance, varying among locations. Algae cover in the present study was higher than recorded previously by Kaly *et al*. (1993) and C and R Consulting (2007b) recorded a mean 'algae' cover of approximately 6 to 7%.

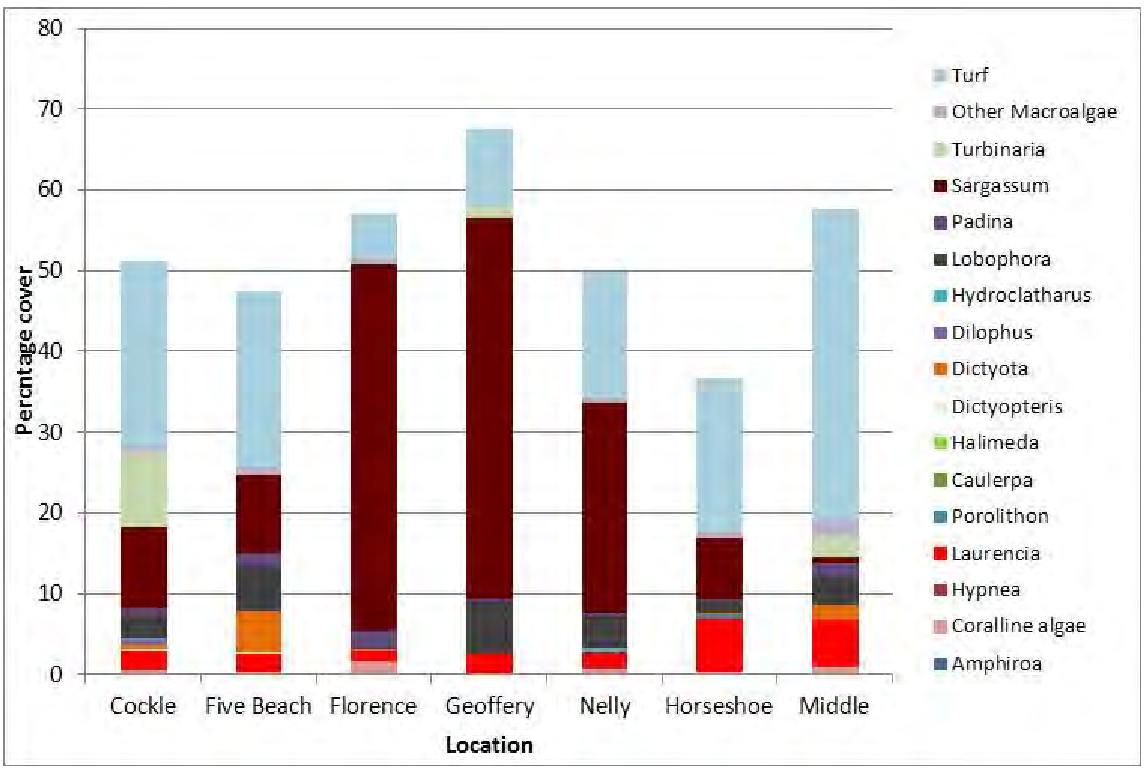
These results suggest that macroalgae cover, as well as the proportion of sand and rubble substrate, are higher than recorded previously. There are two possible, not necessarily mutually exclusive, explanations for this:

1) Macroalgae and bare substrate cover had increased in recent times. Macroalgae can rapidly colonise bare substrate, and can form a dense cover following disturbance to coral reefs (Done, 1999). As previously discussed, the two to three year period leading up to sampling had above average rainfall, and the reefs of Cleveland Bay experienced physical disturbance from Cyclone Yasi in February 2011. Thomson *et al*. (2011) reported that most macroalgae at Geoffrey Bay had been removed by Cyclone Yasi in 2011, however since this time it is apparent that macroalgae has proliferated. High macroalgae cover on coral reefs is typically a transient feature (Done, 1999), however prolonged periods of high nutrients can result in persistent macroalgae cover, resulting in reduced coral reef resilience (Hughes *et al*. 2005).

2) Differences are due to sampling error. It is also possible that differences in sampling effort and transect placement may partly explain differences between studies.



25
20
15
10
5
0
Percntage cover
Cockle
Five Beach
Florence
Geoffery
Nelly
Horseshoe
Middle
Location
Octocoral
Dendrophylliidae
Siderastreidae
Pocilloporidae
Astrocoeniidae
Pectiniidae
Mussidae
Merulinidae
Poritidae
Oculinidae
Fungiidae
Agariciidae
Faviidae
Acroporidae



80
70
60
50
40
30
20
10
0
Percntage cover
Cockle
Five Beach
Florence
Geoffery
Nelly
Horseshoe
Middle
Location
Turf
Other Macroalgae
Turbinaria
Sargassum
Padina
Lobophora
Hydroclatharus
Dilophus
Dictyota
Dictyopteris
Halimeda
Caulerpa
Porolithon
Laurencia
Hypnea
Coralline algae
Amphiroa

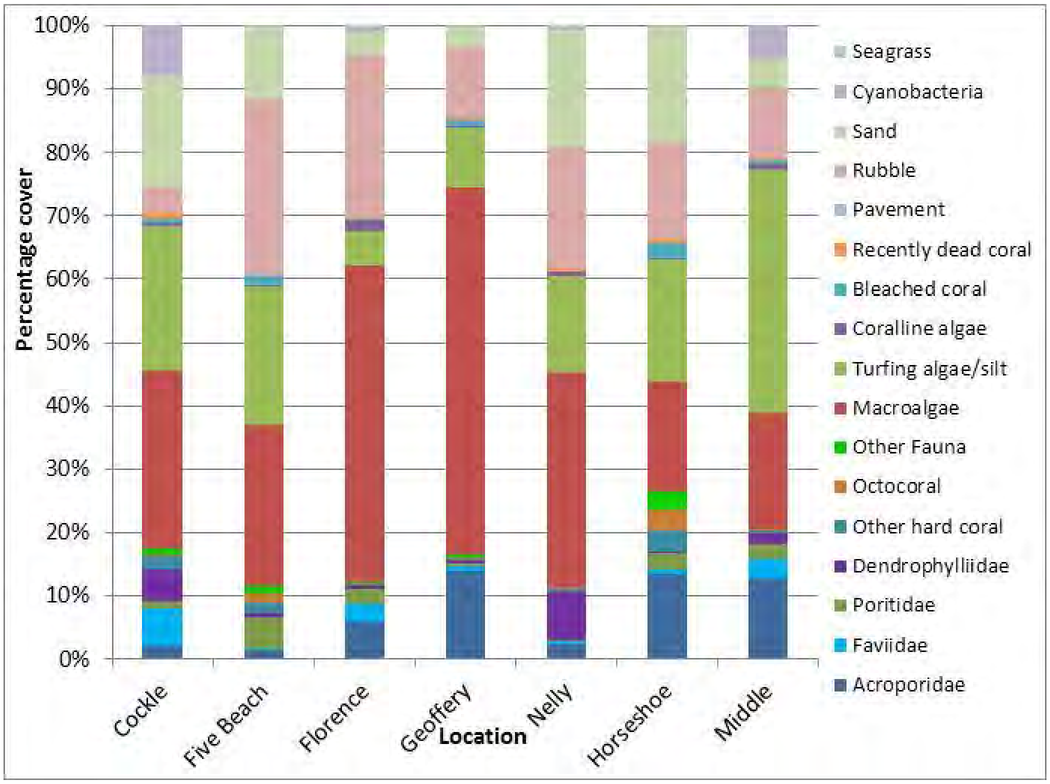


Figure B.6.14 Total percentage cover of coral (upper plot) and algae taxa (middle plot) and total benthic cover recorded at each location – 2012

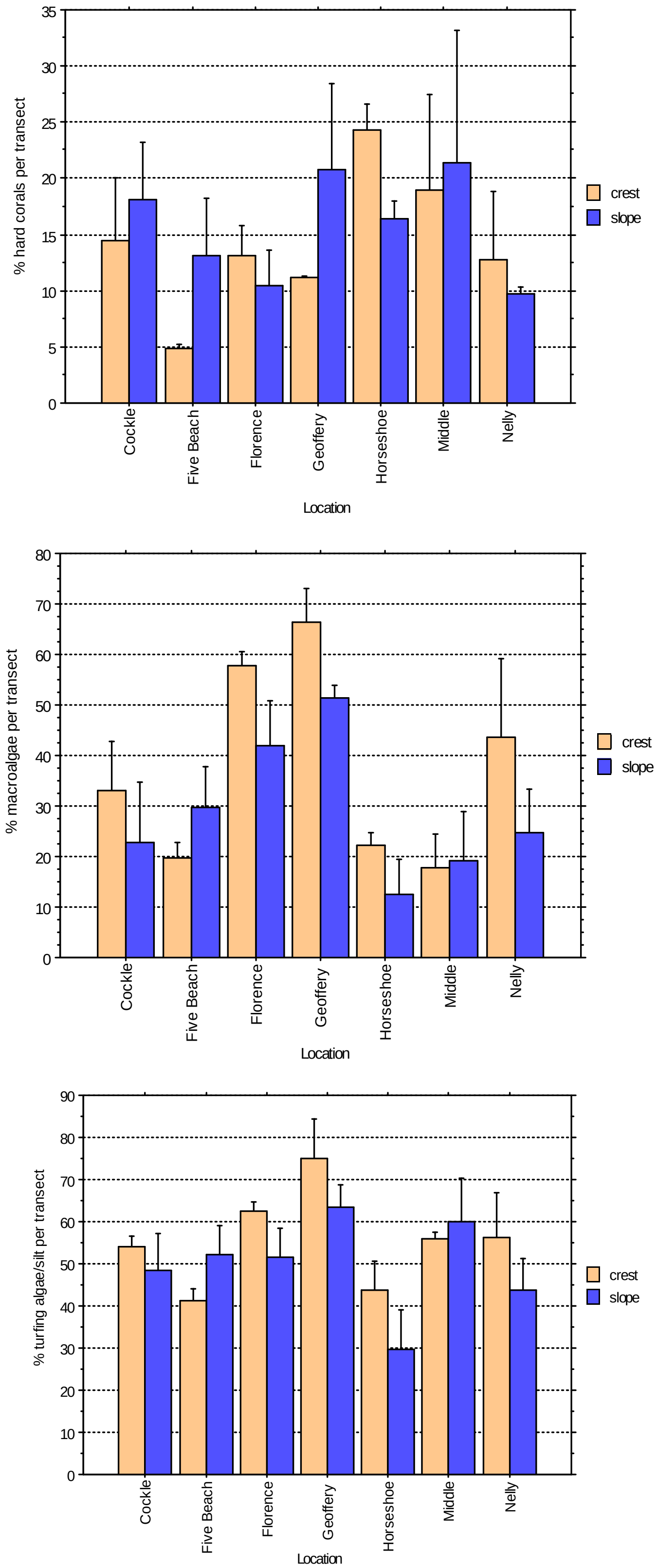


Figure B.6.15 Mean (error bars ± S.E.) percentage cover of macroalgae (upper plot) and turfing algae/silt matrix (lower plot) recorded on 30 m transects at each strata and location – 2012

B.6.3.5.3 Temporal Patterns

Benthic communities on reefs can show marked variation over time in response to seasonal changes in water quality conditions, and in response to disturbance from extreme weather events. The Australian Institute of Marine Science (AIMS) has monitored coral communities at Middle Reef since 1993. Monitoring was undertaken at permanently marked stations using standardised sampling methodologies. Figure B.6.16 shows the mean percentage cover recorded at the Middle Reef in the period 1993 to 2009.

Middle Reef

Monitoring results for hard coral cover and diversity has shown greatly inter-annual variability at Middle Reef, in response to frequent disturbance associated with high temperatures, freshwater and high sediment loads. In the long term, there has been a reduction soft coral cover following a major bleaching event in the 2002. Hard coral cover, particularly Poritidae increased between 2002 and 2008, reaching a maximum cover of 45% (compared to maximum of 40% pre-2002). Hard coral cover (particularly Acroporidae corals) declined again in 2009, most likely in response to a persistent flood plume in February 2009 (AIMS, 2010). Coral cover at Middle Reef in the period 2009 to 2011 again declined (Thompson, Davidson, Uthicke, B, Patel, & Sweatman, 2011), most likely in response to freshwater and physical disturbance resulting from Cyclone Yasi in 2011.

Low levels of coral recruitment have been recorded at Middle Reef in recent years, indicating that corals are under environmental stress from recent climatic disturbances (Thompson, Davidson, Uthicke, B, Patel, & Sweatman, 2011). Consistent with AIMS (2010), Browne *et al*. (2010) suggested that the coral communities of Middle Reef showed rapid recovery following disturbance, and represented a ‘resilient coral reef’.

Magnetic Island Reefs

Monitoring of reef communities by Kaly *et al*. (1993) at Nelly and Geoffrey Bays (12 stations) in the period 1989 to 1992 found that cover of most taxonomic groups (predominantly coral genera) were relatively constant in time (four sampling episodes). The exceptions to this were Acroporids, sponges, *Sargassum* and total algal cover, which all varied significantly in time at some but not all stations. Kaly *et al*. (1993) noted that changes in macroalgae were not surprising given that many species are annuals (including the abundant *Sargassum*), and display great inter-annual and seasonal variability. The fast growing (and typically fragile) Acroporids can also show marked temporal variability (see Thompson *et al*. (2011)), with the direction and magnitude of change varying among stations.

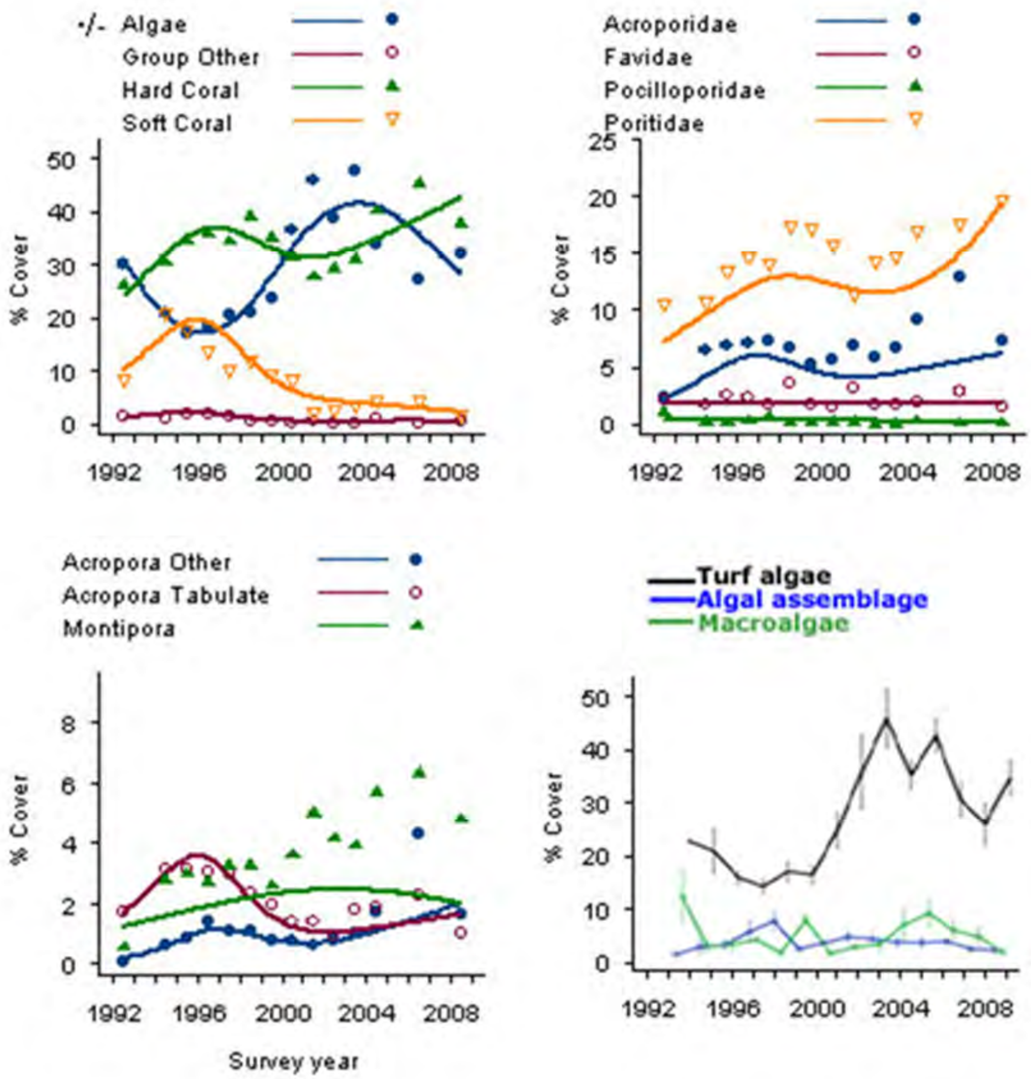


Figure B.6.16 Temporal patterns in reef community structure at Middle Reef between 1993-2009 (AIMS, 2010)

B.6.3.5.4 Resistance and Resilience

The Reef Rescue Monitoring Program (Thompson, Davidson, Uthicke, B, Patel, & Sweatman, 2011) has undertaken annual monitoring of benthic communities (coral cover, macroalgae cover and juvenile densities) at Geoffrey Bay since 2005, which provides an assessment of medium-term inter-annual temporal patterns. In summary, (Figure B.6.17):

- juvenile densities have remained consistently low across the monitoring period (see discussion below regarding resilience);
- total hard coral cover was relatively static over the monitoring period at the five metre depth stratum;
- total hard coral cover was lower in 2010 and 2011 than the 2005, 2007 to 2009 sampling episodes at the two metre stratum; and
- the reduction in hard coral cover between 2009 and 2011 reflected a reduction in Acroporidae cover. There was an increase in cover of 'other families' and Portidae, but further decline in Acroporidae, between 2010 and 2011.

These patterns demonstrate that reef community structure undergoes cyclic changes in response to disturbance processes and subsequent recovery. Coral communities typically rapidly recolonise after periodic (pulsed) disturbance events, with the rate of recolonisation likely to be dependent on ambient water quality and other environmental variables during the recovery period (e.g. Hughes *et al*. (2005)).

Low salinity flood waters in 2009 to 2011, as well as physical disturbance by Cyclone Yasi, are likely to be the main drivers of recent changes in coral community structure at Geoffrey Bay. Thompson *et al*. (2011) noted that Cyclone Yasi caused minor physical damage to Geoffrey Bay coral communities, with some breakage of fragile corals (such as Acroporids) and overturning of loosely attached colonies, and the loss of macroalgae.

Bleaching events have been observed at Magnetic Island sites in 1980, 1982, 1987, 1992, 1994, 1998, 2002, 2006 and 2009 (Jones R. B., 1997; C&R Consulting, 2007b; GBRMPA, 2010b). There was a close correlation between bleaching of corals and periods of average daily seawater temperature approaching 32°C in the period (Jones R. B., 1997). Bleaching also occurs in response to lower salinity due to flooding (GBRMPA, 2010b).

Low salinity conditions also promote disease incidence in Magnetic Island coral communities (Haapkylä, Unsworth, Flavell, Bourne, & Schaffelke, 2011). Haapkyla *et al*. (2011) found that summer outbreaks of the disease atrametous necrosis in corals at Geoffrey Bay and Nelly Bay were strongly correlated with reduced salinity and higher concentrations of particulate organic carbon. It was suggested that low salinity (particularly multiple low salinity events) reduces the immune responses of corals, and/or increased the pathogens causing the disease. Other inter-correlated factors, such as total suspended solid concentrations, may also affect incidence of coral disease. Based on the above, it is apparent that summer represents a naturally stressful period for corals, and would be expected to most vulnerable to further anthropogenic change during such periods.

Like seagrass, coral species differ in their sensitivity to disturbance (i.e. resistance) and capacity to recover following disturbance (i.e. resilience). In terms of resistance, Cleveland Bay has naturally high turbidity levels and corals must have adaptations to cope with periods of low light and high sedimentation rates. This includes for example, (i) the capacity for some corals to switch from phototrophic to heterotrophic feeding strategies by feeding on suspended sediments; (ii) rapid replenishment of energy reserves between turbidity events; (iii) rapid rates of photo-acclimation; and (iv) energy conservation through reduced respiratory and excretory losses (Anthony & Larcombe, 2000). Many nearshore turbid water species also produce mucus to slough settled sediment.

The degree of resilience of corals varies among taxa. Acroporidae corals, for example, can show great changes in cover over time but are generally considered to be resilient. While most Acroporidae species are photophilic (sensitive to light deprivation) and break easily, they are also capable of high growth rates and high reproductive output (Thompson, Schaffelke, De'ath, Cripps, & Sweatman, 2010). Many Faviidae, Porititidae and Fungiidae corals, by contrast, are relatively resistant to physical disturbance, are relatively tolerant of low light conditions (many species can switch to suspension feeding) and high rates of sedimentation, but have low growth rates and recruitment levels.

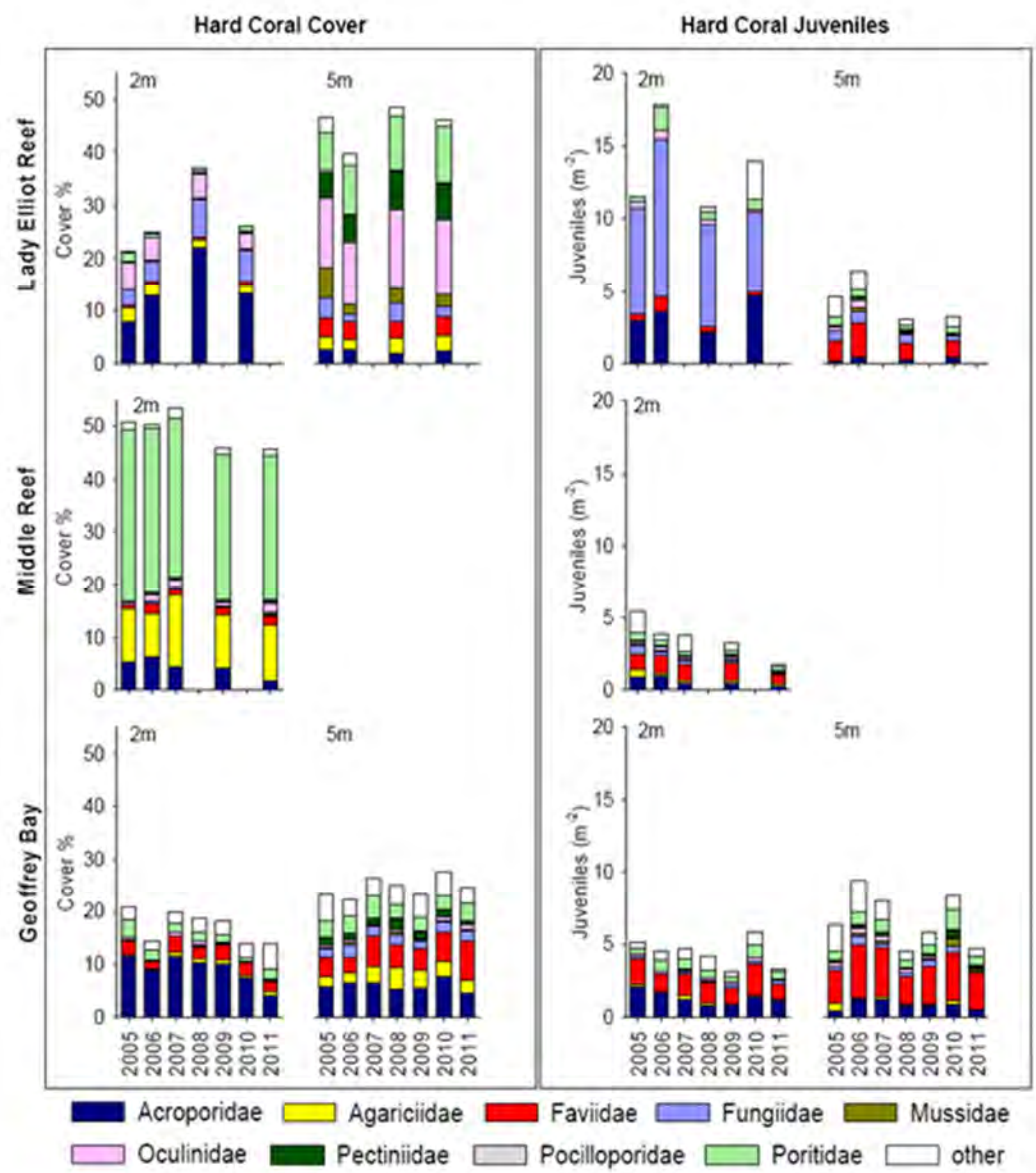


Figure B.6.17 Hard coral cover and juvenile densities recorded at Geoffrey Bay, Middle Reef and Lady Elliot Reef (Thompson, Davidson, Uthicke, B, Patel, & Sweatman, 2011)

As discussed previously, coral reefs of Cleveland Bay are thought to be resilient to change, showing rapid recovery following disturbance [e.g. (AIMS, 2010; Browne, Smithers, & Perry, 2010)]. Notwithstanding this, recovery rates and growth of corals are highly dependent on ambient environmental conditions. Browne (2012) for example found that coral growth (calcification) at Middle Reef was lowest in summer months when sea surface temperatures (monthly average 29° C) and rainfall (total >500 mm) were high. Browne (2012) suggested that while corals on Middle Reef were resilient and robust to their marginal environmental conditions (i.e. high turbidity and sedimentation, periodic low salinities), they would be most susceptible to anthropogenic disturbances in summer months.

Both reactive (during operations) and long-term coral monitoring studies have occurred during the previous Platypus Channel dredging in the mid-1990s. Reactive monitoring showed that partial mortality at impact locations did not exceed that of control locations, and control locations also experienced higher levels of total colony mortality (Stafford-Smith *et al*. 1992). Although these findings suggest that the dredging activities were benign, bleaching rates were higher in impact locations (Geoffrey and Florence Bays), and at least one species appeared close to its survival limit.

It was also suggested that environmental conditions experienced during spring tides, high wind and/or swell events co-occurring with dredge events were the times when corals were most susceptible to bleaching and mortality. Longer term monitoring around this event showed that faviid and soft coral abundance was reduced in impact locations, but these constituted a relatively small amount of total cover (6%). To a large extent, the short term responses of reef communities to disturbance will depend on their condition in the period leading up to disturbance, which has important implications from an impact assessment perspective.

In recent years, Thompson *et al*. (2011) recorded low levels of coral recruitment (predominantly by slow-growing coral species) on settlement plates located at Middle Reef. On the basis of these results, Thompson *et al*. (2011) suggested that conditions in the last few years would not facilitate rapid recovery following any catastrophic disturbance. However, the degree of resilience is expected to improve as communities recover from the succussive climatic disturbances in recent years.

Rock Wall Habitats

In addition to natural reef systems, the Study Area and surrounds contain large areas of rock wall habitat, particularly in the port area and in places along the foreshore of Townsville. Surveys undertaken in the present study suggest that the existing rock walls around the port support abundant marine plant (algal) and invertebrate (primarily sponge and hydrozoan-dominated) communities. The best-developed hard coral communities were recorded on the more quiescent western breakwater, although cover and taxa richness was far lower than recorded on reef systems in Cleveland Bay.

Rock wall habitats represent aggregation areas and habitat for a range of fish and shellfish species, and as such, can represent locally important fisheries habitats. Anecdotal observations of large numbers of boat-based recreational anglers adjacent to the western breakwater suggest that this areas supports locally important recreational fisheries habitats.

B.6.3.6 Soft Sediment Habitats and Communities

B.6.3.6.1 Habitats

Soft sediment habitats in Cleveland Bay include sandy beaches, intertidal mudflats and subtidal soft sediments. In the surrounding area, large intertidal flats occur throughout Cleveland Bay, and are likely to provide a number of ecological functions that are important to the maintenance of local ecosystem processes, including nutrient cycling processes, provision of food resources, and a linkage between littoral wetland areas (mangroves, saltmarsh), seagrass beds and deeper nearshore soft sediment habitats. These areas also provide habitat for benthic microalgae species, which are known to be key drivers of ecosystems, but whose condition is largely unknown (GBRMPA, 2009). Intertidal flat habitats are not represented in the construction footprint, but are present to the south and west of the Port Expansion Project Area

Subtidal ‘unvegetated’ soft sediment is the dominant habitat type in Cleveland Bay. The extent of ‘unvegetated’ soft sediment habitats can show great temporal variability in response to temporal changes in the extent of seagrass meadows (see Section B.6.4.4). Sampling was carried out in 2010 and 2011 by BMT WBM to map the distribution and extent of different soft sediment classes in the Study Area and surrounds. Single-beam sonar and sediment sampling identified seven sediment classes in and adjacent to the Study Area, as shown in Table B.6.1. Maps showing the spatial distribution of sediment classes in the Port Expansion Project Area and surrounds (Figure B.6.18), DMPA (Figure B.6.19) and existing channel and channel extension project area and surrounds (Figure B.6.20) are presented over-page.

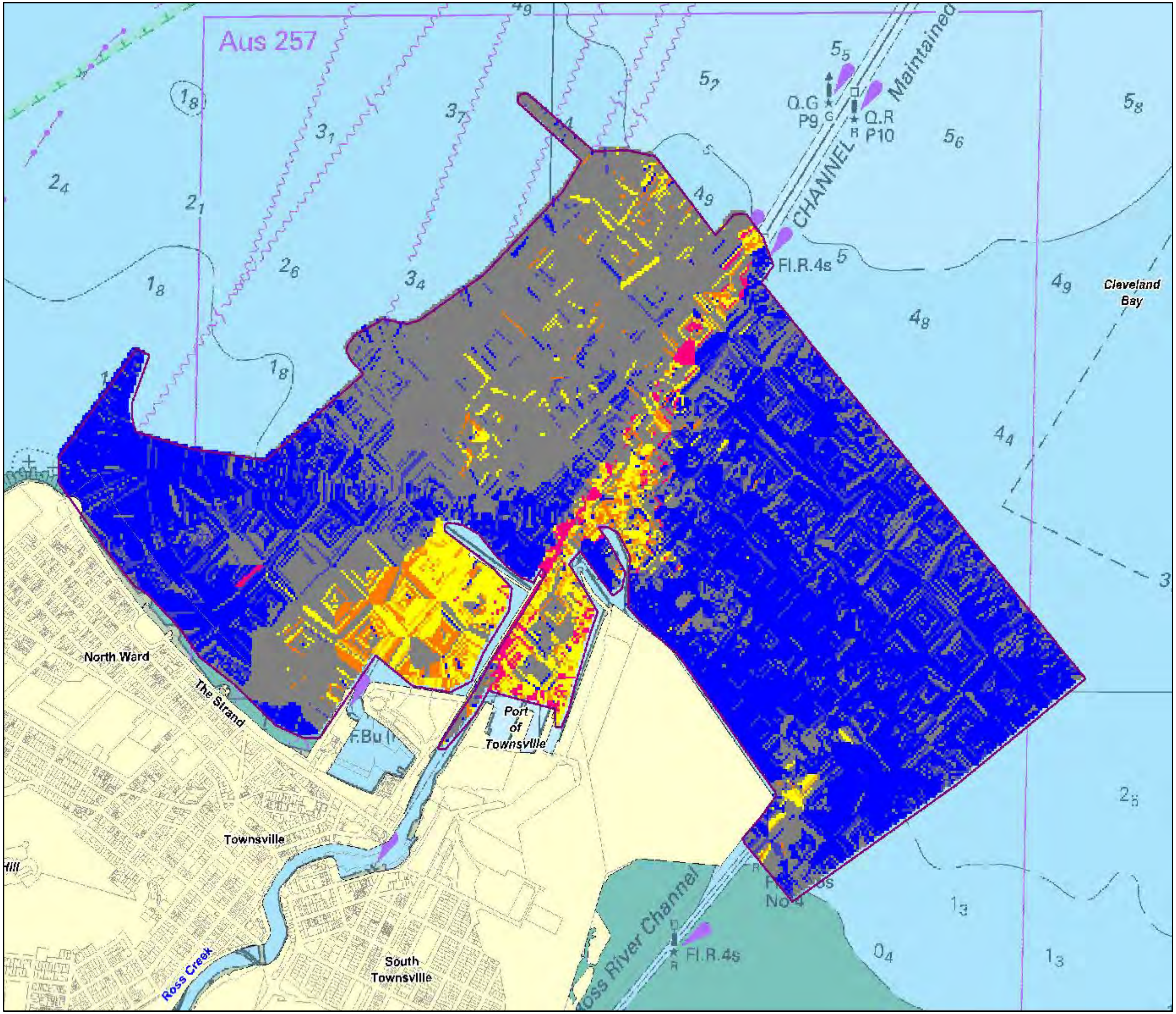
Table B.6.1 Habitat classes identified through sonar-based surveys and corresponding sediment type class

Class number	Colour Code	Abbreviated Sediment Description
2	grey	Mud with sand and occasional gravel
2a	purple	Coarse sands with shell grit
3	navy	Silty fine to medium sands
4	yellow	Silt with fine sand
6	orange	Silt with poorly sorted sands
7	pink	Rock or coral with silt and sand
9	green	Silt

PORT EXPANSION PROJECT
EIS

Acoustic Classes Surrounding the Outer Harbour Project Area

Figure B.6.18



Legend

- Survey Boundary
- Cadastre

Acoustic Class

- 2
- 3
- 4
- 6
- 7

N

Scale: 1:30,000 approx. (when printed at A4)

0 | 0.5 | 1
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_041

Data Source:
Acoustic Classes Surrounding the Outer Harbour Project Area, Figure 7.17 - BMT WBM 2012.
Chart - Australian Hydrographical Service

PORT EXPANSION PROJECT
EIS

Acoustic Classes Surrounding the DMPA

Figure B.6.19

Legend

Port Limits

Dredge Material Placement Area

Acoustic Class

2	
3	
4	
6	
7	

N

Scale: 1:35,000 approx. (when printed at A4)

0 0.5 1

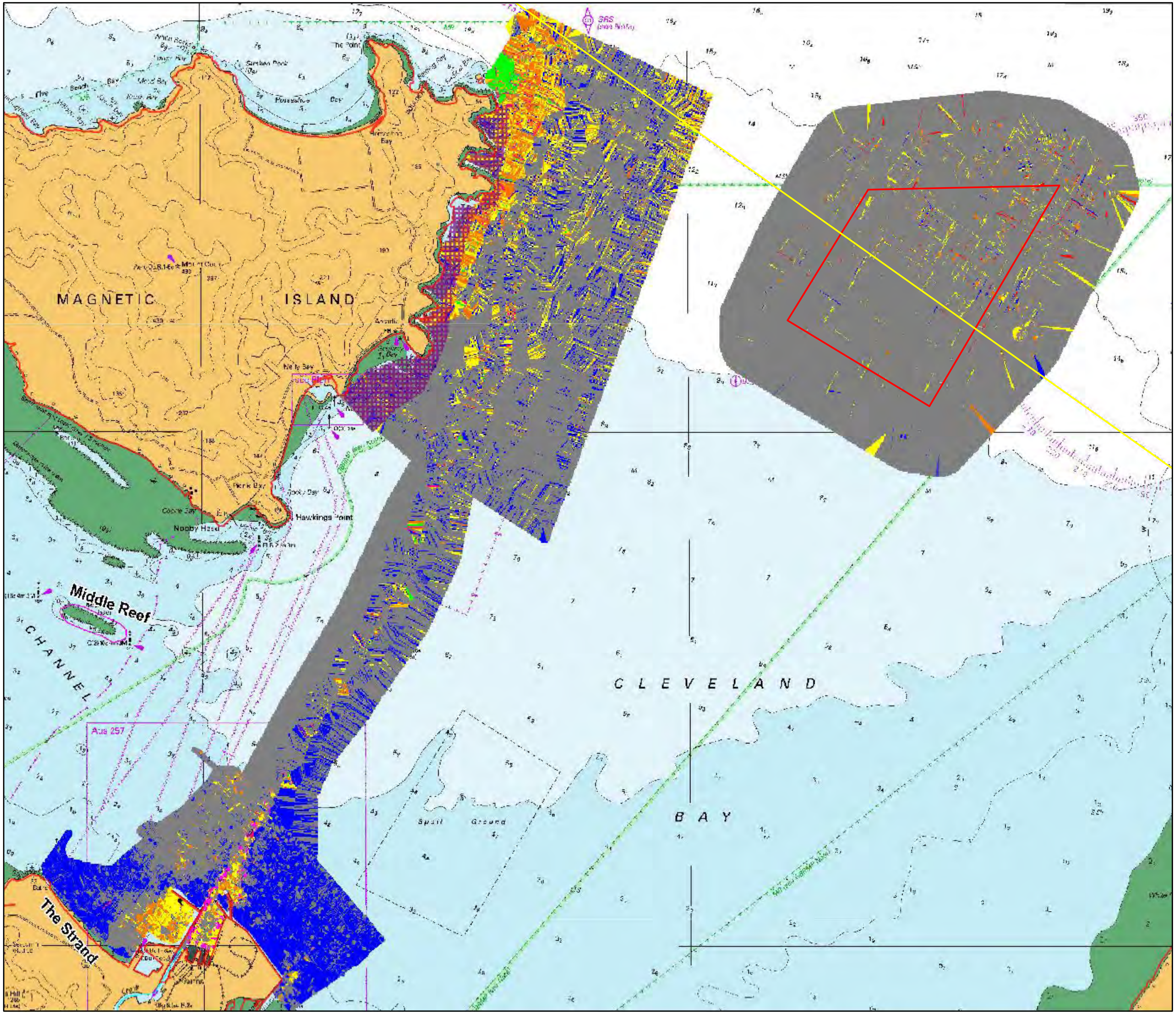
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_042

Data Source:
Acoustic Classes Surrounding the DMPA, Figure 7.18 - BMT WBM 2012.
Chart - Australian Hydrographical Service



PORT EXPANSION PROJECT EIS

Acoustic Classes Surrounding the Project Area

Figure B.6.20

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_043

Data Source:
Acoustic Classes Surrounding the Existing Channels and the Channel Extension Project Area, Figure 7.19 - BMT WBM 2012.
Chart - Australian Hydrographical Service

The Port Expansion Project Area was dominated by silty sands (class 3), which were present along much of the eastern seawall and offshore from the northern part of the Strand, interspersed with other small patches of seabed classes. Fine sand was particularly prevalent offshore of the eastern seawall where it formed small ridges, especially close to the breakwater in the shallower high-energy environment. With increasing distance from the shore, there was an increased prevalence of muddy sand with gravel (class 2). In the swing basin for Berth 11 and west of the western seawall, there were depositional areas composed of silt (classes 4 and 6) and muddy sand with gravel (class 2). This depositional area between the western breakwater and the Strand ends abruptly at its southernmost extremity where beach sand intersect with mud. With increasing distance to the north along the Strand, silty sands extend more gradually from the beach out to sea as wave energy increases. Small patches of rock (class 7) occurred adjacent to the breakwaters, and the margins of the dredged channels and the swing basins. Sediments in the offshore DMPA were more homogeneous than the Port Expansion Project Area. There was a higher percentage of sands in the shallower south-western part of the dredged material disposal area. With increasing distance in a north-easterly direction (and increased depth), there was a greater proportion of muds and silts. Very few rocky substrates (class 7) were observed in either Project Area.

Figure B.6.19 shows the distribution of sediment classes surrounding the existing channel extension project area collected in 2011. Silty sands (class 3) surrounding the Port Expansion Project Area gradually became less concentrated with distance offshore, being replaced by muds with sand (class 2). Silty sands were more prevalent on the eastern side of the channel, while class 2 sediments dominated the western side of the channel. This difference in distribution may be related to wind driven sediment transport by south-east trades. Mobile silty sands may become trapped in the Platypus Channel as they move in a north-westerly direction. The inshore area immediately east of Magnetic Island was composed of coarse class 2a sediments which gradually become muddier with depth and distance offshore. Near the northern extent of this of the surveyed area is a patch of silt (sediment class 9).

Habitat Condition

Environmental integrity of unvegetated soft-sediment habitats in the port area, navigation channels, DMPA and adjacent areas, including the mouth of Ross Creek and Ross River, have been substantially modified by a number of past anthropogenic activities. Most notably, these include port development works, water quality modifications associated with a wide range of activities in the wider catchment, and flow modifications associated with water infrastructure (i.e. damming of Ross River). Benthic habitats and communities are relatively simplified (Sinclair Knight, 1998), and may not retain particularly high values compared with more diverse habitats elsewhere in the surrounding area. As discussed in Chapter B5 (Marine Sediment Quality), some localised areas of seabed in the port contain elevated levels of contaminants of potential concern, including TBT and some trace metals.

At broader spatial scales, the Great Barrier Reef Outlook report (GBRMPA, 2009) considers that the nearshore sedimentary habitats of the GBRWHA appear to be in ‘good’ condition. However, several physical and chemical processes were considered to be in poor condition, most notably sedimentation (which has increased in inshore environments), sea temperatures (increasing across the GBR), nutrient cycling (increased nutrient loads in inshore areas) and pesticide accumulation (found in some areas of the GBRWHA, but as discussed in Chapter B5 (Marine Sediment Quality), is not a contaminant of potential concern in Cleveland Bay).

Epibenthic Communities

Video-based surveys suggested that epibenthic communities (i.e. organisms living on the sea bed) had a sparse cover across the Study Area and surrounds. Sparse and patchy epibenthic communities occurred throughout the Study Area. Of the 73 transects, seagrass was recorded on two transects, and epifauna was observed on 48 transects. In total, 30 fauna taxa, three seagrass species and three genera of macroalgae were recorded.

Epibenthos assemblages in the DMPA were dominated by a type of burrowing goby. Of the 149 fish observed in video transects, 142 (95%) were burrowing gobies, and 124 of these were observed in the DMPA. Sea pens (Pennatulacea) were particularly common at the DMPA, but were only occasionally observed in the midshore controls and construction footprint, and absent elsewhere. Bryozoans, sponges, polychaetes, ascidians (sea squirts), echiurans (spoon worms), hydrozoans and alcyoniid soft corals were occasionally observed. The small patches of rock in the DMPA provide habitat for reef-associated taxa such as sea pens, ascidians and some crinoids, and represent areas of locally higher biodiversity in the DMPA.

Epibenthic assemblages at the offshore control area were generally similar to those at the DMPA, although sea pens and many hard substrate/gravel associated taxa recorded at the DMPA were not observed at the offshore control (Figure B.6.21), and very few Alcyonacea soft corals were recorded at the DMPA compared with the offshore controls. Mid-shore control assemblages were comprised of occasional hydrozoans, sea pens, crinoids and ascidians. Channel assemblages were the most depauperate, with only one feather star (crinoid) recorded. Epibenthos assemblages at the nearshore control and Port Expansion Project Area were structurally similar. Hydrozoans were the most abundant taxon in the nearshore areas, and were much less common in the DMPA, mid- and offshore control areas. Assemblages were dominated by plumulariid and sertularellid stinging hydroids, with occasional alcyonid soft corals, ascidians, and bryozoans.

Epibenthic communities were very sparse over most of the channel extension project area, consisting of the occasional stinging hydroid, mollusc, crustacean, ascidian and macroalgae over bare muddy, sandy or silty substrates (Figure B.6.22). For most transects, only one taxon was recorded at a frequency of 1 to 2 animals per transect. However, there were two reefal areas with abundant benthic communities found at the northern and southern inshore extremities of the site survey area. Both areas occurred adjacent to the fringing reefs of Magnetic Island, and were outside the channel extension footprint (Reefal areas are identified as pink areas in Figure B.6.20).

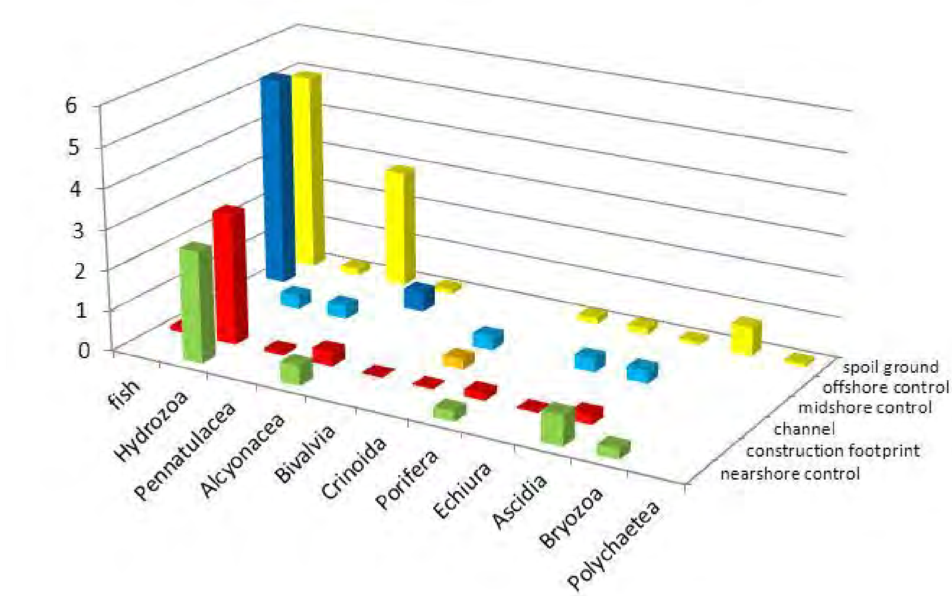


Figure B.6.21 Mean abundances (per 4 minute transect) of epibenthic fauna in the Study Area and surrounds (excluding the channel extension project area)

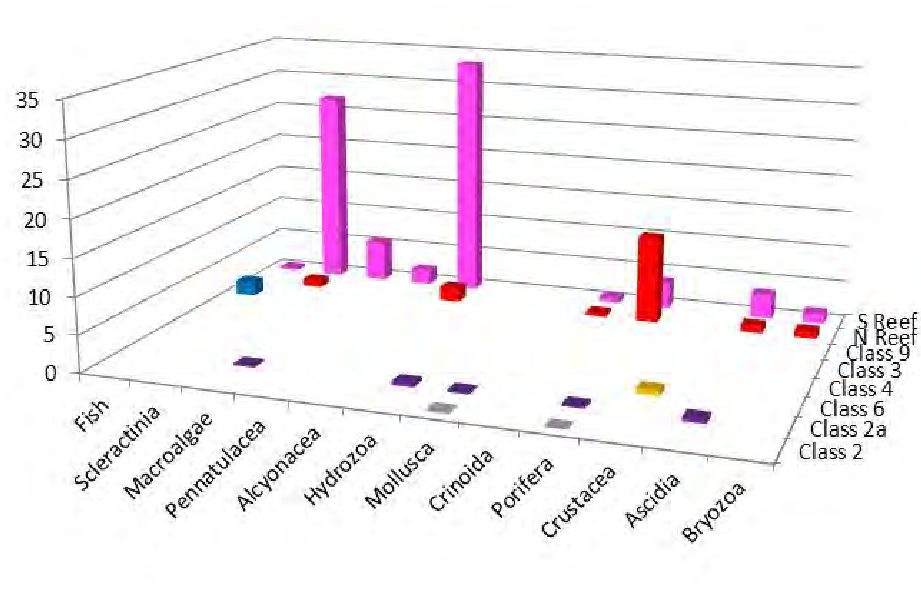


Figure B.6.22 Mean abundances (per 4 minute transect) of epibenthic fauna from sediment classes in the channel extension project area and surrounds

Infauna communities (excluding the channel extension area and surrounds)

Macrobenthos (infauna) communities were sampled by a grab sampler, and were found to be numerically dominated by polychaete worms, amphipods, decapod crustaceans and numerous other invertebrate taxa (Figure B.6.23). Sampling in the Study Area and surrounds in 2010 (excluding the channel extension project area – discussed below) indicated that most taxa had low abundance, with 90 taxa (approximately 84% of taxa) being represented by five or fewer individuals. These 16 most common species are listed in Table B.6.2. Three taxa accounted for 22% of the total number of individuals collected: a brittle star (*c.f. Amphioplus* sp.) comprising 10% of the total number of individuals collected; an amphipod crustacean (Gammarid 1, 8% of individuals); and a polychaete worm (Glyceridae 1, 4% of individuals). The patterns in dominance were typical to that observed in other grab-based studies in the Study Area (C&R Consulting, 2007b) which found that polychaetes were the most abundant taxon, followed by amphipods, bivalves, other marine worms, crabs, isopods, ascidians and brittle stars.

Table B.6.2 List of most common infauna species (i.e. >5 individuals collected) during the 2010 survey

Phyla	Class	Order	Taxa	Common name
Annelida	Polychaeta	Eunicida	Onuphidae 1	segmented worms
			Amphinomidae 1	
			Marphysa sp.1	
			Eunice sp.1	
		Phyllodocida	Glyceridae 1	
		Scolecida	Maldanidae 1	
Crustacea	Malacostraca	Decapoda	Caridean 2	shrimp
			Larval crab 2	crab
		Amphipoda	Gammarid 1	sea lice
			Gammarid 2	
			Gammarid 6	
Mollusca	Bivalvia	Veneroida	*Tellina* sp.1	venus shell/clam
			Mactra sp.1	
Echinodermata	Ophiuroidea	Ophiurida	c.f. Amphioplus sp.1	Brittle star
Nemertea	-	-	Nemertean 1	ribbon worm
Chordata	Leptocardii	Amphioxiformes	*Branchiostoma* sp.1	lancelet

Figure B.6.24 shows the total number of animals recorded at each site (grouped by higher taxa). At the DMPA, abundance at all sites was consistently dominated by polychaete worms and, to a lesser degree, crustaceans. At other locations, the dominant taxa tended to vary between sites. For example, at the Port Expansion Project Area, some sites were dominated by crustaceans, while others were dominated by molluscs. Similarly, at the nearshore control location, the relative proportion of each major taxa group varied inconsistently among sites.

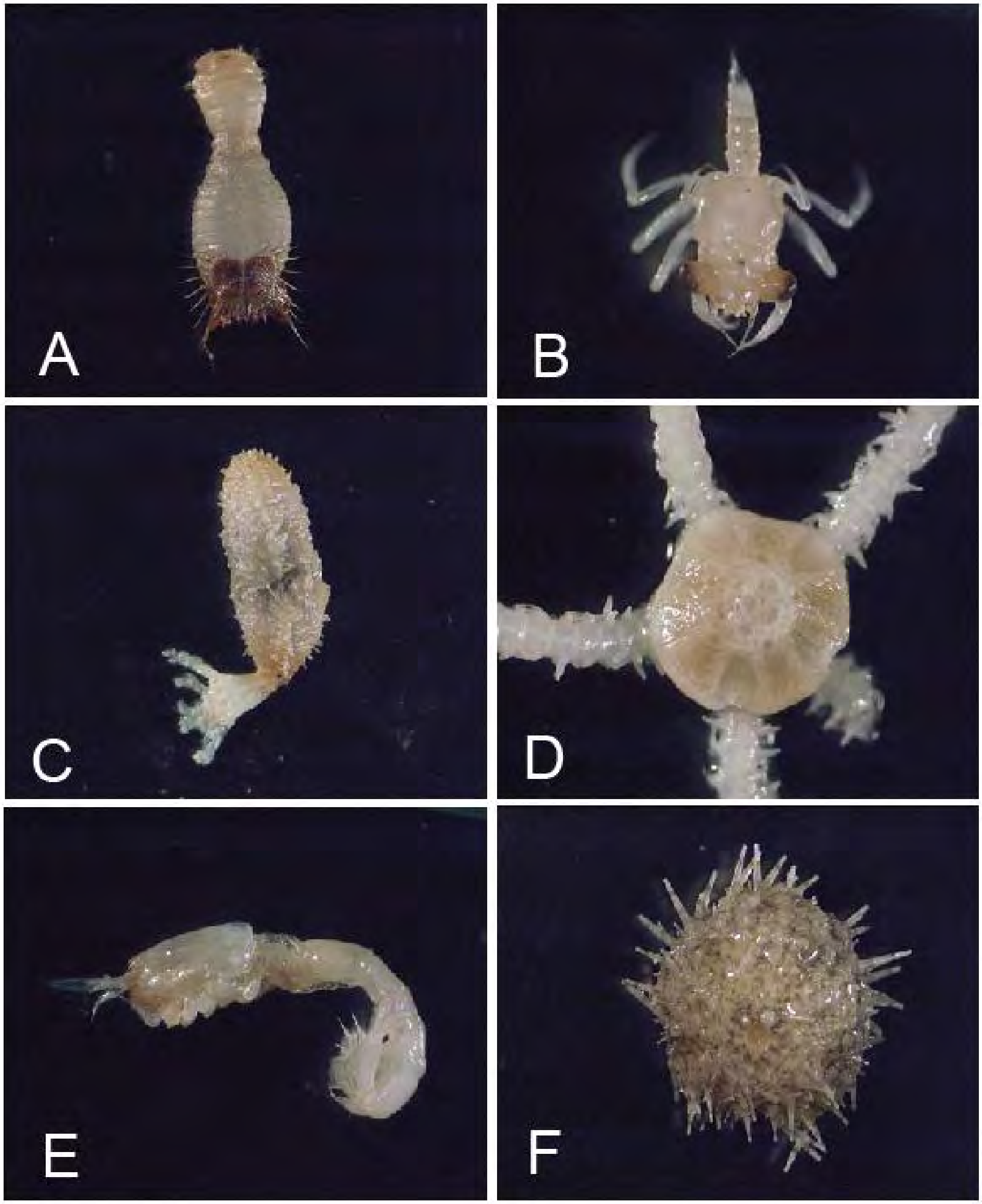
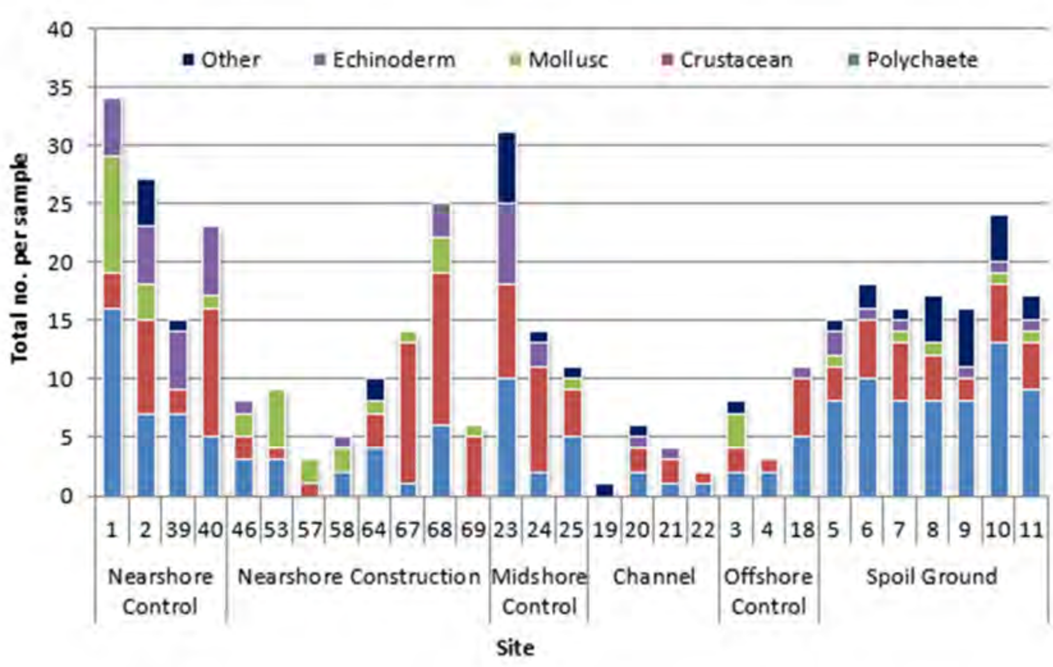


Figure B.6.23 Examples of infauna specimens collected during baseline surveys: sternapsid polychaete (A); brachyuran (larval crab) (B); holothurians (sea cucumber)(C); ophiuroid (brittle star) (D); tanaid crustacean (E); echinoid (sea urchin) (F)



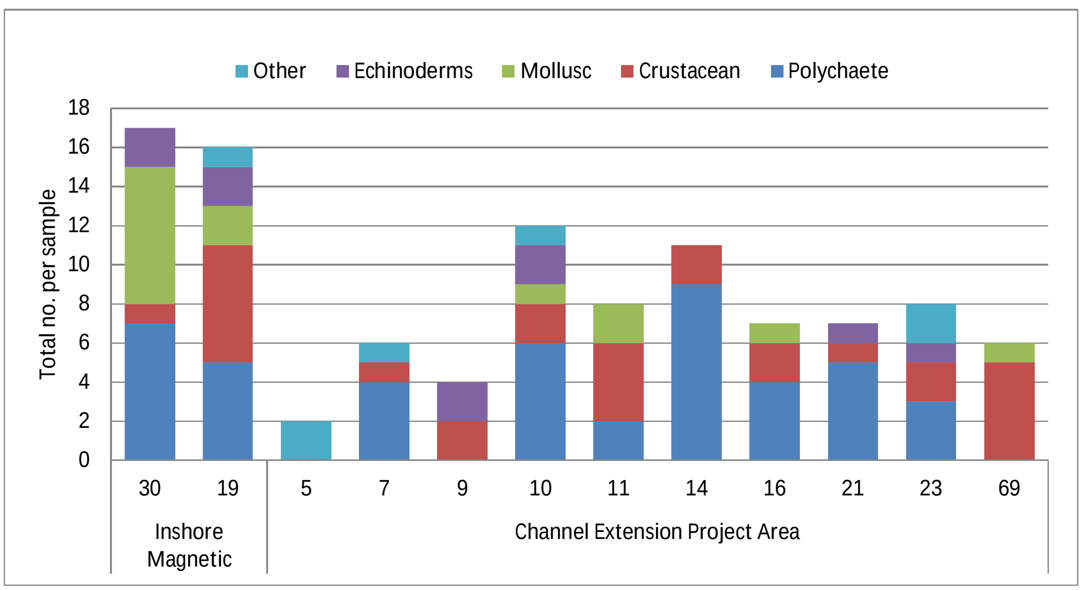


Figure B.6.24 Proportion of each major higher taxon contributing to total abundance (four replicate 0.028 m2 pooled samples) at each site – 2010 survey (upper plot) and 2012 survey (lower plot)

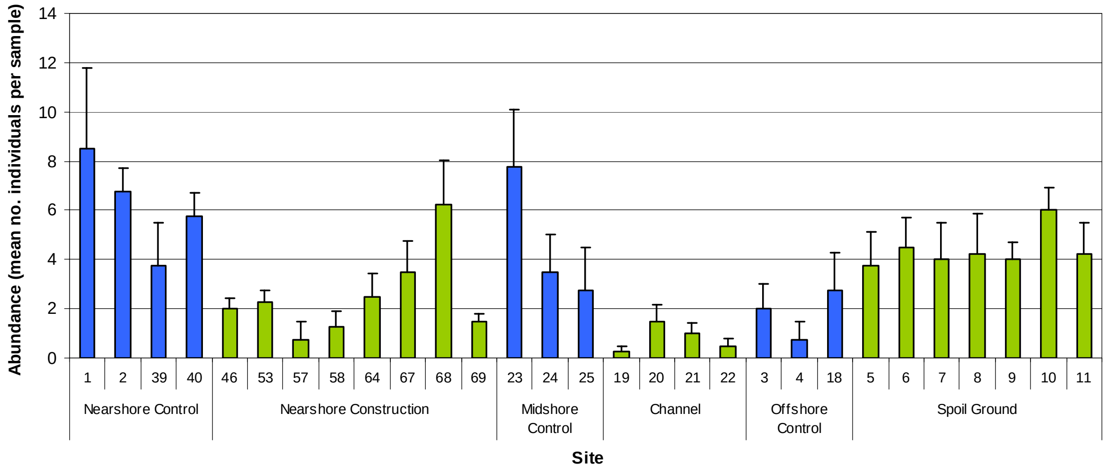


Figure B.6.25 Mean (± SE) abundance of macroinvertebrate individuals per 0.028 m2 samples (n = 4 per site) at control (blue) and putative impact (green) sites

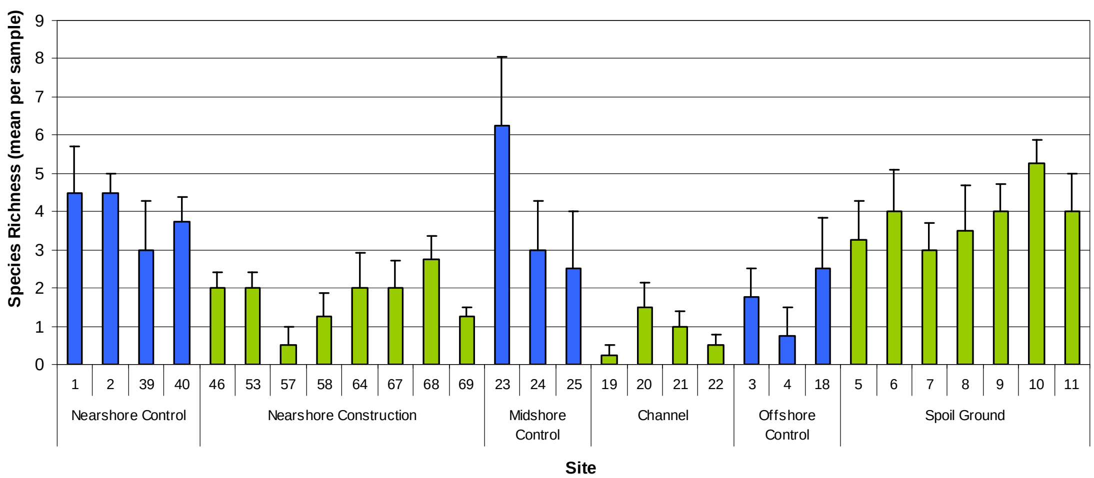


Figure B.6.26 Mean (± SE) macroinvertebrate species richness per 0.028 m2 samples (n = 4 per site) at control (blue) and putative impact (green) sites

Benthic infauna communities at the time of the site survey were depauperate. More than one third of the 116 samples collected contained only one or fewer macroinvertebrate individuals (i.e. 16% of samples contained zero fauna and 22% contained only one individual macroinvertebrate). The majority (58%) of samples containing ≤1 individuals were collected from the channel and construction footprint, which is likely to reflect ongoing disturbance by dredging and other port related activities.

The mean total abundance of individuals varied among sites and locations (Figure B.6.25). Mean abundance was consistently low (<2 individuals per sample) at all four channel sites. Several sites in the construction footprint and offshore control locations had similarly low mean fauna abundance. By comparison, mean abundance at sites in the DMPA was typically approximately 4 individuals per sample, and some sites at the nearshore and midshore control locations averaged 6 to 8 individuals per sample.

As many taxa were recorded as singletons (i.e. only one representative collected), patterns in species richness (Figure B.6.26) closely reflect those described above for abundance. Mean species richness was consistently very low (<2 species) in the channel. Sites with similarly low species richness were located in the nearshore construction and offshore control locations. Similar to abundance, the highest species richness was recorded at the DMPA, nearshore control and midshore control locations.

Channel Extension Project Area and Surrounds

The channel extension project area refers to the seaward extension of the Sea Channel along the existing alignment by approximately 2.7 km that will be created as a result of deepening of the Sea Channel from capital dredging.

A total of 54 infauna taxa (i.e. macroinvertebrate species/morpho-species >1 mm) were collected in the channel extension project area and surrounds. Most infauna taxa were not abundant, with 51 taxa (approximately 89% of taxa) represented by less than five individuals. The 10 most common abundant species are listed in Table B.6.3. The most common taxa included four families of carnivorous polychaete worms, tanaidacean shrimp, bivalve molluscs, brittle stars, and peanut worms. The patterns in dominance were similar to those of the outer harbour, DMPA and existing channel project areas (Table B.6.2).

Table B.6.3 List of most common infauna species (i.e. >5 individuals collected) from the channel extension project area

Phylum	Class	Order	Taxon	Common name
Annelida	Polychaeta	Eunicida	*Eunice* sp.4	segmented worms
			Glyceridae sp 1	
			Goniadidae sp 1	
		Nereida	Nereidae sp 3	
		Sabellida	Sabellidae sp 1	
Crustacea	Malacostraca	Tanaidacea	Tanaidacea 6	
Mollusca	Bivalvia	Veneroida	Tellnidae 1	venus clam
Echinodermata	Ophiuroidea	Ophiurida	Ophiuroidea 1	Brittle star
			Amphioplus 1	
Sipuncula	Sipunculidea	Golfingiiformes	Phascolionidae	peanut worm

Figure B.6.24 shows the total number of animals recorded at each site (grouped by higher taxa). In the channel extension project area, fauna abundance at all sites was consistently dominated by polychaete worms and, to a lesser degree, crustaceans. At other inshore Magnetic Island sites (in sediment class 2a), there were similar numbers of polychaetes, but substantially more crustaceans and molluscs than at other sites surrounding the channel extension area.

Macrobenthos communities of the channel extension project area and surrounds were depauperate. Almost 23% of samples contained no animals and ~16% of samples contained only 1 macroinvertebrate. Samples from the deeper depositional areas (samples 5, 7 and 9) were the least abundant, samples collected from class 2 and 3 habitats around the channel extension were moderately abundant (sites 10, 11, 14, 16, 21, 23), and samples from the inshore Magnetic area (class 2a sediments) were the most abundant (Figure B.6.24, Figure B.6.27). These patterns in abundance were similar to that recorded for richness (Figure B.6.28), and are likely to reflect differences in habitat conditions (i.e. sediment type, hydrodynamic conditions, micro-habitat complexity etc.).

Previous Studies

Previous grab-based sampling studies in Cleveland Bay also recorded low fauna abundance and richness. For example, GHD (2009e) found that only 8 of 17 sites in the nearshore area south of the Port contained any animals. C and R Consulting (2007b) reported mean abundances for sites between the Port and Magnetic Island of 5.17 polychaetes, 1.5 amphipods and between 0.2 and 0.9 individuals of all other taxa per litre of sediment. These values are comparable to the results of the present study.

Studies by Cruz-Motta (2000) and Cruz-Motta and Collins (2004) have investigated the benthic communities at the DMPA and at sites on transects radiating away from the DMPA at a range of temporal spatial after maintenance dredge material disposal. They found little evidence of long-term changes in communities, but changes in communities were apparent immediately after disposal. This change was seen as an overall reduction in diversity and abundance inside the DMPA.

The results of the present study are broadly consistent with benthic epifauna community assessments carried out by GHD (2011c) in Cleveland Bay. GHD (2011c) sampled seven sites in Cleveland Bay on two occasions (November 2010 and April 2011) using a benthic sled towed over 100 m transects. Molluscs were the most abundant phylum, comprising 48% and 43% of the community composition in November and April respectively. Cnidarians, echinoderms, crustaceans and ascidains were also relatively abundant, varying among sites and between sampling episodes.

GHD (2011c) found that assemblages differed between nearshore areas and offshore areas, with lower macroinvertebrate abundance and richness in offshore areas (DMPA and dredged channels) than nearshore areas. Variations in assemblage structure were observed over time, with the magnitude of change varying among sites. This high degree of temporal variability in benthic macroinvertebrate community structure is a typical feature of tropical nearshore environments (Alongi, 1990), including Cleveland Bay (Cruz-Motta, 2000; Cruz-Motta & Collins, 2004). This variability is thought to mainly be a consequence of seasonal and inter-annual changes in water quality and physical disturbance, and biological interactions and processes (competition, predation, recruitment).

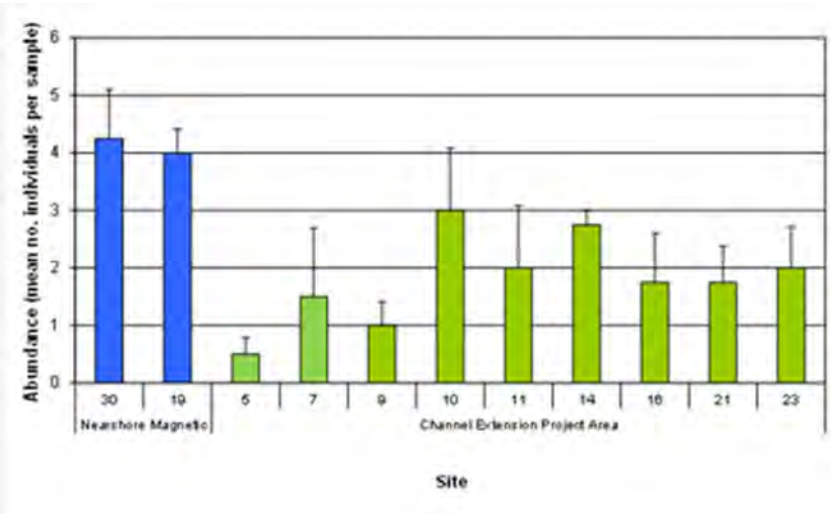


Figure B.6.27 Mean (± SE) macroinvertebrate abundance per 0.028 m2 samples (n = 4 per site); inshore Magnetic Island sites are shown in blue and sites surrounding the channel extension are shown in green

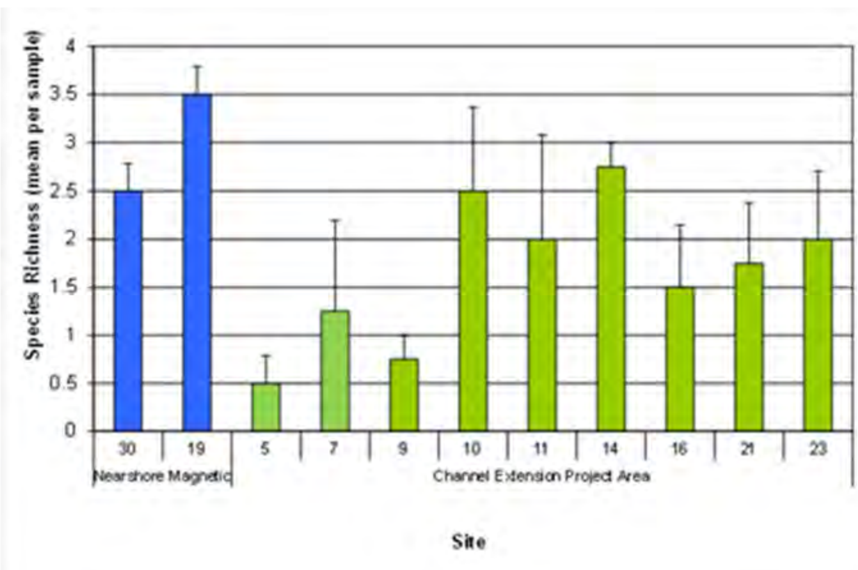


Figure B.6.28 Mean (± SE) macroinvertebrate richness per 0.028 m2 samples (n = 4 per site); inshore Magnetic Island sites are shown in blue and sites surrounding the channel extension are shown in green

B.6.3.7 Marine Species of Conservation Significance

B.6.3.7.1 Threatened Species

The EPBC Act Protected Matters Search Tool was used to identify EPBC listed threatened marine[2] species and ecological communities that occur or could occur in the Study Area. In summary, the following were identified:

- Threatened plants: 1 species
- Threatened marine mammals: 2 species
- Threatened marine reptiles: 6 species
- Threatened sharks: 2 species
- Threatened ecological communities: 0.

Table B.6.4 provides a list of threatened species identified using the EPBC Act Protected Matters Search Tool, together with an assessment of known or likely occurrence in the Study Area, and relevant species recover plans. The recovery plans contain broad conservation management objectives for the recovery of populations of these species, which have been considered as part of the impact assessment process (see Section B.6.5.1).

Section B.6.4.7.2 considers marine mammals and threatened marine reptiles (turtles). The threatened plant species (frogbit, *Hydrocharis dubia*) is restricted to freshwater lagoons, a habitat type that is not supported in the Study Area. It is therefore not considered further.

Two threatened shark species were identified in the search: whale shark *Rhincodon typus* and green sawfish *Pristis zijsron*. The whale shark is a pelagic species that tends to prefer offshore tropical waters. This species is known to form seasonal feeding aggregations in the Coral Sea between November and December, although Ningaloo Reef is thought to represent the only critical habitat for this species in Australian waters (DEHP, 2005). There are occasional records of this species in Cleveland Bay, although it is considered to represent a transient visitor. Neither species were recorded in the GHD (GHD, 2011a)[3] survey, with the most abundant shark species recorded in these surveys being the leopard shark (probably *Stegostoma fasciatum*).

Although once a widespread species (occurring south to southern NSW), green sawfish is now thought to be restricted to waters north of Cairns, located approximately 280 kilometres north of the Study Area. Based on the analysis of Queensland Beach Control Program catch records for the Townsville region (Stevens, Pillans, & Salini, 2005), a major decline in sawfish catches was observed in the 1970's and 1980's, and no sawfish have been recorded by the netting program in the Townsville region since the early 1990's. The disappearance of this species from areas adjacent to dense human habitation suggest that this species is sensitive to human disturbance, including habitat degradation (Stevens, Pillans, & Salini, 2005). On the basis of the range retraction and its sensitivity to disturbance, it is considered unlikely that the nearshore waters of Study Area, including the Port Expansion Project Area, currently represent important habitat for green sawfish.

---

[2] Note – terrestrial mammals, birds and terrestrial reptiles are considered in Chapter B7 (Terrestrial Ecology)

[3] Note that a revised version of the GHD (2011a) marine megafauna report (GHD 2012a) was made available late in EIS preparation, therefore any revised findings have not been incorporated into the Marine Ecology Chapter. However, the latest version of the marine megafauna report (GHD 2012a) is attached as Appendix K4.

Table B.6.4 EPBC Protect Matters database search results for threatened and EPBC Act listed Migratory Marine species

Species	Status (EPBC/ NC Act)	Distribution / Habitat[A]	Outer harbour/ nearshore channel	Offshore disposal site/ offshore channel	Relevant Recovery or Action Plan
Flora					
Hydrocharias dubia Frogbit	EPBC: V	Aquatic plant found in freshwater lagoons.	No – no suitable habitat	No – no suitable habitat	None
Marine Mammals					
Balaenoptera musculus Blue Whale	EPBC: E, M, C NC: Not Listed	Oceanic waters	Unlikely – shallow water depths and port infrastructure limits values.	Unlikely – not common in Cleveland Bay	Department of the Environment and Heritage (2005a); Bannister *et al*. (1996)
Megaptera novaeangliae Humpback Whale	EPBC: V, M, C NCA: V	Oceanic waters	Unlikely – shallow water depths and port infrastructure limits values.	Likely	Department of the Environment and Heritage (2005c); Bannister *et al*. (1996)
Balaenoptera edeni Bryde's whale	EPBC: M, C NCA: Not Listed	Coastal waters of much of Australia and southern Africa where it searches for baitfish (Van Dyke & Strahan, 2008)	Unlikely	Unlikely - transient visitor	Bannister *et al*. (1996)
Orcinus orca killer whale, Orca	EPBC: M, C NCA: Not Listed	Occurs throughout the world's oceans. Marine mammals provide much of the food required by the killer whale (Van Dyke & Strahan, 2008)	Unlikely	Possible transient visitor	Bannister *et al*. (1996)
Orcaella heinsohni, Australian snubfin dolphin	EPBC: M, C (as *O. brevirostris*) NCA: Near Threatened	Recorded across northern Australia (Qld, NT, WA) where it inhabits riverine, estuarine and coastal waters.	Present	Present	Bannister *et al*. (1996)
Sousa chinensis Indo-Pacific humpback dolphin	EPBC: M, C NCA: Near Threatened	Occurs in coastal and estuarine areas in association with rocky reef areas. Food is comprised of fish and the range of this species in Australia is diminishing (Van Dyke & Strahan, 2008).	Present	Present	Bannister *et al*. (1996)

Species	Status (EPBC/ NC Act)	Distribution / Habitat[A]	Outer harbour/ nearshore channel	Offshore disposal site/ offshore channel	Relevant Recovery or Action Plan
Dugong dugon Dugong	EPBC: M, LM NCA: V	Marine habitats with shallow nutrient rich water with silt allowing intact sea grass meadows to grow. Distributed from coastal Shark Bay (WA) to Moreton Bay in Queensland (Van Dyke & Strahan, 2008).	Present - transient visitor	Likely – deepwater seagrass near DMPA	Marsh *et al*. (2002)
Marine Reptiles					
Caretta caretta Loggerhead Turtle	EPBC: E, M, LM NCA: E	Pelagic and benthic species. Cleveland Bay is not known to represent a nesting site. Forages on marine invertebrates (Wilson & Swan, 2003)	Likely – transient visitor to site.	Likely - suitable habitat located at reef and seagrass areas of Cleveland Bay	Department of the Environment and Heritage (DEH, 2005b)
Chelonia mydas Green Turtle	EPBC: V, M, LM NCA: V	Marine waters and near the seabed. Cleveland Bay is recognised as an important foraging area, where it feeds mainly on seagrass and benthic invertebrates (Wilson & Swan, 2003). Low density nesting occurs in Cleveland Bay.	Present – transient visitor to site.	Likely - suitable habitat located at nearby reef and seagrass areas of Cleveland Bay	Department of the Environment and Heritage (DEH, 2005b).
Dermochelys coriacea Leathery Turtle, Leatherback Turtle	EPBC: V, M, LM NCA: E	Oceanic species which feeds on jellyfish and other soft bodied invertebrates (DEWHA, 2007; Wilson, 2005). Rarely sighted in Cleveland Bay and then only in deep waters. Rarely nests on the Australian coastline (mostly Territory and Cape York Peninsula).	Unlikely – oceanic species	Possible – likely transient visitor	Department of the Environment and Heritage (2005b)
Eretmochelys imbricata Hawksbill Turtle	EPBC: V, M, LM NCA: V	Marine species. No critical nesting areas known in Cleveland Bay. Not thought	Possible transient visitor	Possible – likely transient visitor	Department of the Environment and Heritage (2005b).

Species	Status (EPBC/ NC Act)	Distribution / Habitat[A]	Outer harbour/ nearshore channel	Offshore disposal site/ offshore channel	Relevant Recovery or Action Plan
		to be common in Cleveland Bay.			
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle	EPBC: E, M, LM NCA: E	Deep waters around Magnetic Island. May be a transient visitor to Cleveland Bay, but not common.	Possible transient visitor	Possible – likely transient visitor	Department of the Environment and Heritage (2005b).
Natator depressus Flatback Turtle	EPBC: V, M, LM NCA: V	Marine species found around reef areas. Low density nesting occurs in Cleveland Bay but is not known to be abundant.	Possible transient visitor	Possible – likely transient visitor	Department of the Environment and Heritage (2005b).
Crocodylus porosus estuarine crocodile, salt-water crocodile	EPBC: M, LM NCA: V	Coastal rivers, swamps, inland rivers, open sea (Wilson & Swan, 2003). Rare in Cleveland Bay (GHD, 2009e; GHD, 2011a)	Possible transient visitor – occasional sightings in nearshore areas	Unlikely	EPA (2007).
Sharks					
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish	EPBC: V NCA: Not listed	Thought to occur north of Cairns in estuaries and river mouths, embankments and beaches. Benthic feeder, found in depths from 1 m to 70 m.	Unlikely – while suitable habitat is present in the Project Area, the Project Area appear to be outside known geographic range.	Unlikely	No species specific plan. Refer to TSSC (2008) for general advice.
Rhincodon typus Whale Shark	EPBC: V NCA: Not listed	Wide ranging tropical species. Critical habitat in Australia includes Ningaloo Reef in WA, the Coral Sea and Christmas Island. Cleveland Bay not known to represent an important habitat for this species.	Unlikely – Low abundance regionally and lack of deep waters limit habitat value of the Project Area.	Unlikely	Department of the Environment and Heritage (2005d)

A = unless cited otherwise, information was derived from the SPRAT database (DSEWPC, 2012a)
E = Endangered; V = Vulnerable; M = Migratory Marine; C = Cetacean; LM = Listed Marine

B.6.3.7.2 Listed Migratory or Marine Species

The EPBC Act Protected Matters Database identified a range of migratory and listed marine species in the Study Area and surrounds, as summarised below (Table B.6.4):

- migratory mammals: seven species – refer to below.
- migratory reptiles: seven species, including six species of marine turtle (refer below) and estuarine crocodile.
- migratory sharks – one species (Section B.6.3.7.2).
- listed ray-finned species – 34 pipefish and seahorse species.
- listed marine reptiles – 15 species of sea snake, six species of marine turtles (Section B.6.3.7) and the saltwater crocodile.
- cetaceans – 11 dolphin and whale species (refer below).

Saltwater crocodile (*Crocodylus porosus)* is a listed migratory and marine species under EPBC Act, and 'least concern wildlife' under the NC Act. Saltwater crocodiles occur in Cleveland Bay region, and there are annual unconfirmed records for the Ross River and nearshore areas of Cleveland Bay. There are no known nesting sites or preferred feeding habitats in the Study Area and surrounds (i.e. typically mangrove lined creeks), and it is not expected that the PEP would interfere with crocodile movements through the site (should they occur).

The EPBC Protected Matters database search results indicate that 15 species of sea snake and 34 species of pipefish and sea horses occur or could occur in Cleveland Bay. These species are listed marine species and are protected under the EPBC Act, but are not considered to be threatened under EPBC or state legislation. GHD (2011a) recorded a sea snake (unidentified species) at two locations: to the east of Magnetic Island the Port, and near the mouth of Ross River. This indicates that sea snakes occasionally occur in the Port Expansion Project Area.

Marine Turtles

Six species of marine turtle are known to use Cleveland Bay as a feeding ground, all of which are considered threatened under the EPBC Act and NC Act. These species have been recorded in offshore, nearshore and intertidal habitats in Cleveland Bay. Surveys undertaken in 2000 (Preen A. , 2000) suggest that the average total abundance of turtles in Cleveland Bay was 416 individuals ± 105 S.E. This is likely to be an underestimate the true local 'population' size due to bias inherent in the aerial survey methodology.

GHD (2011a) has undertaken the most comprehensive surveys of the distribution and abundance of marine megafauna (including marine turtles) in Cleveland Bay to date[4]. While patterns in relative abundance were mapped, GHD did not attempt to calculate an overall 'population' estimate of turtles. They found that highest numbers of marine turtles occurred near seagrass and reef habitats, most notably (Figure B.6.29):

- at and adjacent to Cockle Reef at southern Magnetic Island.
- at and adjacent to coastal seagrass meadows between the Strand and Cape Pallarenda.
- offshore of the Port in central Cleveland Bay.
- at and adjacent to coastal seagrass meadows near the mouth of Alligator Creek to Cape Cleveland.

[4] As mentioned in footnote 3, a revised version of the GHD (2011a) marine megafauna report (GHD, 2012a) was made available late in EIS preparation, therefore any revised findings have not been incorporated into the Marine Ecology Chapter. However, the latest version of the marine megafauna report (GHD, 2012a) is attached as Appendix K4.

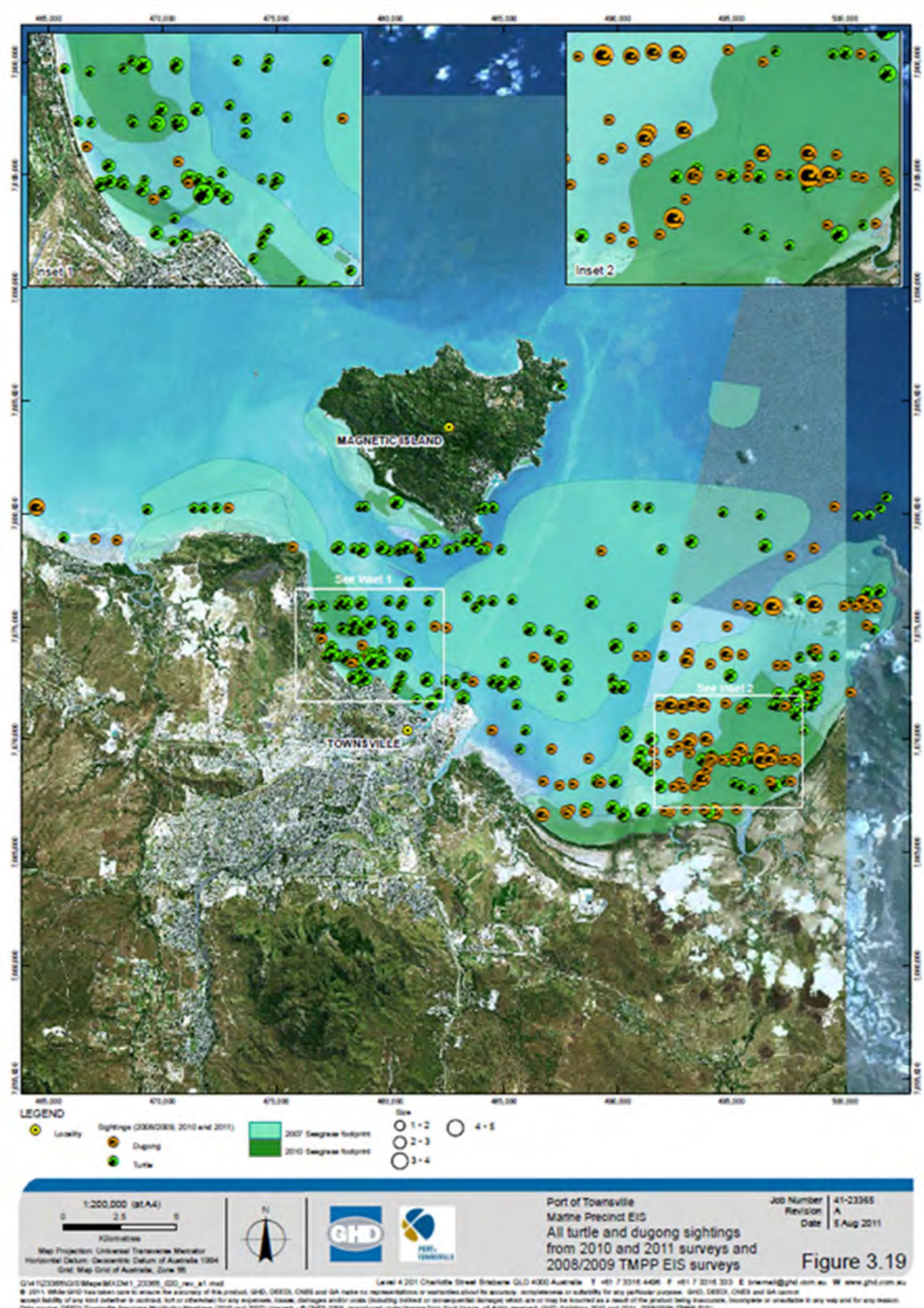


Figure B.6.29 Turtle and dugong sightings in 2008-2011 surveys [Source: (GHD, 2011a)]

Overall, the distribution and relative abundance patterns of turtles in Cleveland Bay are thought to be mainly a function of the availability of suitable food resources, as summarised below.

Green Turtle Distribution and Abundance

Green turtle (*Chelonia mydas*) is listed as vulnerable under both the EPBC Act and the NC Act. Cleveland Bay, together with nearby Halifax and Bowling Green Bay, represent regionally important feeding areas for this species (Ian Bell *pers. comm*. in GHD 2011).

Green turtles are the most abundant turtle species in Cleveland Bay, which based on surveys undertaken in 2000 (Preen A. , 2000), accounted for over 90% of the total abundance in the Bay. Surveys carried out by GHD (2011a) also indicated that green turtles were the most abundant sea turtle species in Cleveland Bay during 2008 to 2011. Given the almost complete numerical dominance of this species in Cleveland Bay, the spatial patterns in abundance of sea turtles shown in Figure B.6.29 are expected to be mainly indicative of those of green turtle.

Green turtles feed directly on seagrasses and algae (Brand-Gardner *et al*. 1999), and highest numbers tend to occur around dense and abundant coastal seagrass meadows. Important foraging areas are present at seagrass meadows and reefs at Cape Cleveland and Cockle Bay, and seagrass meadows adjacent to the Strand, Cockle Bay (Magnetic Island) and seaward of the Port [(GHD, 2011a); see Figure B.6.29]. Green turtles were also recorded feeding on algae on the northern breakwater wall. Some turtles were recorded away from reefs and seagrass meadows, most likely transiting between feeding sites.

Acoustic tracking of juvenile green turtles by GHD (2011a) suggests that individuals can display high degree of site fidelity. GHD (2011a) cited turtle tracking work done by Dr Mark Hamann (James Cook University) in Cleveland Bay, which also suggested that green turtles display high site fidelity when foraging. However, green turtles are known to move between seagrass meadows fairly regularly, in response to drying of intertidal flats, and episodic losses (and gains) in seagrass meadows. Adult green turtles can move great distances (hundreds to thousands of kilometres) when migrating to turtle nesting beaches.

Other Species

Preen (2000) estimates that other sea turtle species represented approximately 10% of the total number of sea turtles in Cleveland Bay. The other sea turtle species known or likely to occur in Cleveland Bay are primarily carnivorous, as described below.

Olive Ridley turtle (*Lepidochelys olivacea*) is listed as endangered under both the EPBC Act and the NC Act. This species is typically found in deeper waters around Magnetic Island, but has been recorded in waters as shallow as five metres in Cleveland Bay (GHD, 2011a). This species is mostly carnivorous, with a diet mostly comprised of urchins, small crabs, and molluscs (Wilson, 2005). This species is not known to favour shallow seagrass meadows or coral reef habitats (Limpus, 2008). Soft sediment habitats in deeper waters of Cleveland Bay and surrounds represent potential foraging habitat for this species, however this species is not common in the GBR region (Limpus, 2008).

Hawksbill turtle (*Eretmochelys imbricata*) is listed as vulnerable under both the EPBC Act and the NC Act. The diet of this species is primarily sponges seagrasses, algae, soft corals and a range of benthic shellfish (Whiting, 2000). GHD (2011a) did not record this species in their baseline surveys, however they are known to occur around inshore reefs of Cleveland Bay [Ian Bell pers. comm. in GHD (2011c)].

Loggerhead turtle (*Caretta caretta*) is listed as endangered under both the EPBC Act and the NC Act. It is a carnivorous species which feeds on jellyfish, crustaceans, echinoderms, and bivalve molluscs from seagrass meadows and reef areas (Limpus, Couper, & Read, 1994). Surveys by GHD (2011a) did not record loggerhead turtle, although it would be expected to forage on reefs around Magnetic Island and Middle Reef.

Flatback turtles (*Natator depressus*) are listed as vulnerable under both the EPBC Act and the NC Act. They are carnivorous, feeding mainly on soft-bodied invertebrates (sea cucumbers, sponges, soft corals, jellyfish etc.) from the sea floor (Wilson, 2005; Wilson & Swan, 2003). It would be expected that soft sediment habitats of Cleveland Bay would provide potential foraging habitat for this species, however it is not known to be particularly abundant here (GHD, 2011a).

Leatherback turtles (*Dermochelys coriacea*) are listed as vulnerable under the EPBC Act and endangered under the NC Act. They are not known to be common in Cleveland Bay, possibly reflecting their preference for deeper waters (GHD, 2009e). Leatherbacks feed on jellyfish and other soft bodied invertebrates (DEWHA, 2007; Wilson, 2005). Leatherbacks suffer from high mortality associated with accidental ingestion of plastic bags, due to mistaken identity of bags to jellyfish prey (Wilson & Swan, 2003).

It is likely that marine turtles exist in the Port Expansion Project Area, channel areas and DMPA as transients rather than resident, primarily due to the lack of optimal or perennial feeding resources in this area. Nevertheless, it is likely that the sparse seagrass and epibenthic fauna assemblages in the Study Area and surrounds (particularly the DMPA) are used sporadically or occasionally by some marine turtles. Loggerhead turtles may also feed on jellyfish that occur in the Study Area.

Turtle Reproduction and Recruitment

Cleveland Bay is not an important turtle breeding area, with most turtles in the region believed to have originated from rookeries elsewhere on the central and north Queensland coast and islands, or in other countries. The exceptions to this are flatback and green turtles. Low density nesting for these species has been reported on a number of sandy beaches adjacent to the Study Area and surrounds, including Magnetic, Herald and Rattlesnake Islands, the Strand and AIMS beach (GHD, 2009e). The most notable flatback turtle nesting areas occur around the Shoalwater coast, and on beaches north of Bundaberg (Table B.6.5).

With the exception of the juvenile green turtle tracking studies (GHD, 2011a), there are few data currently available describing patterns in habitat use by different life-stages of turtles. Young turtles are primarily pelagic, and are mainly carnivorous during this period. Green turtles undergo rapid ontogenetic shift in habitat and diet at three to five years age, to benthic algae and seagrass (Reich, 2007). It is unknown whether older juvenile, sub-adult and adult turtles display ontogenetic partitioning of food resources in Cleveland Bay.

Table B.6.5 Breeding activities of key marine megafauna species

Species	Reproductive activities in Cleveland Bay	Breeding/nesting season in central and north Qld	Main breeding/nesting areas
Sea Turtles			
Caretta caretta loggerhead turtle	None known	Hatchlings emerge December to April.	Southern Great Barrier Reef (Capricorn/Bunker group) and adjacent mainland near Bundaberg.
Chelonia mydas green turtle	Nesting – low density nesting recorded at Sandy beaches at Magnetic Island and the Strand.	Nesting: Late October to February. Hatchlings emerge December to May.	Southern GBR Stock: Mackay and offshore islands in the Capricorn/Bunker group.
Dermochelys coriacea leathery turtle, leatherback turtle	None known	Nesting: December to January. Hatchlings emerge February to March.	Indonesia and PNG – no major rookeries in Australia, but nesting recorded around Mackay and Bundaberg.
Eretmochelys imbricata hawksbill turtle	None known	Not known for region.	Three main breeding areas in Australia, including northern Great Barrier Reef (several thousand nesting females). In the GBR region, nesting areas mainly occur north of Princess Charlotte Bay and in the Torres Strait.
Lepidochelys olivacea olive Ridley turtle	None known	Not known for region.	No nesting by the species has been recorded in the Great Barrier Reef World Heritage Area.
Natator depressus flatback turtle	Nesting – low density nesting recorded at Sandy beaches at Magnetic Island and the Strand.	Nesting: November to February. Hatchlings emerge January to April.	Breeding is centred in the southern Great Barrier Reef around Peak, Wild Duck, Curtis and Facing Islands. Low density nesting by flatbacks occurs on many mainland beaches and offshore islands north of Gladstone. The largest amount of nesting occurs in Torres Strait.
Marine Mammals			
Dugong dugon Dugong	Mating and calving – sandbanks and estuaries (DSEWPC, 2012c)	Mating and calving peaks in spring and summer, but year-round.	Cooktown, Hinchinbrook Island, Cleveland Bay, Shoalwater Bay, Hervey Bay and Moreton Bay (Marsh, Penrose, Eros, & Hugues, 2002)
Megaptera novaeangliae humpback whale	Nursery habitat	Humpback whales come from Antarctic waters to the Great Barrier Reef World Heritage Area from May to September to calve before they return to the Antarctic in summer.	GBR lagoon.
Orcaella heinsohni Australian snubfin dolphin	Calving and likely mating	Year-round calving (Parra G. , 2006)	No detailed information.

Species	Reproductive activities in Cleveland Bay	Breeding/nesting season in central and north Qld	Main breeding/nesting areas
Sousa chinensis Indo-Pacific humpback dolphin	Calving and likely mating	Year-round calving (Parra G. , 2006).	Insufficient information, but high abundances recorded in Moreton Bay and Great Sandy Strait regions (Bannister, Kemper, & Warneke, 1996), as well as Cleveland Bay.

Resistance and Resilience of Turtle Populations

Food resource availability is likely to be a key control on green turtle populations, particularly during years when seagrass abundance is low. As discussed in Section B.6.3.4, seagrasses meadows of Cleveland Bay vary greatly in extent in time, mainly in responses to periodic storm and flood disturbance. The period 2009 to 2011 were exceptionally wet years, which in combination with disturbance from Cyclone Yasi, caused major declines in seagrass meadows throughout Cleveland Bay and the wider Burdekin region. Cyclone Yasi represented a significant weather event, being the first category five cyclone to cross the coast since 1918 (GBRMPA, 2012b).

The loss of seagrass meadows has been implicated as the major cause of turtle strandings (and dugong) in the region. Turtle stranding reports for the GBR region (i.e. south of Port Douglas) increased from an annual average of 678 per annum in the period 2008 to 2010, to 1232 turtles in 2011 (GBRMPA, 2012b; GBRMPA, 2012a). The Townsville region was identified as a hot-spot for strandings in 2011, with 262 marine turtle strandings compared to 35 (2008), 44 (2009) and 93 (2010) turtles in the period 2008 to 2010. Furthermore, in the period January to August 2012, incidence of turtle strandings was still high in the Townsville region [(DEHP, 2012c) see Figure B.6.30].

The following key factors are thought to enable turtle populations to cope with periodic disturbance:

- While there has been a large decline in seagrass meadows in Cleveland Bay, relatively large coastal meadows still persisted in 2011 (1267.7 ± 287.7 ha). Surveys carried out in October to December 2011 show that Cape Cleveland had the largest seagrass meadows, with small fragmented meadows also present at Cockle Bay, Cape Pallarenda and the Strand. Meadows suffered a major decline in biomass, however this trend has been evident since monitoring commenced in 2007 (McKenna & Rasheed, 2011). The seagrass meadows persisting in 2011 contain the preferred seagrass species utilised by turtles (and dugongs).
- While seagrass represents the main food resource of green turtles, they can supplement their diet with red algae and mangrove leaves and fruit (Limpus, 2008; Arthur, McMahon, Limpus, & Dennison, 2009), and are also known to eat jellyfish. Arthur *et al*. (2009) described green turtles as ‘an opportunistic and versatile forager’, which has the ability to switch their diet to red algae and mangroves during periods when seagrass is limited. Arthur *et al*. (2009) further suggested that mangroves also had similar (or greater) nutrient content as seagrass. Turtles therefore have some capacity to seek these alternate (and plentiful) food resources during periods when seagrass biomass is low. As discussed in Section B.6.4.5, macroalgae cover appears to have greatly increased on Cleveland Bay reefs following Cyclone Yasi, whereas mangroves forests did not significantly decline.
- Green turtles are capable of moving large distances. Few studies have examined the movement patterns of green turtles associated with shortage of food resources.

Notwithstanding the above, the resilience of local sea turtle ‘populations’ is expected to be comparatively lower during periods when seagrass is least plentiful.

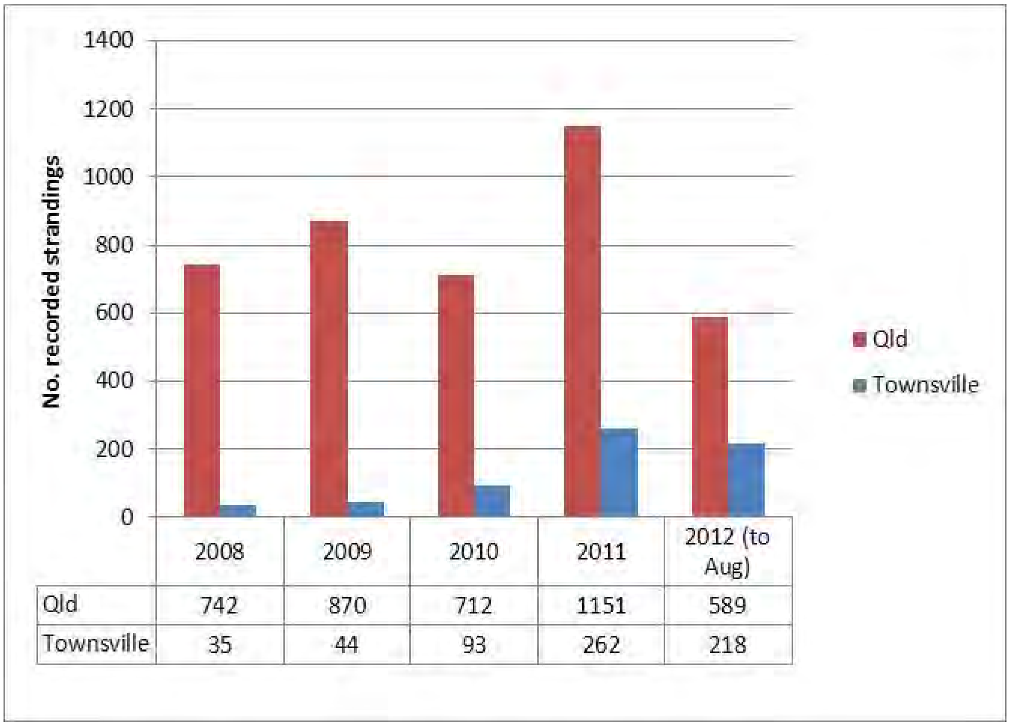


Figure B.6.30 Number of marine turtle strandings recorded in the Queensland standings database (DEHP, 2012c)

Marine Mammals

There are a number of listed migratory marine mammals that could occur in or adjacent to the Study Area (Table B.6.4). The following species are threatened/near-threatened species that are known or likely to have a regular occurrence in the Study Area and are considered in detail below: Australian snubfin dolphin (*Orcaella heinsohni*), Indo-Pacific humpback dolphin (*Sousa chinensis*), dugong (*Dugong dugon*) and humpback whale (*Megaptera novaeangliae*). All other threatened, near-threatened and/or migratory marine mammal species (Table B.6.4) are considered to be transient visitors to the region, and unlikely to regularly occur in Cleveland Bay.

Other EPBC Listed Cetaceans (not listed as Migratory or threatened under the EPBC Act or NC Act) that could occur in the Study Area, include minke whale (*Balaenoptera acutorostrata)*, common dolphin (*Delphinus delphus)*, Risso's dolphin (*Grampus griseus)*, spotted dolphin (*Stenella attenuata)*, Indian Ocean bottlenose dolphin (*Tursiops aduncus)*, and bottlenose dolphin (*Tursiops truncatus)*. While many of these species favour offshore habitats, Indian Ocean bottlenose dolphin prefers nearshore waters, and species such as bottlenose dolphin may occur in nearshore environments from time to time. None of these species were recorded in the Cleveland Bay by GHD (2011a) or Wildlife Online database searches.

Australian Snubfin Dolphin Distribution and Abundance

GHD (2011a) notes that Australian snubfin dolphin (*Orcaella heinsohni*) and Indo-Pacific humpback dolphin (*Sousa chinensis*) are common in nearshore environments throughout Cleveland Bay, and are likely to regularly feed in the port area, including the Port Expansion Project Area, and adjacent to the mouths of Ross Creek and Ross River (Figure B.6.31).

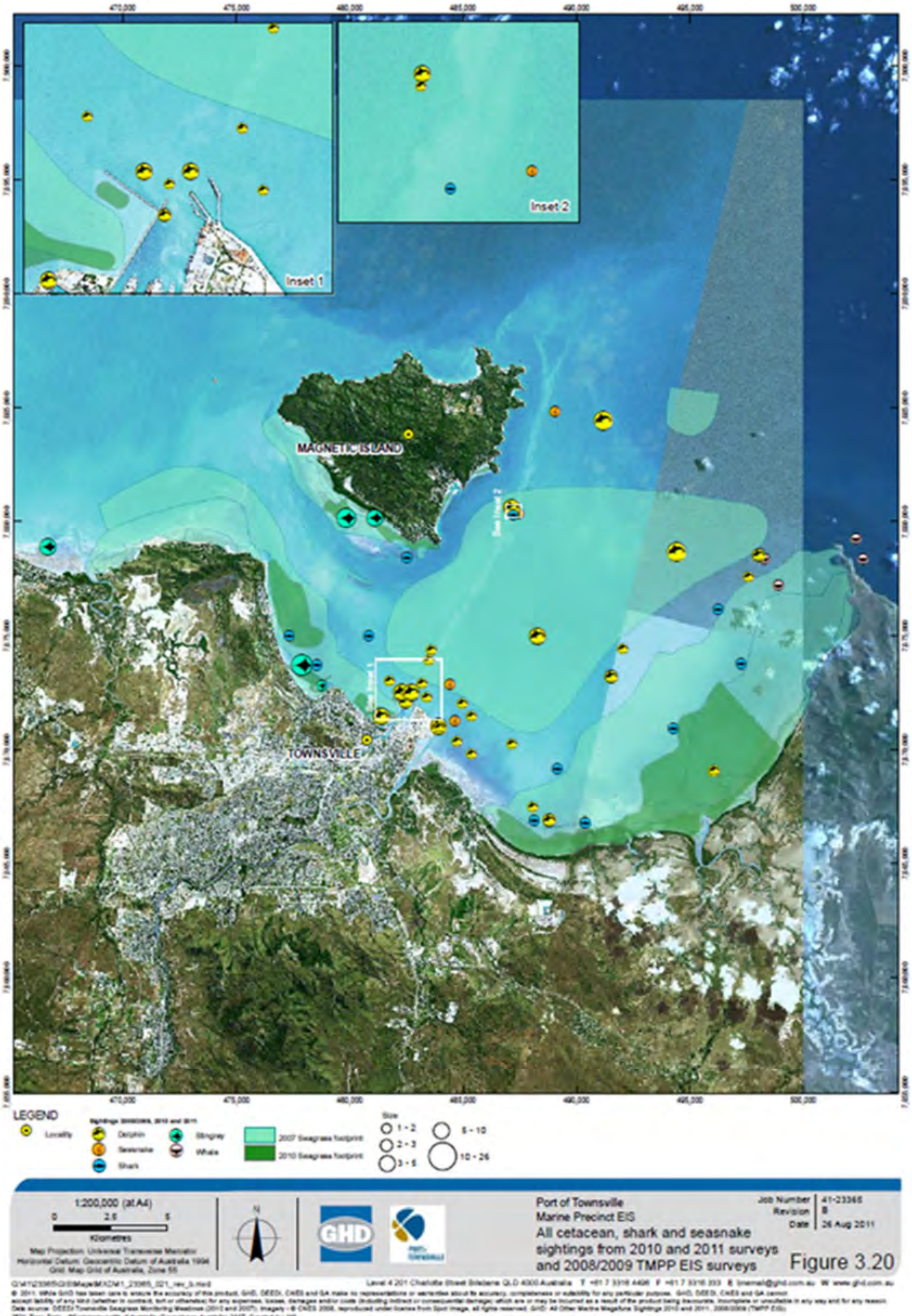


Figure B.6.31 Cetacean, shark and sea-snake sightings in 2008-2011 surveys. Source: (GHD, 2011a)

The Australian snubfin dolphin has a global (International Union for Conservation of Nature – IUCN) listing of near threatened (IUCN, 2010). It is listed as a migratory marine mammal under the EPBC Act and near threatened under the NC Act. Australian snubfin dolphin is the only cetacean that is restricted to northern Australian and possibly Papua New Guinean waters (Beasley, Robertson, & Arnold, 2005). They have been recorded from Roebuck Bay in Western Australia, across northern Australia, and south-east to the Fitzroy River region (Parra, Azuma, Preen, Cockeron, & Marsh, 2002; Parra G. , 2006). While this species has a relatively broad geographic distribution, it is uncommon in most areas, and is often found in small groups (Parra G. , 2006) (Parra G. , 2005)

Studies to date indicate that this species generally occurs in waters less than 15 m deep, within 10 kilometres of the coast and within 20 kilometres of a river mouth (Parra, Corkeron, & Marsh, 2004). The species is an opportunistic generalist, feeding on fish and cephalopods (octopus, squid etc.) from coastal, estuarine and nearshore reef habitats ((Parra G. , 2006; Parra & Jedensjö, 2009).

The estimate for the Australian snubfin dolphin 'sub-population' in 2002 in Cleveland Bay was 63 individuals (95% confidence interval = 51-88) (Parra, Corkeron, & Marsh, 2006; Parra, Schick, & Corkeron, 2006). Of this number 51 were observed in more than one calendar year between 1999 and 2002 and certain individuals repeatedly came back to specific areas in the broader Cleveland Bay area. Parra (2006) found a core use area for this species around Ross Creek and Ross River mouth. GHD (2011a) also found that the Ross River and Creek areas were a centre of dolphin abundance with Cleveland Bay (Figure B.6.31). This species was also found to favour shallow waters (1-2 m deep) where seagrass is present. The Ross River and Creek mouths and adjacent seabeds are therefore considered to represent important habitat for Australian snubfin dolphin.

At a state scale, the Australian snubfin dolphin population for Queensland is expected to be in the thousands rather than 10s of thousands (Parra, Corkeron, & Marsh, 2006). DSEWPC (2012d) suggests that the distribution of this species is contiguous throughout its geographic range, with areas of high usage having locally higher abundances.

GHD (2011a) concluded that observations of recurrent use of Cleveland Bay by adult and calf snubfin and Indo-Pacific humpback dolphins for foraging indicates that this area, particularly around the mouth of Ross Creek and River, is an important feeding area at a local scale. There is limited information on the reproductive ecology of this species. In Cleveland Bay, Australian snubfin dolphins socialise year-round, and calves have also been observed year-round (Parra G. , 2006; Parra, Corkeron, & Marsh, 2006). This suggests that this species does not have a defined mating season (DSEWPC, 2012d).

Indo-Pacific humpback Dolphin Distribution and Abundance

Indo-Pacific humpback dolphin has a global IUCN listing of 'near threatened' (IUCN, 2010). It is listed as a migratory marine mammal under the EPBC Act and near threatened under the NC Act.

In Australia its distribution stretches from northern New South Wales along the coast of Queensland to Shark Bay in Western Australia. Studies to date indicate that this species, like the Australian snubfin dolphin, generally occurs in waters less than 15 m deep, within 10 kilometres of the coast and within 20 kilometres of a river mouth (Parra, Corkeron, & Marsh, 2004). Indo-Pacific humpbacks do not display any preference for turbid or clear-waters, and have been recorded from a broad range of coastal habitats including coastal lagoons, enclosed bays, and open coastal waters (Jefferson & Karczmarski, 2001). The species is also an opportunistic generalist, feeding on fish and crustaceans from coastal, estuarine and nearshore reef habitats (Parra G. , 2006; Parra, Schick, & Corkeron, 2006).

Parra *et al.* (2006) estimated that the Indo-Pacific humpback dolphin sub-population in Cleveland Bay during 2002 was 54 (95% confidence limit = 38 to 77). Of this number 32 were observed in more than one calendar year between 1999 and 2002. A core area for this species was centred on around Ross Creek and Ross River mouth (2006). This species also favoured water two to five metres deep in dredged channels. The Ross River and Creek mouths and adjacent seabeds are therefore considered to represent important habitat for Indo-Pacific humpback dolphin.

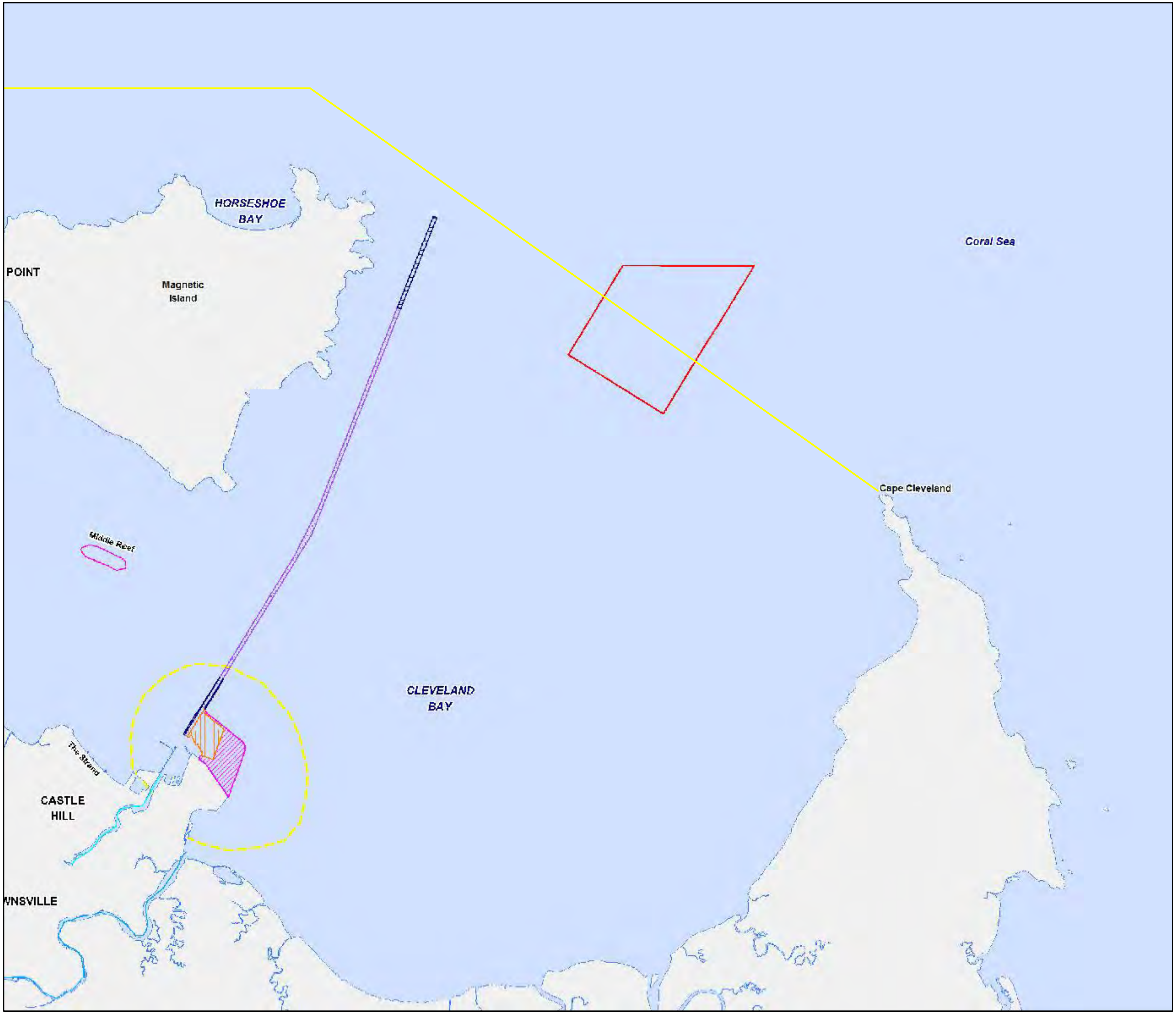
This species, like Australian snubfin dolphin, has a wide home-range and undertakes regular movements in and out of Cleveland Bay. In the Great Sandy Straits region, this species forms relatively discrete local sub-populations with little genetic mixing with other sub-populations (Cagnazzi, Harrison, Ross, & Lynch, 2011).

Resistance and Resilience of Near-Shore Dolphins

The preferred nearshore habitat of both of these dolphin species represents a highly dynamic environment. These nearshore environments are highly turbid, subject to periodic physical disturbance (storms, cyclones, floods) have characteristically highly temporally variable water quality conditions. As a result, benthic communities in these areas are in a state of flux, and are typically comprised of species that are capable of rapid recovery, or are able to move between areas.

This has important implications in terms of resistance of near-shore dolphin species to changes in environmental conditions. In this regard, near-shore dolphins have the following biological characteristics that allow them to cope with altered environmental conditions:

- Feeding behaviour and turbidity. Nearshore dolphin species are capable of successfully foraging in turbid waters. Dolphins often stir up bed sediments when foraging for benthic prey, resulting in limited to no visibility for prey detection. It is thought that dolphins detect prey using echolocation rather than visual cues (Mustoe, 2006; Mustoe, 2008). On this basis, nearshore dolphins therefore have adaptations that allow them to feed in high turbidity waters (Parra & Jedensjö, 2009).
- Opportunistic diet. Both nearshore dolphin species are considered to be ‘opportunistic-generalist feeders’ (Parra & Jedensjö, 2009). Gut contents analysis performed on dolphins captured along the Queensland coast (Parra & Jedensjö, 2009) found that both dolphins primarily fed on a range of demersal and pelagic fish species commonly found in estuarine and shallow nearshore habitats. In addition to fish, snubfin dolphins were found to feed on squid and cuttlefish, which typically occur in the water column. The opportunistic, generalist diet of these species reduces their susceptibility to changes in availability of particular prey types.
- Home range and site fidelity. Indo-Pacific dolphins are migratory species, with studies elsewhere suggesting that they can have a large home range [up to 395 km^2; Hung in (DSEWPC, 2012e)]. Snubfin dolphins are also thought to have large home ranges. Surveys by Parra (2006) in Cleveland Bay found that most identified individuals spent <30 days at a time in the 310 km^2 Cleveland Bay area, and periods of over a month before entering the Bay again. On the basis of these findings, Parra (2006) concluded that snubfin dolphins in Cleveland Bay were not permanent residents, but regularly visit the area. Both dolphin species can therefore temporarily move from habitats that have sub-optimal environmental conditions.



PORT EXPANSION PROJECT
EIS

Core Areas for Australian Snubfin and Indo-Pacific Dolphins in Cleveland Bay (Parra 2006)

Figure B.6.32

Legend

- Ross River
- Ross Creek
- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Reclamation Area
- Snubfin/Indo-Pacific Dolphins Core Area

N

Scale: 1:135,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_046

Data Source:
Core Areas for Australian Snubfin and Indo-Pacific Dolphins in Cleveland Bay (Parra 2006), Figure 7.31 - BMT WBM 2012.

Despite possessing a range of adaptations that allow a degree of resistance to short-term changes in environmental conditions, both nearshore dolphin species are considered to have low capacity to recover from population declines. In this regard:

- Both are long-lived species with low reproductive rate. While the reproductive ecology of these species has not been well studied, most Delphinids bear one calf every two to three years (DSEWPC, 2012e; DSEWPC, 2012d). Consequently, these species would have slow rates of population recovery.
- Both species have small overall population sizes, and also have small local sub-population sizes. The state wide populations of both species are less than 10,000 individuals. Despite having wide home-ranges, both species can form small localised groups (such as the Cleveland Bay 'sub-populations'). There are conflicting views regarding the degree of inter-mixing among these groups. DSEWPC (2012) argues that populations of both nearshore dolphins are contiguous, citing the extensive home range and broad movement patterns of these species [see also Cleveland Bay findings reported by Parra (2006)]. However, in the Great Sandy Straits region, Indo-Pacific humpback dolphins were observed to form small discrete groups with little interactions among groups (Cagnazzi, Harrison, Ross, & Lynch, 2011). Whatever the case, a substantial decline in dolphin numbers is expected to reduce the viability of local sub-populations.
- Both species are under increasing threat from human activities. In this regard, both species have narrow habitat requirements, being restricted to near-shore habitats (often around river mouths and seagrass meadows). These environments are subject to the high levels of anthropogenic pressures. Key threats include habitat loss and degradation, entanglement in gill nets, pollution (both direct and indirect impacts) and vessel strike from fast-moving watercraft (Parra, Corkeron, & Marsh, 2004; DSEWPC, 2012d; DSEWPC, 2012e).

Dugong

Habitat Use, Distribution and Abundance

The dugong has a global IUCN listing of 'vulnerable to extinction' (IUCN, 2010). It is 'listed threatened', 'listed migratory' and 'listed marine' species under the EPBC Act 1999 and the Queensland dugong population is considered as 'vulnerable' under the NC Act 1992.

The dugong has a relatively broad geographic range that extends from east Africa to Vanuatu, between the latitudes of approximately 27° north and south (Marsh, Penrose, Eros, & Hugues, 2002). The IUCN listing reflects the significant contraction in their global distribution and abundance. Australia is thought to represent the last strong-hold for this species, where it occurs from Shark Bay in the west to Moreton Bay in the east. The most important dugong areas south of Cooktown are Hinchinbrook Island, Cleveland Bay, Shoalwater Bay, Hervey Bay and Moreton Bay (Marsh, Penrose, Eros, & Hugues, 2002).

Population estimates for the broader region have been developed from aerial survey data. Marsh *et al*. (2002) estimated that the number of individuals in the area between Hinchinbrook Island (north of Townsville) and the southern boundary of the Great Barrier Reef Marine Park (north of Bundaberg) was approximately 3500 in 1986, and in 1994 at 1700 individuals. Marsh (2000) examined changes in dugong numbers between the 1960s and 2000 for the Queensland coastline south of Cairns, based on by-catch records from the government shark-netting program. It was estimated that dugong catch-per unit effort declined by approximately 3% during this period. Notwithstanding these results, it is not possible to quantify the direction and magnitude of change in dugong populations in the region. Nevertheless, it is thought that numbers in the region are now relatively stable (DSEWPC, 2012c).

Dugongs are principally herbivores and have been shown to be highly selective feeders, preferring certain species of seagrass to others. Preen (Preen A. , 1995) reported dugongs showing a preference for grazing on seagrass from the genus *Halophila*, which dominate seagrass meadows in Cleveland Bay (Section B.6.4.4). Elsewhere (Moreton Bay), dugongs are also reported to feed deliberately on invertebrates such as ascidians. This omnivory is thought to be a response to nutritional stress caused by seasonality in abundance of seagrasses (Preen A. , 1995b) .

Dugongs are abundant in Cleveland Bay, and as mentioned above, the Bay is thought to be an important dugong habitat at a regional scale (Sheppard, 2007). Aerial survey data collected in 2008, 2010 and 2011 was modelled by James Cook University to determine relative density of dugong habitat use in

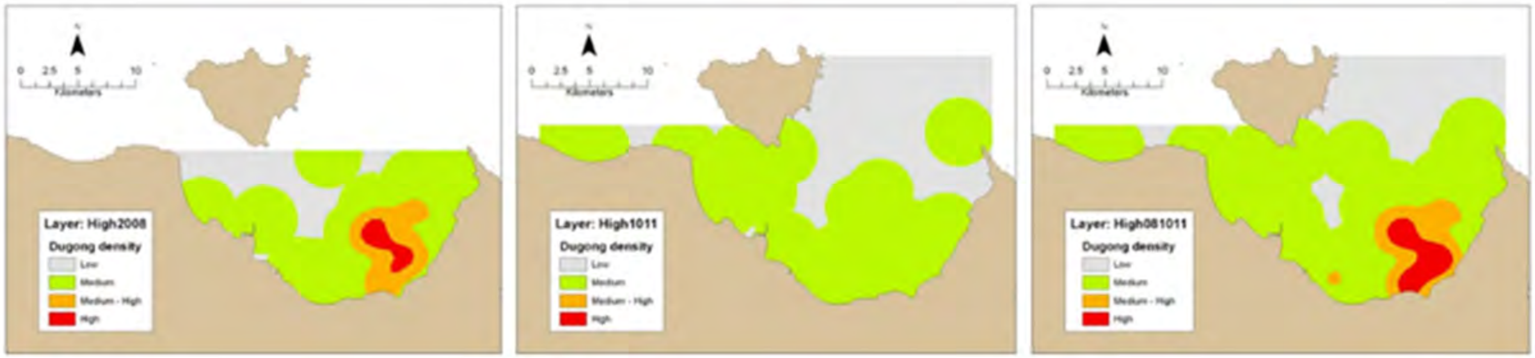
Cleveland Bay (GHD, 2011a). Records of dugong observations are shown in Figure B.6.29, and modelled dugong relative density data are shown in Figure B.6.33.

The greatest density of dugongs was recorded in eastern Cleveland Bay, which is consistent with previous modelling undertaken by Sheppard (2007). Cape Pallarenda was observed to support medium dugong densities. Patterns in relative abundance varied between tidal stages, with high densities recorded in eastern Cleveland Bay on high tides, and medium densities recorded in the same area during low tides. Sandfly Creek was the only area in Cleveland Bay observed to support high densities during low tide (GHD, 2011a). The change in abundance between tidal stages reflects the drying of intertidal flats during low tides, and the associated movement of dugongs into deeper waters.

At a local scale, the patterns in relative abundance of dugongs in Cleveland Bay reflect patterns in seagrass meadow distribution and abundance. Figure B.6.33 shows that medium and high dugong densities in eastern Cleveland Bay were coincident with the largest and most abundant seagrass meadows in Cleveland Bay. The seagrass meadows at Cape Pallarenda and southern Magnetic Island, despite being relatively abundant, were found to have medium to low dugong abundance. GHD (GHD, 2011a) suggested that changes in relative densities of dugongs in time could reflect changes in seagrass extent/abundance, or sampling error due to high turbidity in 2010.

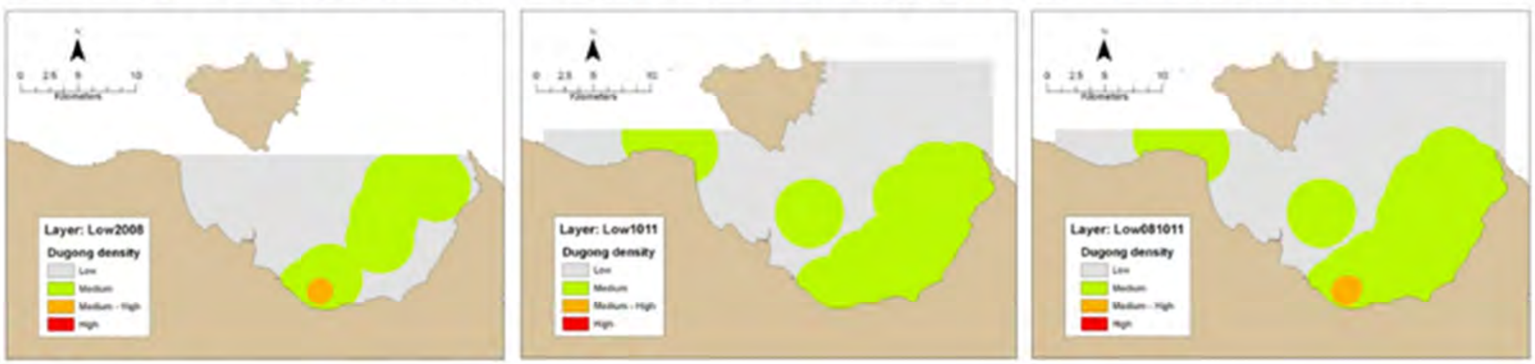
While dugongs are most abundant around dense seagrass meadows, it is apparent that they move throughout Cleveland Bay as they move between feeding sites (seagrass meadows). There is little seagrass in the Port Expansion Project Area and sparse seagrass cover has been reported previously in the DMPA and surrounds by others, but none was observed in the present study. It is possible that dugongs move through both of these areas from time to time, although aerial surveys suggest that dugongs have low abundance in these areas [(GHD, 2011a) Figure B.6.33].

Dugongs also breed in Cleveland Bay. While dugongs breed year round, mating and calving tend to peak in spring and summer, particularly at high latitudes (DSEWPC, 2012c). Calving sites reportedly include sandbanks and estuaries, which is possibly a strategy to avoid predation by sharks (DSEWPC, 2012c). Dugongs delay their breeding until there are sufficient seagrass food resources (DSEWPC, 2012c). Females do not bear their first calf until they are 10 to 17 years old. Juveniles begin to feed on seagrasses shortly after birth, but also suckle during this time (DSEWPC, 2012c).



2008 | 2010 and 2011 | 2008, 2010 and 2011

Figure 3-11 High tide dugong density modelling of aerial survey data from 2008, 2010 and 2011 and all three years combined



2008 | 2010 and 2011 | 2008, 2010 and 2011

Figure e dugong density modelling of aerial survey datasets from 2008, 2010 and 2011 and all three years combine

Figure B.6.33 Dugong relative densities during high and low tide surveys [Source: (GHD, 2011a)]

Resistance and Resilience of Dugongs

Like green turtles, food resource availability is thought to be a key control on dugong populations. The loss of seagrass meadows has been implicated as the major cause of dugong strandings in the region. Dugong stranding reports for the GBR increased from an annual average of 63 per annum in the period 2008 to 2010, to 187 dugongs in 2011 (GBRMPA, 2012b; GBRMPA, 2012a). The Townsville region was identified as a hot-spot for strandings in 2011, with 54 dugong strandings compared to 5 (2008), 11 (2009) and 19 (2010) dugongs in the period 2008 to 2010. Furthermore, in the period January to August 2012, there were only three recorded stranding in the Townsville region, which was relatively low compared to previous years[(DEHP, 2012c) see Figure B.6.34].

Similar to green turtles, a number of factors facilitate dugong population's capacity to cope with periodic disturbance:

- Maintenance of 'permanent' seagrass meadows in eastern Cleveland Bay – see Section B.6.4.4.
- Dugongs may supplement their diet with algae (Marsh, Channells, Heinsohn, & Morissey, 1982) and benthic macroinvertebrates (Preen A. , 1995a) during periods when seagrass resource availability is low.
- Dugongs are capable of moving large distances [measured in hundreds of kilometres; see (DSEWPC, 2012c)]. It is thought that these extensive movements are a response to food resource availability (DSEWPC, 2012c).

Notwithstanding the above, it is apparent that dugong population resilience was markedly reduced as a result of the 2011 floods. Reductions in dugong abundance associated with post-flood reductions in seagrass meadows are well documented (e.g. Preen and Marsh 1995). However, the number of strandings recorded in 2011 was considered by Department of Environment and Heritage Protection (2012b) to be 'exceptional', reflecting the significant severity and wide geographic extent of the 2011 floods compared to previous events.

Recovery rates of dugong populations will be slow (due to low birth rates of dugongs), and contingent on the recovery of seagrass meadows. Marsh *et al*. (2002) estimated that under optimum conditions (i.e. low natural mortality), the maximum rate of population increase would be 5% per annum. Key anthropogenic threats that could impact on recovery of dugongs include boat strike, loss of seagrasses and entanglement in gill nets (DERM, 2010b).

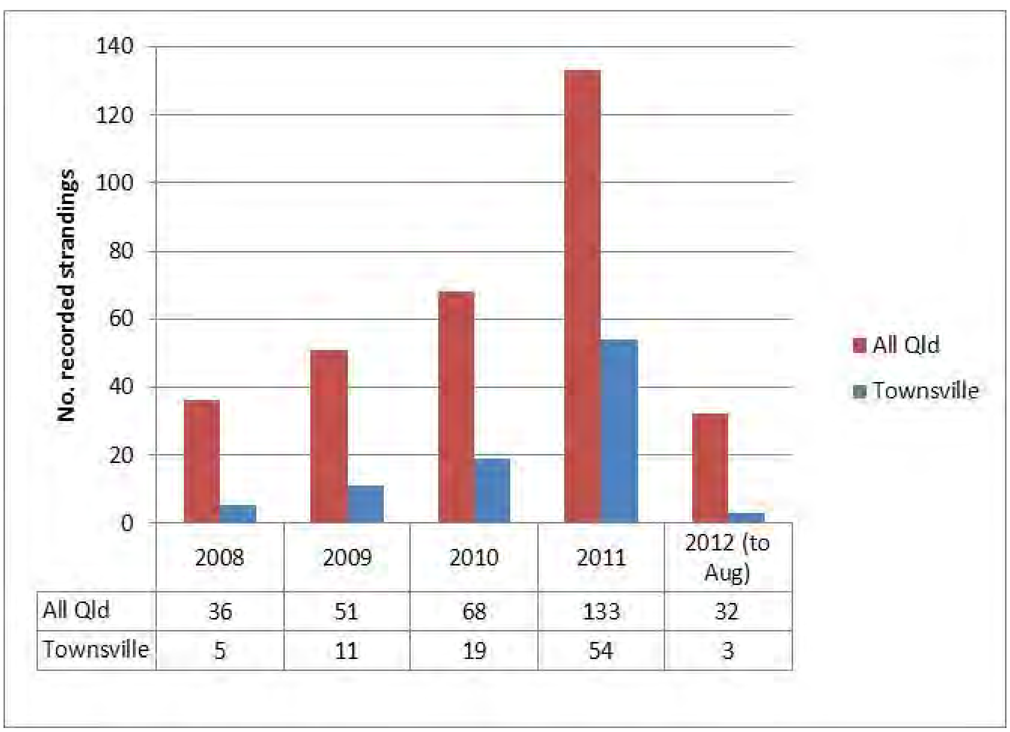


Figure B.6.34 Number of dugong strandings recorded in the Queensland standings database (DEHP, 2012c)

Humpback Whale

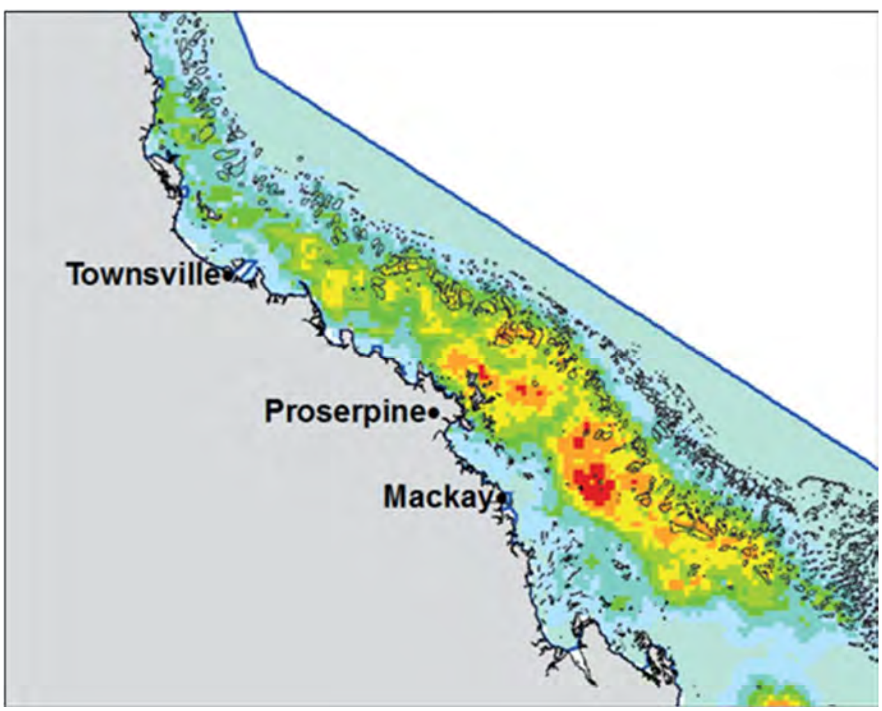
The humpback whale has a global IUCN listing of least concern (IUCN, 2010). It is listed as vulnerable under both the EPBC Act and the NC Act.

Humpback whales calve in the protected waters of the GBR between July and August then travel down the Australian coast to Antarctic waters where they spend spring and summer before returning (DERM, 2010c). They mainly feed on krill (*Euphausia superba*) and small fish while in Antarctic waters, but may undertake opportunistic feeding while migrating along the Australian coast (DSEWPC, 2012b).

Prior to whaling, 40,000 animals were estimated to migrate along the east coast of Australia (DERM, 2010c). When whaling in Australian coastal waters ceased in 1962, numbers had dwindled to an estimated 500. In 2007 the total population estimate was between 9,500 and 12,500. Their numbers appear to be increasing at approximately 10% per annum now that commercial whaling has ceased. Nonetheless, populations are vulnerable to further change.

Smith *et al*. (2012) developed a predictive spatial habitat model of humpback whale occurrence in the Great Barrier Reef, based on presence-absence data from aerial surveys. The model identified two core areas of higher probability of occurrence: (1) offshore of Proserpine extending south to Mackay in the inner reef lagoon region, and (2) the Capricorn and Bunker groups of islands and reefs approx. 100 km east of Gladstone (Figure B.6.35). They suggested that the first area was an important wintering area, whereas the second area represented an important migration route. The waters of Cleveland Bay were predicted to have a low level of environmental suitability for humpack whales.

A search of the Wildlife Online database for Cleveland Bay has 15 confirmed humpback whale records since 1980. GHD (2011a) recorded humpback whales, including calves, in Cleveland Bay during August to September 2010 (n = 19 incidental observations). The timing of these records indicates that were whales were making their return journey to southern waters. These whales were recorded in deep waters of Cleveland Bay and adjacent to Cape Cleveland. Predictive modelling suggests that humpback whales are most likely to occur in water depths of 30 to 58 m (Smith, Grantham, Gales, Double, Noad, & Paton, 2012), however they are known to occur in shallow waters from time to time. This species has been recorded in both turbid and clear waters; however the behavioural response of whales to turbid plumes is unknown.



Red = most suitable; green = moderate suitability; blue = least suitable

Figure B.6.35 Model prediction of environmental suitability for humpback whales in the GBRWHA Source: (Smith, Grantham, Gales, Double, Noad, & Paton, 2012)

B.6.3.8 Exotic Marine Species and Marine Pests

More than 250 non-indigenous marine species have been recorded in Australian waters to date (NIMPCG, 2011). There are several potential vectors by which non-indigenous species may enter domestic waters, however it is thought that most species are unintentionally introduced through shipping movements, either in ballast waters or from biofouling on the hull of vessels (Hewitt & Campbell, 2010). Other vectors include intentional transfer of aquaculture and mariculture organisms, transfer of food products for the aquarium trade and use of biological material for packing (Hewitt & Campbell, 2010). Asian green mussel (*Perna viridis*), considered to be a potential threat in tropical waters, was found on a vessel's hull at Cairns Harbour in 2001 and Caribbean tubeworm (*Hydroides sanctaecrucis*) has also been introduced there (Souter, 2009).

A port wide baseline survey of non-indigenous species was undertaken by James Cook University and the CRC Reef in November 2000 (Neil, Sheaves, Cruz, Hoedt, & Choat, 2001). The aim of this baseline survey was to describe existing marine communities in the Port, and identify any non-indigenous species, including target pest species listed by the Australian Ballast Water Management Committee, Hewitt and Martin (1996) and Furlani (1996). The baseline survey recorded over 1300 organisms, however no targeted marine pest species were recorded (Neil, Sheaves, Cruz, Hoedt, & Choat, 2001). A range of species that resemble non-indigenous species were recorded in the baseline survey, however none of these potential non-indigenous species are considered to represent a serious pest in Australian waters.

B.6.3.9 Fish and Fisheries Resources

C and R Consulting (2007b) compiled existing records of soft sediment habitat associated fish species in Cleveland Bay (excluding reef fish and pelagic species). They identified 253 species from 65 families in Cleveland Bay and the lower reaches of Ross Creek and Ross River. Approximately one-third of these species are migratory, including over 40 species that migrate between marine and freshwaters but not for breeding (amphidromous), 23 species that migrate in marine waters, 12 species that migrate between marine and freshwaters for breeding, and two species that migrate in freshwater environments. These migratory species are particularly vulnerable to habitat fragmentation and isolation.

Fisheries are an important commercial, recreational, traditional and biologically diverse resource in the Townsville region. C and R Consulting (2007b) estimate that of the 253 fish species recorded from Cleveland Bay and the Ross River and Creek 163 species are of low to medium commercial fisheries value; 60 species are of recreational fisheries value; 34 species are of aquaculture industry value and 25 species are of value to the aquarium fishery.

The commercial fishery of the Townsville region typically contributes approximately 11% to Queensland gross value of production. Restrictions to commercial fishing activities in Cleveland Bay include a Dugong Protection Area (netting restrictions), Cleveland Bay Fish Habitat Area (trawling restrictions), and commercial fishing closures of Ross River, Ross Creek, Alligator River and Crocodile Creek.

The main commercial fisheries operating directly in Cleveland Bay are the Queensland Mud Crab, East Coast Otter Trawl, Queensland Blue Swimmer Crab, Queensland East Coast Spanish Mackerel and Queensland East Coast Inshore Fin Fish fisheries. The Queensland Spanner Crab Fishery includes waters adjacent to Cleveland Bay.

The key species targeted by commercial trawl, net, line and crab fisheries in Cleveland Bay are prawns (i.e. tiger, banana and Endeavour prawns), mud crabs, blue swimmer crabs, bugs, barramundi, tropical sharks, mackerel (primarily grey mackerel) and threadfin, Spanish mackerel, coral trout and red throat emperor. Many other species of molluscs, crustaceans and finfish are also retained by trawl fishers as commercial by-product.

Based on analysis of DAFF (then DEEDI) catch data (Figure B.6.36), Cleveland Bay is not considered to represent a key production area for mud, spanner, and blue swimmer crabs, but produces regionally important catches for the East Coast Otter Trawl and East Coast Spanish Mackerel fisheries, and has a locally important net fishery (focusing on barramundi, but also threadfin salmon and grey mackerel). The Study Area and surrounds are not known to represent regionally important areas for the aquarium fish or sea cucumber fisheries.

Cleveland Bay supports significant recreational fisheries, and a number of inshore, reef and pelagic species are targeted. Recreational fishers generally target similar species to commercial fishers, with a strong focus on barramundi, mullet, whiting, bream and mud crabs in inshore areas; and reef fish such as coral trout (*Plectropomus* spp.), snapper (Lutjanidae), sweetlip (Lethrinidae) and trevally (*Caranx* spp.) when further from shore (Ludescher, 1997).

Most line-based recreational fishing tends to occur around artificial structures such as navigation structures and breakwaters, as well as reef environments around Middle Reef and Magnetic Island. Some crabbing occurs in coastal creeks throughout the bay. The value of recreational fishing is likely to be considerably more than the commercial fishing industry. There is little information about the amount of Indigenous fishing conducted, however it is likely to be small when compared to the general recreational and commercial sectors.

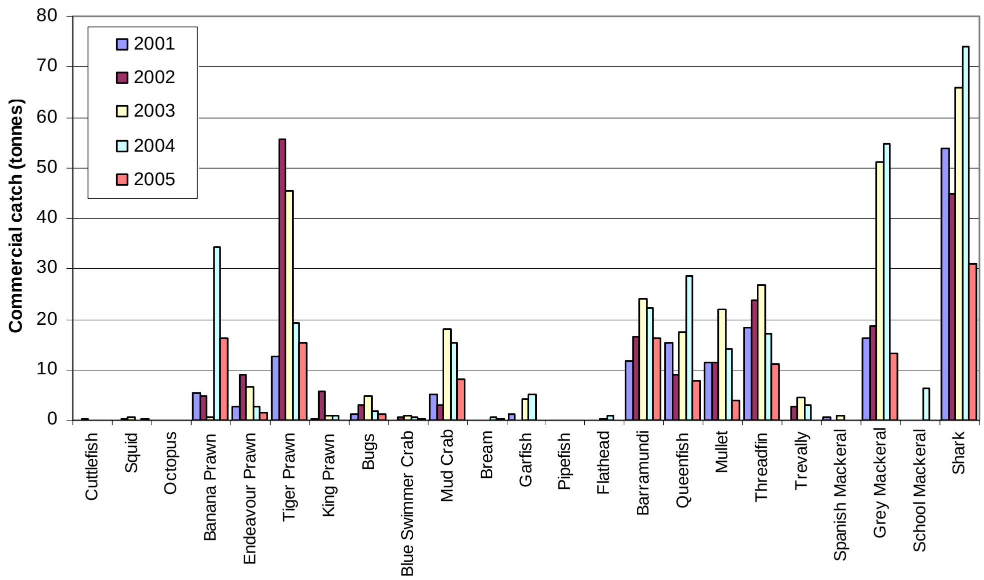
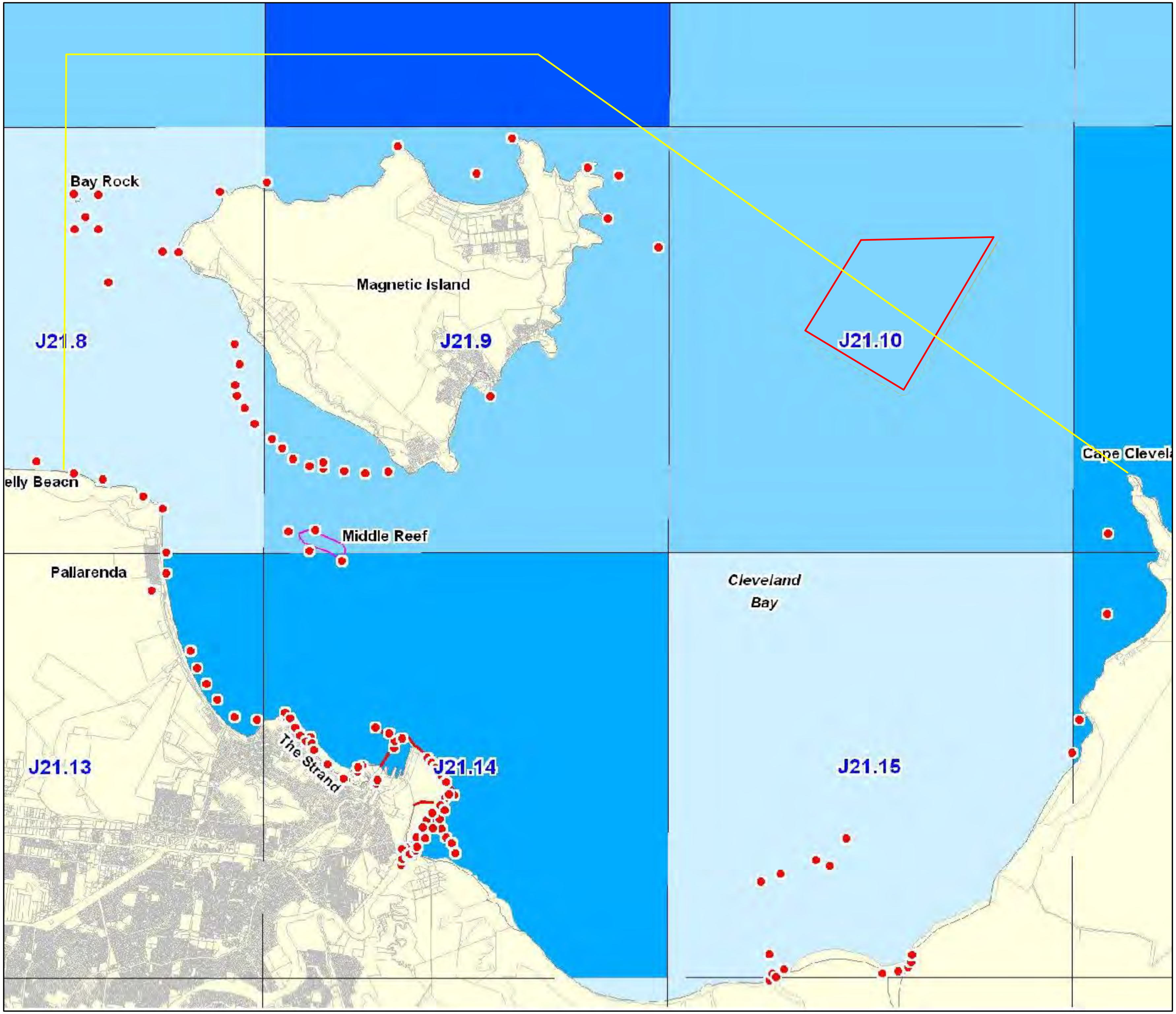


Figure B.6.36 Annual commercial catch of key species for the Study Area and surrounds 2001-2005 (DEEDI, 2011)

PORT EXPANSION PROJECT
EIS

Commercial Trawling and
Recreational Fishing Activity
at Cleveland Bay (DEEDI 2011a)

Figure B.6.37



Legend

- Recreational Fishing Spots
- Recreational Fishing Spots
- Port Limits
- Dredge Material Placement Area

Commercial Trawling Activity

- Very Low
- Low
- Medium
- High
- Very High

N

Scale: 1:130,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_086

Data Source:
Commercial Trawling and Recreational Fishing Activity at Cleveland Bay (DEEDI 2011a), Figure 7.36 - BMT WBM 2012.

B.6.4 Assessment of Potential Impacts

B.6.4.1 Assessment Process and Overview of Impacts

A risk-based approach was adopted in this environmental impact assessment. This is based on the identification of potential impacting processes (Table B.6.6), and characterisation of the likely level of impact to the existing environment. The risk assessment process is described in Part A of this EIS. For the purposes of this Marine Ecology assessment, impacts levels and risks were defined on the basis of the following:

- Magnitude of Impact – made up of assessment of the intensity, scale (geographic extent), duration of impacts and sensitivity of environmental receptors to the impact. Impact magnitude ratings take into account the conservation management objectives for protected areas (Section B.6.3.2) and threatened species (as outlined in recovery plans listed in Table B.6.4). Table B.6.6 is a summary of the categories used to define impact magnitude.
- Likelihood of Impact – which assesses the probability of the impact occurring. Table B.6.7 is a summary of the categories used to define impact likelihood.
- Risk rating – which assesses the level of risk for key impacting processes. The risk rating was generated from the Magnitude and Likelihood scores, based on the matrix presented in Table B.6.8.

Table B.6.6 Categories Used to Define Magnitude of Impact

Magnitude	Description
Very High	The impact is considered critical to the decision-making process as it would represent a major change to the ecological character of Cleveland Bay. This level of impact would be indicated by: Complete loss of any habitat type presently supported in Cleveland Bay, in the short or long term; <u>or</u> Substantial effects on ecosystem structure or function, such that many species are extirpated; <u>or</u> Major regional-scale changes to the ecological character of the GBRWHA, Bowling Green Bay Ramsar site, Commonwealth Marine Area, Fish Habitat Areas, Dugong Protection Areas; Major impacts to populations of Commonwealth or State listed threatened species, such that their capacity to reproduce and recover is significantly affected; <u>and</u> Lead to impacts that are irreversible or otherwise long term (i.e. greater than decades).
High	The impact is considered important to the decision-making process as it would a detectable change to the values that underpin the ecological character of Cleveland Bay. This level of impact would be indicated by: Measurable impacts to key ecosystem structure or functions. Large changes in abundance of many species, at spatial scales measured in 10's of kilometres; <u>or</u> Mortality of a small number of individuals of internationally/ nationally threatened species, but no detectable change in population status and the capacity of populations to recover; <u>or</u> Measurable loss in fisheries production at local (Cleveland Bay-wide) spatial scale, but no impacts at regional scales; <u>and</u> Lead to impacts that are medium term (measured in years) or longer.
Moderate	While important at a state or regional or local scale, these impacts are not likely to be critical decision making issues. This would be indicated by: Measurable but small changes to supporting ecosystem components (e.g. habitat extent, water quality) and functions (e.g. fisheries production, reproduction/recruitment of fish or shellfish) at scales measured in kilometres, but no impact at a broader scales; <u>or</u> Small changes in abundance of many species, or large changes in some species, at scales measured in kilometres; <u>or</u> Loss of important life history functions of threatened species, or species of high fisheries or otherwise ecological value, but no detectable change in their population status at local (Cleveland Bay) spatial scales (i.e. capacity to recover); <u>and</u> Impacts that are medium term (years) or shorter.
Low	Impacts are recognisable/detectable but acceptable. These impacts are unlikely to be of importance in the decision making process. Nevertheless, they are relevant in the consideration of standard mitigation measures. This would be indicated by:

Magnitude	Description
	Species of fisheries or conservation significance or its habitat affected but no impact on local population status (e.g. stress or behavioural change to individuals); Impacts tend to be short term or temporary and/or occur at local scale; No effects to threatened species are expected at even local spatial scales.
Negligible	Minimal change to the existing situation. This could include, for example, impacts that are below levels of detection, impacts that are within the normal bounds of variation or impacts that are within the margin of forecasting error.
Beneficial	Any beneficial impacts as a result of the Project such as for example, the creation/establishment of new habitat.

Table B.6.7 Categories Used to Define Likelihood of Impact

Likelihood Categories	
Highly Unlikely/Rare	Highly unlikely to occur but theoretically possible
Unlikely	May occur during construction/life of the Project but probability well <50%; unlikely but not negligible
Possible	Less likely than not but still appreciable; probability of about 50%
Likely	Likely to occur during construction or during a 12 month timeframe; probability >50%
Almost Certain	Very likely to occur as a result of the project construction and/or operations; could occur multiple times during relevant impacting period

Table B.6.8 Risk ratings

	Magnitude (Consequence)				
Likelihood	Negligible	Low	Moderate	High	Very High
Highly Unlikely	Negligible	Negligible	Low	Medium	High
Unlikely	Negligible	Low	Low	Medium	High
Possible	Negligible	Low	Medium	Medium	High
Likely	Low	Medium	Medium	High	Critical
Almost Certain	Low	Medium	High	Critical	Critical

Key assumptions and limitations of the impact assessment are outlined in the subsequent report sections. Table B.6.10 is a summary of the predicted extent of habitat loss or modifications as a result of various port construction and operation activities. Figure B.6.38 and Figure B.6.39 shows the extent of possible habitat loss or modification due to these activities.

Table B.6.9 Marine ecology impacting processes during construction (C) and operational (O) phases

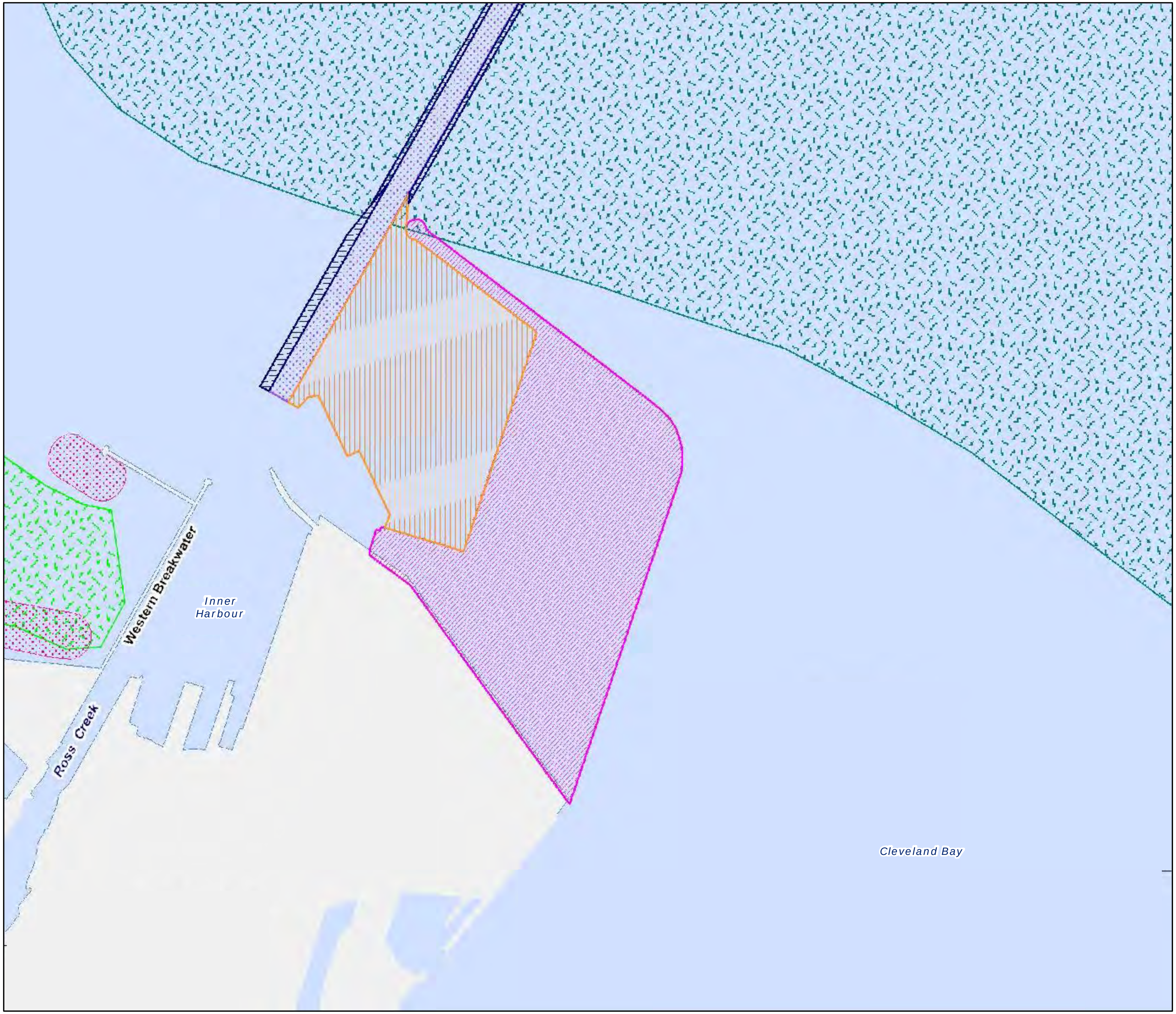
Phase	Activity	Primary Impact	Secondary Effects	Section
C	Dredging and dredged material placement	Temporary loss and mobilisation of benthic fauna	Change in prey availability for marine fauna	B.6.5.3, B.6.5.4, B.6.5.5
C/O		Long term change in benthic habitat conditions and benthic fauna	Change in prey availability for marine fauna	B.6.5.2, B.6.5.3, B.6.5.4, B.6.5.5
C/O		Increased suspended solid concentrations	Loss or degradation of seagrass and corals	B.6.5.4, B.6.5.5
C/O		Increased sedimentation	Loss or degradation of seagrass and corals	B.6.5.4, B.6.5.5
C/O		Acoustic impacts to marine fauna	Avoidance of area by marine fauna	B.6.5.7
C/O		Direct impacts of dredge plant on marine megafauna	Injury or mortality to marine megafauna	B.6.5.6
C	Reclamation	Loss of soft sediment habitat	Change in prey availability for marine fauna	B.6.5.2, B.6.5.3, B.6.5.4, B.6.5.5
C		Increase in hard substrate habitat	Increase in relative abundance of reef associated species at a local scale	B.6.5.2, B.6.5.5
C		Increased sedimentation and suspended solids associated with tailwater discharge	Loss or degradation of seagrass and corals	B.6.5.4, B.6.5.5
C		Acoustic impacts to marine fauna (e.g. physiological damage, masking of biologically important sounds) associated with piling and rock placement	Adverse marine fauna behavioural responses	B.6.15.7
C/O	Increased vessel movements	Increase in boat strike	Injury or mortality to marine megafauna	B.6.5.6 (construction) B.6.5.7 (operation)
C/O		Increase potential for marine pest introductions	Out-competition of native species and loss of biodiversity values	B.6.5.10
C/O		Increase in propeller wash and disturbance of seabed habitats and benthic fauna	Change in prey availability for marine fauna	B.6.5.6
C/O	Construction plant and port lighting	Increased light spill into the marine environment	Disorientation of marine fauna, particularly marine turtles	B.6.5.8
O	Operation of facility on reclamation area	Altered hydrodynamics leading to changes in benthic habitats and communities	Change in prey availability for marine fauna	B.6.5.3, B.6.5.4, B.6.5.5
O		Noise and vibration generated by vessels interfering with marine megafauna communication	Temporary avoidance or displacement of affected area	B.6.5.7
C/O	Increase in rubbish entering the marine environment	Ingestion or entanglement of marine megafauna	Stress or mortality of marine megafauna	B.6.5.11

Phase	Activity	Primary Impact	Secondary Effects	Section
C/O	Increased potential for hydrocarbons, including cargos to be handled, to enter the marine environment	Toxicity effects to marine flora and fauna	Loss of biodiversity values	B.6.5.11

PORT EXPANSION PROJECT
EIS

Sensitive Ecological Receptors and Cumulative Disturbance Footprint for the Nearshore Components of the PEP

Figure B.6.38



Legend

Disturbance Footprint

- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area

Sensitive Ecological Receptors

- 2007 Coastal Seagrass (Permanent and Semi-permanent Meadows)
- 2007 Deepwater Seagrass (Sparse Ephemeral Meadows)
- Seagrass Monitoring Meadows, October 2010 (DEEDI)

N

Scale: 1:20,000 approx. (when printed at A4)

0 200 400 800
Metres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

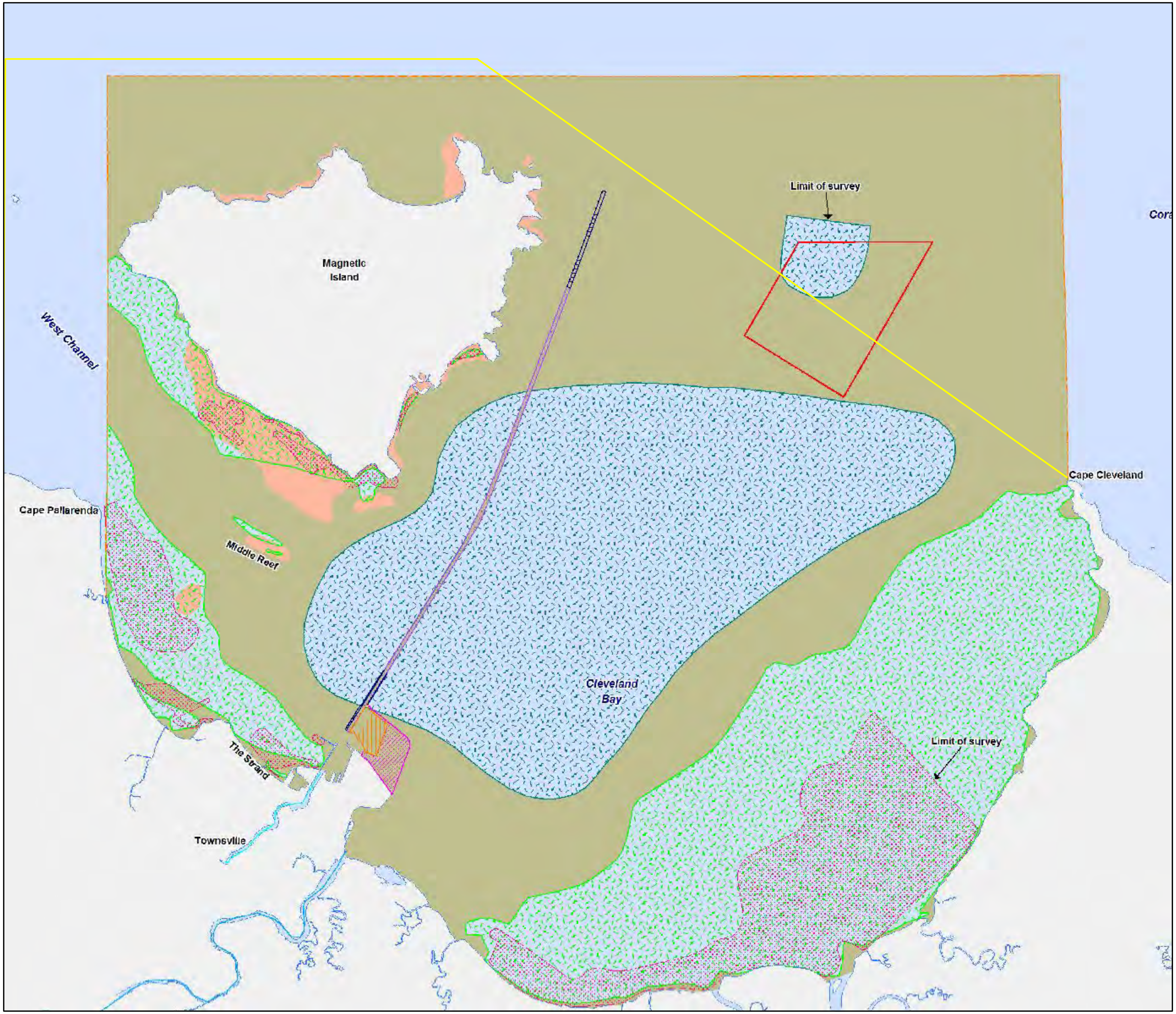
FILE NAME 60161996_PLN_087

Data Source:
Cumulative Disturbance Footprint for the Outer Harbour Project Area and Nearshore Sections of the Navigation Channel (BMT - WBM), Figure 7.37 - BMT WBM 2012.

PORT EXPANSION PROJECT
EIS

Sensitive Ecological Receptors and Cumulative Disturbance Footprint for the DMPA and Offshore Components of the PEP

Figure B.6.39



Legend

Port Limits
Ross River
Ross Creek
Cleveland Bay Project Extent
Dredge Material Placement Area

Disturbance Footprint
Channel to be Dredged
Existing Channel to be Deepened
Harbour Basin
Reclamation Area

Sensitive Ecological Receptors
2007 Coastal Seagrass (Permanent and Semi-permanent Meadows)
2007 Deepwater Seagrass (Sparse Ephemeral Meadows)
Seagrass Monitoring Meadows, October 2010 (DEEDI)
Corals
Sub-tidal Soft Sediments (Cleveland Bay)

Scale: 1:130,000 approx. (when printed at A4)

0 0.5 1 2 3 4 5
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_047

Data Source:
Cumulative Disturbance Footprint for the DMPA and Offshore Sections of the Navigation Channel, Figure 7.38 - BMT WBM 2012.

Table B.6.10 Area of disturbance in each impact location

Phase	Activity	Impact Type	Habitat Type	Area (ha) Affected
Direct Irreversible Losses and Gains				
C, O	Reclamation and Rock Walls (without western breakwater)	Loss of soft sediment habitat	Subtidal soft sediments	109.66 ha
		Increase in rock wall habitat	Intertidal rock wall habitat	+ 1.45 ha (net gain)
			Subtidal rock wall habitat	+ 10.55 ha (net gain)
C, O	Reclamation and Rock Walls (assuming western breakwater constructed)	Loss of soft sediment habitat	Subtidal soft sediments	114.38 ha
		Increase in rock wall habitat	Intertidal rock wall habitat	+ 2.29 ha (net gain)
			Subtidal rock wall habitat	+ 12.65 ha (net gain)
Direct Habitat Disturbance Associated with Dredging				
C, O	Dredging and deepening of harbour basin for Berths 14 to B19 (outside reclamation footprint)	Habitat modification - Increase in depth; ongoing disturbance by maintenance dredging	Subtidal soft sediments	42.54 ha
C, O	Deepening of the existing navigation channel	Habitat modification - Increase in depth; ongoing disturbance by maintenance dredging	Subtidal soft sediments	149.4 ha
C, O	Channel widening between beacons P11/P13 and P12/P14	Habitat modification - Increase in depth; ongoing disturbance by maintenance dredging	Subtidal soft sediments	3.42 ha
C, O	Dredged material placement at the DMPA	Direct habitat modification due to dredged material placement: Reduced water depths Temporary loss of sparse seagrass (if present)	Subtidal soft sediments Seagrass	1122 ha 253 ha (note – ephemeral meadow – not recorded post 2008)
C, O	Lengthening of the Sea Channel in previously undredged areas	Habitat modification - Increase in depth; ongoing disturbance by maintenance dredging	Subtidal soft sediments	24.84 ha

B.6.4.2 Direct Modifications to Benthic Habitats Associated with Dredging and Reclamation

This section describes direct impacts to benthic habitats and communities due to reclamation and dredging activities. Note that impacts associated with offshore dredged material placement (Section B.6.4.3), turbid plume generation (Section B.6.4.4) and flow-on effects to marine fauna (Section B.6.5.5) are considered later.

B.6.4.2.1 Reclamation and Deepening of the Outer Harbour

Figure B.6.38 and Figure B.6.39 shows the Port Expansion Project dredging and reclamation footprint. Construction of the port facilities and associated reclamation (Location A) would result in the direct loss of approximately 109 hectares of soft-sediment habitat. The soft sediment habitat in the reclamation footprint is well represented in the nearshore environments of Cleveland Bay (Section B.6.4.6). The soft sediment in the reclamation footprint do not represent high quality habitats, being structurally simple, in a moderately modified condition (primarily by existing port operations), and are not known or likely to support seagrass, macroalgae or diverse/abundant sessile epifauna assemblages (e.g. soft corals, sponges etc.).

The outer harbour basin development (Location B) would result in the disturbance of approximately 50 hectares of soft sediment habitat. The construction and operation of the outer harbour basin would result in ongoing modifications to habitat types present, and their condition. In this regard:

- Capital dredging will result in a reduction in water depths in the outer harbour basin, from an existing water depth of -3 to -4 m CD, down to -12.7 to -13.6 m CD (see Part A of EIS - Project Description).
- This zone will experience more quiescent conditions during the operational phase than occur at present. Seabed sediments (presently silts and silty sands) in this area are likely to change in response, with an increase in the proportion of silts (Chapter B3 - Coastal Processes). Benthic communities are expected to change in response to alterations in water depths and sediment conditions.
- Maintenance dredging will be carried out in this area on a regular basis, resulting in ongoing disturbance of seabed habitats. Maintenance dredging is expected to occur annually, with volumes predicted to decrease as a result of PEP (Chapter B3 - Coastal Processes).
- Day to day port operations and accidental releases of pollutants (Section B.6.4.11) could also lead to impacts to habitats in this area.

Once operational, the values and condition/integrity of habitats in the proposed outer harbour basin are expected to be similar to those presently found at existing operational port areas (e.g. inner harbour etc.). These operational port areas will continue to provide a range of ecological functions (e.g. fish feeding habitat, habitat for soft sediment benthos etc.), despite being in a modified condition.

The direct impacts from reclamation and deepening are not avoidable or mitigable and therefore represent residual impacts that will be subject to environmental offsets (Chapter B23.2).

B.6.4.2.2 Increase in Rock Wall Habitat

The Project will see the construction of a seawall, which will be constructed of an inner core of clean rock with outer layers of rock armour. The construction of the new seawall would see a net increase in intertidal rock wall habitat of 1.4 ha (no western breakwater) or 2.3 ha (with western breakwater constructed), and subtidal rock wall habitat of 10.5 ha (no western breakwater) or 12.6 ha (with western breakwater). The new rock wall will provide habitat that is structurally similar to that occurring in the northern breakwater area at present. The existing rock wall provides structurally complex habitats for a range macroalgae hard and soft corals, sponges and hydrozoans, which in turn represent micro-habitats (albeit not particularly complex) for other sessile species. The rock walls (and to a lesser extent their epibenthic assemblages) provide feeding areas and shelter for a range of reef-associated fish species, including species of economic significance.

Algae, sessile fauna and fish will begin to colonise the new rock walls within months of the construction. It is expected to take several years for assemblages to reach levels of diversity and community structure as currently found on existing rock walls. This is expected to result in localised short-term loss of food and habitat resources for fish, turtles and other fauna that presently use these rock wall habitats. While green turtles have been observed to feed on existing rock walls in the Port area, it is not known to represent a critical foraging area for this species compared to seagrass meadows and natural reefs (GHD, 2011a).

The new rock walls will likely provide similar habitat and other functional ecological values as existing walls in the medium to long term (measured in years). As populations of reef fish are not generally considered to be habitat limited (Sale, 2006), it is unlikely that the increase in available rock wall habitat will lead to a commensurate increase in fish productivity. However, the rock wall habitats will attract fish to the port area and lead to an increase in the abundance of reef associated species at highly localised spatial scales (i.e. within the port area).

B.6.4.2.3 Habitat Modifications due to Dredging of the Navigation Channels

Ship access to the existing harbour is along the Platypus and Sea channels, which are presently maintained to achieve a declared depth of -11.7m CD, and have a combined approximate length of 13 kilometres. The Project would involve the deepening of the existing channels to an ultimate navigation design depth of -13.4 to -13.7 m CD (Part A - Project Description). The Project will also see the lengthening of the Sea Channel (seaward) by a further 2.1 kilometres, and some minor dredging works to widen the approaches to the outer harbour. The total area of seafloor in the navigation channels will increase from an existing 149 hectares (i.e. areas denoted as Location C) to approximately 177 hectares (i.e. Locations D and F) following the completion of the works.

It is expected that dredging of the channel extension area will create benthic habitat conditions that are similar to those found in the existing navigation channel. As discussed in Section B.6.3.6, existing benthic habitats and macroinvertebrate assemblages in the navigation channels are highly simplified and have low diversity compared to adjacent undredged areas. These navigation channels are subject to ongoing disturbance as a result of maintenance dredging.

While in a modified condition, it would be expected benthic habitats and communities in the existing channel and channel extension area will support similar benthic communities and ecological functions as found in the existing channels. As discussed in Section B.6.3.6, benthic communities in the channel extension area are sparse, depauperate and are representative of other soft sediment benthic communities found elsewhere in outer Cleveland Bay. No reef communities or other features of high biodiversity value occur in the channel extension area. Modifications to benthic habitats and communities in the channel extension area are therefore expected to result in highly localised reductions in benthic richness and abundance, which are not expected to cause detectable flow-on effects to other ecosystem components or functions at scales measured in kilometres from the channel extension area.

B.6.4.2.4 Habitat Changes due to Altered Hydrodynamics

Hydrodynamic changes associated with the Port Expansion Project in areas outside the outer harbour basin are not expected to be large in magnitude or extent, being confined to changes in velocity magnitude in the immediate vicinity of the breakwaters and reclamation area. Furthermore, the depositional area that presently occurs to the west of the port (immediately offshore of the Strand) is predicted to continue to represent and continue to function as a depositional area, with only negligible changes (increases and decreases) in the rate of fine sediment accumulation expected. Consequently, only relatively small, highly localised (scales measured in tens of metres) impacts to bed morphology and sediment grain size are expected in the immediate vicinity of the reclamation area. Intertidal environments nearby (i.e. the Strand, intertidal banks adjacent to the Marine Precinct) are not expected to be greatly impacted by such changes.

Changes in hydrodynamics and bed morphology outside the outer harbour basin are not expected to result in major changes to benthic communities in the affected areas. Furthermore, no particularly sensitive ecological receptors or high conservation value features (e.g. seagrass beds, reefs etc.) are known or likely to occur in the affected areas. Such changes in hydrodynamics are not expected to result in major disruptions or alterations to marine fauna recruitment patterns or pathways at local or regional spatial scales.

In the harbour basin there will be a reduction in current velocities of up to approximately 0.08 to 0.14 m/second. Combined with the deepening of the outer harbour basin, changes to benthic substrates are likely, with a likely increase in the proportion of fine, silty sediments in this area. Benthic communities in the outer harbour area are likely to be modified, with a possible increase in abundance of species that prefer fine sediments (e.g. possibly some deposit-feeders).

B.6.4.2.5 Disturbance of the Seabed by Propeller Wash

Propeller wash generated by large construction vessels (most notably the dredgers) could lead to the disturbance of the seafloor. Propeller wash could lead to mobilisation of seabed sediments, resulting in scouring in affected areas and possibly disturbance of benthic organisms. It would be expected that the scale of impact of propeller wash will be relative to disturbance associated with dredging and dredged material placement. Note that numerical modelling results presented in later sections incorporate propeller wash as a source of suspended sediments.

B.6.4.2.6 Habitat Fragmentation due to Reclamation and Deepening of the Outer Harbour

The design has been developed to avoid forming a barrier to tidal currents and fluvial flows from the Ross Creek. The design has also been developed to reduce impacts to the movement patterns of mobile marine fauna (e.g. fish, prawns, dolphins, etc.). The Port Expansion Project will not create a barrier to the movement patterns of mobile fauna between Ross Creek and Cleveland Bay. Furthermore, the Port Expansion Project will not form a complete barrier between the eastern and western sections of the Port Expansion Project Area, although marine fauna will need to travel a greater distance to move around the reclamation area. Such changes are expected to result in highly localised changes to marine fauna movement patterns (impacts measured in hundreds of metres of the final structure), however such changes are not expected to result in detectable changes to the habitat, biodiversity or fisheries values of Cleveland Bay.

B.6.4.2.7 Mitigation and Residual Impacts

The reclamation will result in the replacement of subtidal soft sediment habitat with intertidal and subtidal hard substrate habitat. This represents an irreversible impact that cannot be mitigated through the implementation of mitigation measures. Accordingly, appropriate offsets will be explored by POTL with DAFF (as discussed in Chapter B23.2).

Notwithstanding any offsets, best management practices will be employed to reduce the potential impact to neighbouring estuarine fauna and their habitats, which are outlined in the Dredge Management Plan (DMP) (Chapter C2.1). This will include:

- Designing and constructing rock wall habitats to create a wide diversity of micro-habitats for intertidal and subtidal flora and fauna;
- Adoption of a design that reduces impacts on hydrodynamics, and maintains connectivity between the outer harbour and adjacent habitats;
- Ensuring that construction activities are restricted to the approved development footprint; and
- Ensuring that vessels operate in designated shipping channels and implementation of suitable speed limits to reduce the risk of benthic habitat disturbance from propeller wash.

Overall, it is predicted that the habitat loss due to dredging and reclamation will have a Medium level impact (see Table B.6.20).

B.6.4.3 Dredged Material Placement Impacts to Benthos

B.6.4.3.1 On-site Impacts

As described in the Part A of the EIS - Project Description, the Port Expansion Project is to be undertaken sequentially in four stages between 2014/15 and 2035, with capital dredging to occur intermittently over this timeframe. A total *in-situ* volume of capital dredged sediment of approximately 5,700,000 m^3, mostly comprised of clays, silts and sands, will be placed in the existing offshore DMPA (see Project Description). Assuming material is placed in the DMPA in accordance with the strategy outlined in the Project Description, the Port Expansion Project will result in the complete burial of substrates over the entire 11.14 km^2 DMPA area, with the thickness of dredged material varying among depths (>1m in places).

In the short term, dredged material placement is expected to result in the smothering of most sessile flora (i.e. seagrass and algae if present) and fauna (e.g. soft corals, sea pens, gorgonians, sponges etc.) in the DMPA. Depending on the depth of placed sediment, it is possible that some more mobile burrowing fauna will be able to migrate through the placed sediments.

As the capital and ongoing maintenance dredging campaigns will affect different parts of the DMPA at different times, dredged material placement will create a mosaic of patches with different disturbance histories. During and after the dredge campaign, benthic organisms will colonise the DMPA through the following mechanisms:

1) Survival of dredging and re-invasion by biota entrained in dredged material (plumes): (passive settlement to seafloor and/or active re-invasion of sediment by re-suspended organisms). Initially, the passive settling of organisms surviving entrainment in the dredged material may facilitate primary recolonisation (Morton, 1997).
2) Larval settlement from water column: (active and passive depending larval habitat choice and biology). Recolonisation may also occur via larvae settling, which may be dependent on sediment conditions and is typically slower than adult migration (Skilleter, 1998).
3) Post-colonisation invasion by adults and juveniles: (active from non-disturbed patches, possible in response to new resources). Adult and sub-adult macrobenthic fauna can also actively recruit to the DMPA. This means recolonisation may depend on the mobility of the animals present in adjacent areas i.e. tube dwellers versus mobile burrowers.

While opportunistic species and primary colonisers will commence settlement shortly after disturbance, other less mobile species will take longer to re-colonise the DMPA. Some more mobile surface dwelling fauna such as prawns and shrimps, amphipods, isopods and some worms may move from adjacent undisturbed habitats into the DMPA. Most benthic fauna species have a planktonic stage, and will in time would colonise the DMPA through larval settlement.

During favourable conditions, sparse seagrass assemblages have been observed in the DMPA. These seagrasses would in time also be expected to re-colonise the DMPA. Since seagrass will be completely buried by the placed sediments, it will not be able to re-colonise via asexual vegetative growth. Instead, it is expected that dispersal of seagrass seeds from adjacent areas, together with resident seed banks, will represent the main routes for seagrass recolonisation.

The recovery timescales will depend on the species or assemblage under consideration. In terms of benthic infauna, most studies done in dynamic coastal environments such as the Port of Townsville DMPA, have found relatively rapid recolonisation following dredged material placement (measured in time scales of weeks to months). For example, assessments by Cruz-Motta and Collins (2004) at the Port of Townsville found that assemblages in the DMPA were not different from controls three months after dredging, despite impacts being observed one week after dredging. Sampling at Hay Point found no significant differences in benthos between controls and DMPA sites approximately 2 years after dredging (Hydrobiology, 2003b), but unfortunately sampling intervals were too coarse to determine recovery rates in the short-term.

Recent studies at the Port of Hay Point examined the impacts of capital dredging (and dredged material placement) on seagrass and epibenthic fauna communities (nine months duration), and their subsequent recovery over a 12 month period (Chartrand, Rasheed, & Sankey, 2008). Hay Point is located in the same biogeographic province and has similar habitats and assemblages as those at the Port of Townville DMPA, and results are therefore directly applicable to the present study.

Chartrand *et al.* (2008) found that one of the two seagrass species (*Halophila decipiens*) present prior to dredging was recorded in the DMPA nine months after the completion of dredging and bed levelling activities, but had very low biomass compared to baseline conditions. It was argued that *H. decipiens* and other deepwater seagrass such as *H. spinulosa*, have adaptations that allow it to rapidly recover following disturbance assuming ambient conditions post disturbance return to baseline conditions (see also Section B.6.4.4).

Chartrand *et al.* (2008) also found that the sessile epifauna communities at the DMPA had lower abundance than adjacent 'control' locations during dredging, which they speculated was a result of fauna burial, clogging of feeding and respiratory cilia from sedimentation, or by lack of suitable recruitment habitats. However, they also found that abundances of epifauna at the DMPA were higher than at control sites shortly after the completion of dredging. It was speculated that dredging activities enhanced epifauna abundances, possibly in response to an increase in available nutrients and organic matter. Similar reports of benthic enhancement have been reported in other dredge monitoring studies [e.g. (Jones & Candy, 1981; Poiner & Kennedy, 1984; WBM, 2004)].

B.6.4.3.2 Off-site Impacts

Previous investigations demonstrate that dredged material placed at the existing offshore DMPA rapidly settles and tends to have little effect on areas outside the DMPA (MDG, 1989; Cruz-Motta, 2000). As discussed in the Chapter B3 (Coastal Processes), waves will tend to remobilise placed sediments, resulting in the dispersion of sediments outside DMPA (Benson, Goldsworthy, Butler, & Oliver, 1994; AECOM, 2009). Under normal conditions, only fine sediments will be redistributed, whereas heavier sand fractions may be re-mobilised and dispersed during cyclonic events (TPA, 1995). The dispersal of sediments from the DMPA will occur over long time-frames, subject to the frequency of high energy wave events.

Monitoring of benthic communities in and adjacent the DMPA by Cruz-Motta (2000) indicate benthic macroinvertebrate communities are resilient to changes in morpho-dynamics, and that despite a long history of dredged material placement activities, long-term changes in community structure in or adjacent to the DMPA have not been observed. Rasheed and Taylor (2008) reached similar conclusions regarding the long-term impacts of port activities on seagrass assemblages in Cleveland Bay.

It is therefore expected that the Port Expansion Project will not result in major changes to benthic macroinvertebrate communities and seagrass assemblages outside the DMPA. Monitoring of seagrass and benthic communities will be undertaken to quantify any off-site impacts, as discussed in Section B.6.5.2.

B.6.4.3.3 Mitigation and Residual Effects

The DMP (Chapter C2.1) provides guidance on the mitigation measures that will be adopted to reduce impacts to marine flora and fauna. This includes the following relevant strategies and components:

- A bathymetry survey of the DMPA and immediate surrounds will be undertaken immediately prior to capital dredging in order to optimise the dredged material relocation strategy and to describe baseline conditions.
- Dredge contractor will distribute the dredged material evenly over the DMPA, thereby minimising high spots.
- A bathymetry survey of the DMPA and surrounds will be undertaken to confirm final depths at the completion of the capital dredging campaigns.

The residual risk for dredged material relocation is considered to be Low (refer to 3e in Table B.6.20).

B.6.4.4 Turbidity and Sedimentation Impacts Due to Dredging and Placement

Dredging and dredge material disposal, together with tailwater discharges, will generate turbid plumes that are predicted to occur over areas containing benthic primary producer communities (seagrasses, hard corals) and their habitat, and other marine fauna. Trailer Suction Hopper Dredge (TSHD) dredging of the Platypus and Sea channels has the largest potential to adversely affect these habitats. All other scenarios (i.e. cutter suction dredger, grab dredge, tailwater discharges) either generate insignificant plumes compared to ambient suspended sediment concentrations, or generate plumes that do not coincide with sensitive receptors. The following describes the direct impacts of turbid plumes and sedimentation on marine habitats, and flora and fauna. Note that secondary (flow-on) impacts of habitat and food resource loss/modification to marine fauna species are considered in Section B.6.4.5.

B.6.4.4.1 Hard Coral Assemblages

Tolerances

Sediments generated by dredging may affect corals by smothering associated with the settlement of sediments, and by reducing light availability for photosynthesis. High levels of sedimentation and suspended sediments (light attenuation) can lead to coral stress, which may then lead to disease, reduced calcification and growth rates, and if persistent, coral bleaching and eventually mortality. Thus, the potential effects of sediment include both direct mortality and a range of sub-lethal effects. While coral communities in Cleveland Bay have adaptations to cope with periodic high sedimentation and turbidity levels (e.g. mucous secretions), levels outside the range of natural variability generally cannot be tolerated in the medium to long term.

The risk and severity of impacts from dredging on corals is related to the intensity, duration and frequency of exposure to increased turbidity and sedimentation (Figure B.6.40). As shown in Figure B.6.40, sublethal stress and/or mortality of corals may occur either as result of short-term, high sediment stress levels, or long-lasting chronic exposure to moderate stress (Erftemeijer, Reigl, Hoeksema, & Todd, 2012). Repetitive stress events over an extended timeframe, particularly during periods when corals have low resilience, have the greatest potential for environmental impact.

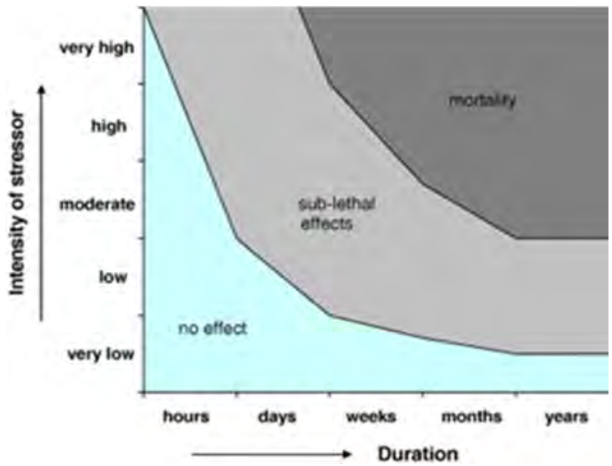


Figure B.6.40 Conceptual relationship between the intensity and duration of a stress event and the risk of sublethal and lethal effects to corals (Erftemeijer, Reigl, Hoeksema, & Todd, 2012)

There are numerous studies describing the light requirements of corals. For example, Cooper *et al*. (Cooper, Ridd, Ulstrup, Humphrey, Slivkoff, & Fabricius, 2008) examined light regimes and coral 'condition' at a near-shore monitoring site at Horseshoe Bay, north Queensland, which included a period of four weeks following a flood event in March to April 2007. They found that turbidity levels >5NTU resulted in approximately 94% light extinction in the water column. The target coral species *Pocilliopora damicormis* showed signs of stress as a result of zero light conditions (i.e. reduction in symbiont densities and colony 'brightness'), however recovery was rapid when 'ambient' light conditions were restored. Cooper *et al*. (2007) quantified the percentage of surface irradiance at which a coral community can exist and reproduce in the Whitsunday region of the Great Barrier Reef. They found that a surface irradiance range of 6 to 8% was required to maintain functional coral communities (Cooper, Uthicke, Humphrey, & Fabricius, 2007).

Erftemeijer and Reigl (2008) reviewed 53 studies examine the sensitivities of corals to total suspended solid concentrations and/or sedimentation, and found that some species in naturally turbid nearshore environments could tolerate total suspended sediment concentrations up to 165 mg/L, and that maximum tolerable sedimentation rates of >300 mg/cm^2/day (over a 14 days period) were found for some species.

Increased sedimentation can cause a range of impacts to coral including smothering and burial of coral polyps, shading, tissue necrosis and population explosions of bacteria in coral mucus (Erftemeijer, Reigl, Hoeksema, & Todd, 2012). A review of case studies by Erftemeijer *et al*. (2012) found that maximum sedimentation rates that can be tolerated by corals ranged from <10 mg/cm^2/day to >400 mg/cm^2/day. The durations that corals can survive high sedimentation rates range from <24h for sensitive species to a few weeks (>4 weeks of high sedimentation or >14 days complete burial) for very tolerant species.

Flores *et al*. (2012) reported full colony mortality at sedimentation rates of 25 mg/cm^2/day (for the sensitive horizontal foliose species *Montipora aequituberculata*) and 83 mg/cm^2/day (for the upright branching species *Acropora millepora*) over a 16 week period. Both of these species are found in Middle Reef and Magnetic Island reefs (Appendix K2 - Marine Ecology Baseline Report). *Turbinaria mesenterina*, a dominant coral taxa at most reefs in Cleveland Bay (Appendix K2), is highly tolerant of sedimentation, with sediment loads greater than 110 mg cm^2 having no effect over a 5 week period (Sofonia & Anthony, 2008).

In addition to acute and chronic physiological effects, high rates of sedimentation can also lead to other effects to populations by reducing recruitment rates (Rogers, 1990; Thompson, Davidson, Uthicke, Schaffelke, Patel, & Sweatman, 2011). High rates of sedimentation during the peak summer recruitment period therefore have the potential to impact on coral community structure.

Gilmour *et al*. (2006) examined the susceptibility of different coral genera to changes in light regime and sedimentation, and developed preliminary estimates of the loads and durations of sedimentation and turbidity likely to cause increasing levels of impact to corals (Figure B.6.41). In terms of dominant coral taxa found in Cleveland Bay, Gilmour *et al*. (2006) found that:

- *Monitopora*, Agaricidae, Pectiniidae, *Acropora* (plating) and other plating/encrusting corals were found to be most susceptible to sedimentation and turbidity. These taxa had a low to moderate cover at most Cleveland Bay reefs.
- Branching forms of *Acropora*, the dominant coral at most sites, was classified as having medium susceptibility to major changes in light regime and sedimentation.
- Faviidae and Poritidae corals, which were sub-dominant at most reefs in Cleveland Bay (except Cockle, where Faviidae was dominant during 2012 surveys), was classified as having medium susceptibility to major changes in light regime and sedimentation.
- *Turbinaria*, which is typically a sub-dominant genus at Cleveland Bay (except in 2012 at Nelly Bay, when it was dominant), was described as have low susceptibility to major changes in light regimes and sedimentation. *Fungia*, *Gonipora*, *Galaxea*, *Pavona*, branching *Porites* and other branching corals were also considered to have low susceptibility to major changes in light regimes and sedimentation. These were also sub-dominant taxa in Cleveland Bay reefs (Appendix K2 - Marine Ecology Baseline Report).

The numerical dominance of taxa that are tolerant of low light regimes and high rates of sedimentation is not unexpected given ambient conditions experienced in Cleveland Bay. As discussed in Chapter B4 (Marine Water Quality), coral communities in Cleveland frequently experience low light conditions that can extend for periods measured in weeks.

SKM (2011) reviewed case studies of coral tolerances to low light levels in order to formulate impact prediction thresholds for a major dredging project in the Port Hedland region of Western Australia. Like Cleveland Bay, coral communities in the Port Hedland area experience low light and high sedimentation levels, and are considered to be high turbidity and sedimentation adapted communities. On the basis of the case-studies they investigated, SKM (2011) concluded that the loss of light for periods of from 10 to 28 may cause sub-lethal stress to studied corals, but did not lead to mortality.

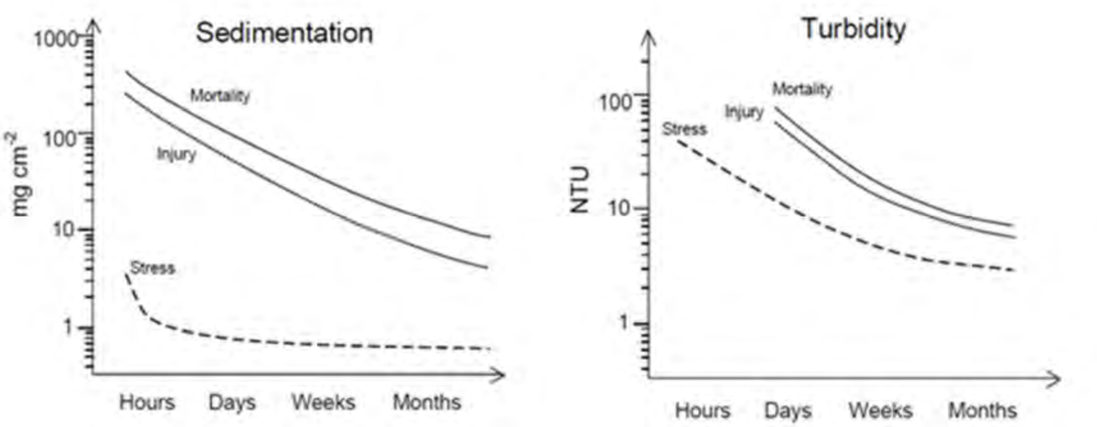


Figure B.6.41 Preliminary estimates of the loads and durations of sedimentation and turbidity likely to cause increasing levels of impact to corals. The curves apply to relatively 'tolerant' species of corals from inshore reefs in the Pilbara region (Source: Gilmour et al. 2006)

Monitoring of the 1993 Capital Dredging Campaign

Previous monitoring studies examining impacts from the placement of dredge material associated with the 1993 capital dredging of Platypus Channel provide a basis for determining potential impacts associated with the Port Expansion Project. The two projects involved broadly similar dredging activities (Table B.6.11).

Table B.6.11 Comparison of PEP and 1993 Port Expansion

	1993 Dredging Campaign	PEP

Works description	capital dredging of the harbour and existing Platypus and Sea channels disposal of dredged material at the existing DMPA reclamation for the development of nearshore port facilities	capital dredging of the harbour capital dredging of existing Platypus and Sea channels, and channel extension area disposal of dredged material at the existing DMPA reclamation for the development of nearshore port facilities
Dredge type	TSHD – 5000 m^3 capacity (no green valve employed)	TSHD – 10,000 m^3 capacity (green valve to be employed)
Duration of dredge campaign	11 weeks	11 weeks (including 2 week environmental delay contingency = approx. 9 weeks)
Timing of dredging	Summer	Winter preferred (see below)

Consistent with the Port Expansion Project, the 1993 port expansion included harbour dredging, extensive dredging of the navigation channels, and reclamation for the development of nearshore port facilities. Both projects involved the use of a trailer suction hopper dredger (TSHD)[5], however the capacity TSHD to be used in the Port Expansion Project is larger. The TSHD proposed for the Port Expansion Project would employ a green valve to mitigate turbidity impacts; however no green valve was used in the 1993 port expansion. The duration of the 1993 (Stage 1) capital dredging campaign was approximately 11 weeks (Benson, Goldsworthy, Butler, & Oliver, 1994), similar to the duration of channel dredging for the Port Expansion Project. It is noted that the 11 weeks of dredging for the PEP includes two weeks of non-dredging for environmental delays (note that modelling conservatively assumes that dredging will occur over the entire 11 week program).

Larcombe and Ridd (1994) described the findings of the turbidity monitoring program for the 1993 capital dredging campaign. In summary:

- Dredge related effects were identified in outer Cleveland Bay, with dump events resulting in TSS values up to 50 mg/L and lasting periods measured in hours, and swell induced re-suspension of sediments raised TSS for periods measured in hours to days.
- Sediment trap data indicated that there were periods where dredging resulted in detectable increases in sediment accumulation, particularly where rough seas resulted in the re-suspension of dredged material. It was noted however that the sediment traps used in the monitoring program do not measure erosion events, nor sediment fallout from the water column.
- Magnetic Island reef sites were observed to be periodically affected by turbid plumes generated by dredging, however the authors noted that 'no extreme suspended sediment concentration occurred at any of the Magnetic Island bay sites as a direct result of dredging' and 'given available data, dredge related effects appear to lie within normal variation at seagrass sites in SE Cleveland Bay and the coral systems at Middle Reef.'
- Cleveland Bay is well flushed by offshore waters. Tidal currents generate eddies which effectively flush sediments from the embayments of Magnetic Island. Therefore, even when wind-waves resuspend sediments, tidal currents are able to advect turbid water offshore.

Taking into account the findings of sediment and biological monitoring studies, Larcombe and Ridd (1994) concluded that the fringing reefs of Cleveland Bay appear to be adapted to moderate to high levels of turbidity and sedimentation. They suggested that prolonged TSS values of up to 30 mg/L appear to be acceptable in most fringing reef situations, and that acute levels of over 100 mg/L may not cause permanent damage if maintained for no more than one or two tidal cycles and not accompanied by high sedimentation rates. Levels of 100 mg/L were not measured in their study at reef sites. Furthermore, it was suggested that threshold value for chronic stress of 150 mg/cm^2/day (using sediment traps – see below regarding background values using other equipment). The sedimentation rates recorded by Larcombe and Ridd (1994) were within the range reported in previous studies at these and other fringing reef sites, which they suggested 'implied little or no impact of corals at these sites'.

[5] A mechanical dredge will also operate for 14 weeks in parallel with the TSHD

Kaly *et al.* (1994) examined the impacts from dredging and material placement on coral abundance at impact sites around Magnetic Island through monitoring prior, during and after the dredging and dumping campaign. The study reported, 'few impacts of dredging on percentage cover by corals and algae were detected'. Of the coral communities observed, Faviidae corals and soft corals showed declines in abundance which they considered were likely to be attributable to impacts from dredging. Other changes in coral abundance (*Montipora* and total hard coral cover) were not attributable to dredging, and observed declines in macroalgae at putative impact sites were interpreted as being a potential artefact of the sampling design (i.e. control sites had low macroalgae cover throughout the monitoring period).

Stafford-Smith *et al.* (1994) undertook a reactive coral monitoring program to determine the short term response to turbidity on four coral species (selected by an expert panel) at locations around Magnetic Island most likely to be impacted by dredging and dredge material placement. The aims and design of the study sought to distinguish impact-related changes to coral health compared to impacts which might be occurring naturally through monitoring a range of impact sites on the eastern side of Magnetic Island and Middle Reef and control sites unlikely to be affected by dredging at Rattlesnake Island and Bay Rock. Data on partial mortality and white bleaching were collected weekly in relation to pre-determined threshold criteria that were reviewed by an expert panel and provided for immediate action to be taken (e.g. the cessation of dredging and material placement) if decision thresholds were exceeded.

The key thresholds for implementing contingency actions (e.g. immediate action and review panel thresholds) were not exceeded during the dredging and dredged material placement programme (Stafford-Smith, Kaly, & Choat, 1994). Impacts attributed to the dredging and placement reported as part of the study included:

- Partial mortality of individual colonies at principal impact locations was less than 12% of colony tissue area;
- Evidence of stress (in the form of moderate bleaching) was observed in one transect species at Geoffrey and Florence Bays (indicating the species likely came close to its tolerance limit); and
- Potential stress was greatest during the month of February when natural adverse conditions were prevalent (e.g. spring tides, strong winds, ground swell and/or persistent low light due to high ambient turbidity). They recommended that major dredging should be avoided or closely monitored when such adverse conditions coincide.

Background TSS Conditions

As discussed in Chapter B4 (Marine Water Quality), TSS levels and sedimentation rates are largely driven by variations in the wind-wave climate and rainfall, which vary seasonally. It is expected that corals may be closer to their critical light limits and sedimentation tolerance limits during wet periods with high winds than low wind, dry periods.

Baseline monitoring indicates that reefs of Cleveland Bay experience periodic high TSS concentrations. In this regard:

- Background TSS measurements undertaken by Belperio (1978) near south-east Magnetic Island found TSS concentrations were 10 to 20 mg/L under moderate wind conditions (18 to 25 km/hour winds), and TSS concentrations were >50 mg/L under rough wind conditions (27 to 34 km/hour winds).
- Hopley and van Woesik (1988 in Larcombe and Ridd 1994) found that TSS concentrations at Cleveland Bay reefs varied depending on wind speed. Winds <20 knots (1m off the seabed) had TSS concentrations of:
    - 37 to 58 mg/L (50 m from reef front) and 40 to 72 mg/L (20 m from the reef front) at Nelly Bay;
    - 44 to 77 mg/L at southern Geoffrey Bay; and
    - 44.1 to 115 mg/L off Bright Point.
- Monitoring carried out in 2008 to 2009 indicates that the median, 80th, 95th and 99th percentile TSS values at Geoffrey Bay were 11, 17, 41 and 62 mg/L respectively during dry, calm conditions, and 15, 57, 145 and 308 respectively mg/L during windy wet conditions.

Baseline monitoring indicates that light extinction at the base of reefs in Cleveland Bay occurs at approximately 20 to 30 mg/L, which falls between the median and 80th percentile baseline values (Chapter B4 – Marine Water Quality).

While light extinction in shallow waters would occur at higher TSS values, impacts to deeper water corals would be expected to occur when TSS levels are between 20 to 30 mg/L (Chapter B4 – Marine Water Quality). These TSS values are similar to the critical TSS threshold developed by Mapstone *et al*. (1989), and subsequently adopted by GBRMPA, for the control of dredging activities relating to the Magnetic Quays development.

Background Sedimentation Levels

Browne *et al*. (2012) measured seasonal variations in sedimentation at Middle Reef and Paluma Shoals (located in Halifax Bay). At Middle Reef, sedimentation rates varied between 30 to 74 g/m^2/day, which were lower than previously reported for Middle Reef and other inshore turbid reefs in the GBR. For example, sediment trap data from Middle Reef collected before dredging recorded sedimentation rate of 270 g/m^2/day (Larcombe, 1994). Sedimentation rates recorded at fringing reefs of Magnetic Island varied between 26 to 3640 g/m^2/day (Mapstone *et al*. 1992 in Larcombe and Riff 1994). Browne *et al*. (2012) suggested that differences between studies reflecting differences in sampling methods. In this regard sediment traps used in earlier studies modify hydrodynamics and not allow for natural resuspension of sediments, whereas those used by Browne *et al*. (2012) allowed natural resuspension of sediments.

Browne *et al*. (2012) found that highest sedimentation rates occurring along the eastern windward reef edge of Middle Reef. In general, the dry winter and autumn months typically had lower sedimentation rates than wet summer months. Sedimentation rates at Middle Reef remained low during strong SE and NE wind periods (>20 km/hour), reflecting natural resuspension of sediments by wave action.

Professor Peter Ridd from James Cook University (in BMT WBM 2009) measured accumulated sediment surface density at sites throughout Cleveland Bay during October 2008 to May 2009. For most of the time, accumulated sediment surface density was <0.1 mg/cm^2/15 minute period and during periods when sediment deposition was >1 mg/cm^2/15 minutes winds were typically between ~8 and 35 km/hour, with the strength of this pattern varying among sites. The influence of wind on accumulated sediment surface density was not readily apparent at the Strand (i.e. site 6), where high accumulated sediment surface density levels were recorded at low and high wind speeds.

Overall, the accumulated sediment surface density results indicate that low and high wind speeds were generally associated with low deposition, with higher levels of deposition occurring between these two extremes. Little or no sediment re-suspension will occur at low wind speeds and associated low wave action. Hence, deposition of sediment is expected to be low. On the other hand, strong winds and associated high wave action keep the sediment in suspension, resulting in low levels of deposition.

Table B.6.12 Site descriptions and seasonal variations in sedimentation rates for sites around Middle Reef, and calculations for mean seasonal and annual sediment deposition rates, resuspension rates, and two-way total sediment flux. Source: (Browne, Smithers, Perry, & Ridd, 2012)

	Middle Reef					Paluma Shoals	
Reef							
Site description	Eastern windward	Western windward	Western central	Leeward	Windward	Reef flat	Leeward
Exposure to dominant waves	High	Medium	Low	Medium to low	High	High	Low
Depth (m) at LAT	−3	−3	−3	−2	−2.5	0.5	−1.5
Hard coral cover (%)	82	60	27	51	31	23	39
Dominant corals	*Acropora, Montipora*	*Gonipora, Acropora*	*Montipora, Acropora, Turbinaria, Pachyseris*	*Gonipora, Acropora*	*Turbinaria, Acropora, Montipora*	*Goniastrea, Platygyra, Porites*	*Galaxea, Goniastrea, Porites*
Sediment dynamics							
Dominant sediment mode (µm)	350–710	90–400	30–150	20–90	50–250	710–1200	10–90
Sediment description	Medium to coarse sand	Very fine to medium sand	Medium silt to fine sand	Medium to very coarse silt	Coarse silt to medium sand	Coarse sand to very fine gravel	Medium to very coarse silt
Sedimentation rate (g/m²/d, *D*)							
Spring (Sep–Nov)	0 ± 0.0	51.4 ± 0.3	98.6 ± 13.0	29.1 ± 0.0	0.0 ± 0.0	0.9 ± 0.2	62.6 ± 24.0
Summer (Dec–Feb)	27.4 ± 6.7	1.3 ± 0.2	72.0 ± 10.1	8.6 ± 2.1	2.8 ± 1.0	1.5 ± 0.0	14.0 ± 10.0
Autumn (Mar–May)	78.2 ± 5.2	39.8 ± 0.2	109.5 ± 7.0	30.0 ± 4.3	13.4 ± 8.3	1.2 ± 0.0	85.8 ± 70.0
Winter (Jun–Aug)	61.0 ± 18	42.9 ± 3.6	14.8 ± 5.9	51.4 ± 10.0	26.4 ± 8.9	0.0 ± 0.0	324.1 ± 105
Mean sedimentation rate (g/m²/d, D_S)	41.7	33.8	73.7	29.8	10.6	0.9	121.6
Net annual sediment deposition (g/m²/d, D_A)	23.3	8.1	62.1	4.7	0.0	0.0	44.1
Seasonal sediment resuspension function (%, R_{FS})	94	20	27	73	79	87	67
Seasonal sediment resuspension rate (g/m²/d, R_S)	626	9	27	80	40	6	251
Annual sediment resuspension function (%, R_{FL})	44	76	16	84	100	100	64
Annual sediment resuspension rate (g/m²/d, R_A)	18	26	12	25			78
Two-way sediment flux (g/m²/d, *F*)*	644	34	38	105			329

* The two-way total sediment flux cannot be calculated for the reef flat and windward location at Paluma Shoals due to 100% annual resuspension fractions.

Impact Criteria

Numerical modelling results for TSS and sedimentation are described in Chapter B4 (Marine Water Quality) and Appendix H1 (Technical Modelling Report), respectively.

There are a number of approaches to develop impact thresholds for corals (e.g. DHI in Chevron 2010; McArthur *et al*. 2002). For the purposes of this EIS, potential impacts to corals as a result of TSS and sedimentation were determined on the basis of the following:

a) <u>Acute (pulsed) TSS impacts</u>

- The McArthur *et al*. (2002) threshold values outlined in Chapter B4 (Marine Water Quality) provide an approach for examining potential impacts to corals and seagrass. Impact thresholds values are based on the 95th percentile of baseline data. These threshold values cannot be directly compared to modelled TSS values given that modelling outputs do not take into account background levels. To compensate for this, the median background TSS value was subtracted from the 95th percentile background value, which was then compared to modelled (above background) TSS values. For the purposes of this assessment, the 95th percentile excess (i.e. above background) TSS that is greater than the derived threshold value has been adopted as an indicator of **potential** acute (pulse type disturbance) TSS impacts.
- A TSS concentration of 25 to 30 mg/L has been suggested to represent a critical threshold for corals (e.g. Mapstone *et al*. 1989; Ridd and Larcombe 1994; DHI in Chevron 2010). As described in Chapter B4 (Marine Water Quality), TSS concentrations of 25 to 30 mg/L are

expected to result in total light extinction at the base of deepwater reef areas (7 to 8 m), and reduced light in shallower sections of the reef. Based on TSS monitoring data, levels above 30 mg/L occur frequently mostly in response to wind-wave driven sediment re-suspension. Long-term (200 days) TSS measurements at Middle Reef (Lambrechts, et al., 2010) found that TSS ranged from approximately 5 to 50 mg/L, with events resulting in values >30 mg/L generally at once to three times a month during winter, and can last up to 1 to 6 days. For the purposes of this assessment, an average daily excess (i.e. above background) TSS of >20 mg/L > 3 days duration > 1 time per month has been adopted as an indicator of **potential** acute (pulse type disturbance) impact.

b) Chronic TSS impacts

- While corals of Cleveland Bay are adapted to turbid waters, sustained periods of low to moderate TSS can reduce light availability for corals. A chronic threshold value of 5 mg/L has been conservatively selected. For the purposes of this assessment:
  - average daily potential TSS >5 mg/L >50% of the entire dredge campaign has been adopted as an indicator of **likely** chronic (press-type disturbance) TSS impacts.
  - average daily excess TSS >5 mg/L >50% of the time in any fortnight has been adopted as an indicator of **potential** chronic (press-type disturbance) TSS impacts. This is the functional equivalent of a Zone of Partial Mortality indicator developed by DHI (2010).

c) Sedimentation impacts

Different approaches to measuring and modelling approaches produce different estimates of sedimentation levels. Modelling results presented in the Technical Modelling Report (Appendix H1) show net deposition levels at 15 minute time-steps, which take into account both deposition and erosion of sediments by waves and currents. These are expressed in mm per time period. Sediment deposition rates outlined in Table B.6.12 also provide a measure of net deposition (allowing for sedimentation and erosion), and as discussed above, earlier monitoring studies using sediment traps modify hydrodynamics and may either over-estimate or underestimate rates (depending on type of equipment used). These monitoring studies express deposition as grams or kilograms per m^2 per day.

Threshold values developed by DHI (DHI, 2010), which are based on coral tolerance limits, are as follows:

- Net deposition above background >17.5mm/14 day[6] (>500 g/m^2/day) – **likely** impact; and
- Net deposition above background 3.5 to 17.5 mm/14 days (100 to 500 g/m^2/day) – **possible** impact.

As outlined in Table B.6.12, mean sedimentation rates measured at Middle Reef by Browne *et al*. (2012) range from 30 to 74 g/m^2/day, and are far lower than recorded using sediment traps (on which DHI threshold levels are based). For this reason, direct comparisons of data from Browne *et al*. (2012) to values to DHI (2010) are not likely to be meaningful.

Potential Impacts (Unmitigated Case)

The maps below show the predicted 95th percentile values for TSS (above background) during summer and winter over the duration of the dredging campaign (refer to Chapter B4 and Appendix H1for details). The 95th percentile value is approaching the maximum value (i.e. TSS concentrations above this level are predicted to occur 5% of the time), and is therefore a highly conservative measure of plume concentrations. Plots are also provided for the median TSS (above background) concentrations for both winter and summer periods.

Modelling predicts that TSS concentrations generated by dredging activities (above background) will be greater during winter than in summer for expected case scenarios. In summary, for the expected case:

- During winter (Figure B.6.42), it is predicted that reefs south of Geoffrey Bay to the western extent of Cockle Bay, as well as Middle Reef and Virago Shoal, would be periodically (i.e. 95th percentile) influenced by dredge plumes with a TSS >20 mg/L above background. The north-eastern Magnetic Island reefs (Gowrie Bay, Florence Bay, Arthur Bay and Orchard Rocks) are predicted to have a 95th percentile TSS <15 mg/L.

---

[6] DHI (2010) the conversion from kg/m^2/day to mm/14 days of initial dry density of 400 kg/m^3

- During winter, it is predicted that the median TSS concentration at reef sites would be less than 5.5 mg/L (Figure B.6.43). Geoffrey Bay is predicted to have the highest median TSS concentration (5.2 mg/L), whereas as all other reef sites had median TSS values less than 4 mg/L. Assuming background concentrations of 11 to 15 mg/L at the eastern side of Magnetic Island, it is predicted that deep water corals at Geoffrey Bay and Nelly Bay would experience low to moderate light conditions for >50% of the dredge campaign.
- During summer (Figure B.6.42), it is predicted that the 95th percentile above background TSS concentrations would be <13 mg/L at reef sites along the northern and eastern side of Magnetic Island. Reefs south (and inclusive) of Geoffrey Bay are predicted to have a 95th percentile above background TSS concentrations of 12 (Geoffrey and Nelly Bay) to 20 mg/L (Middle Reef).
- During summer, it is predicted that median TSS concentrations at reef sites would be <6 mg/L. Geoffrey Bay is predicted to have the highest median TSS value (5.7 mg/L), which is slightly greater than predicted for winter (5.2 mg/L).

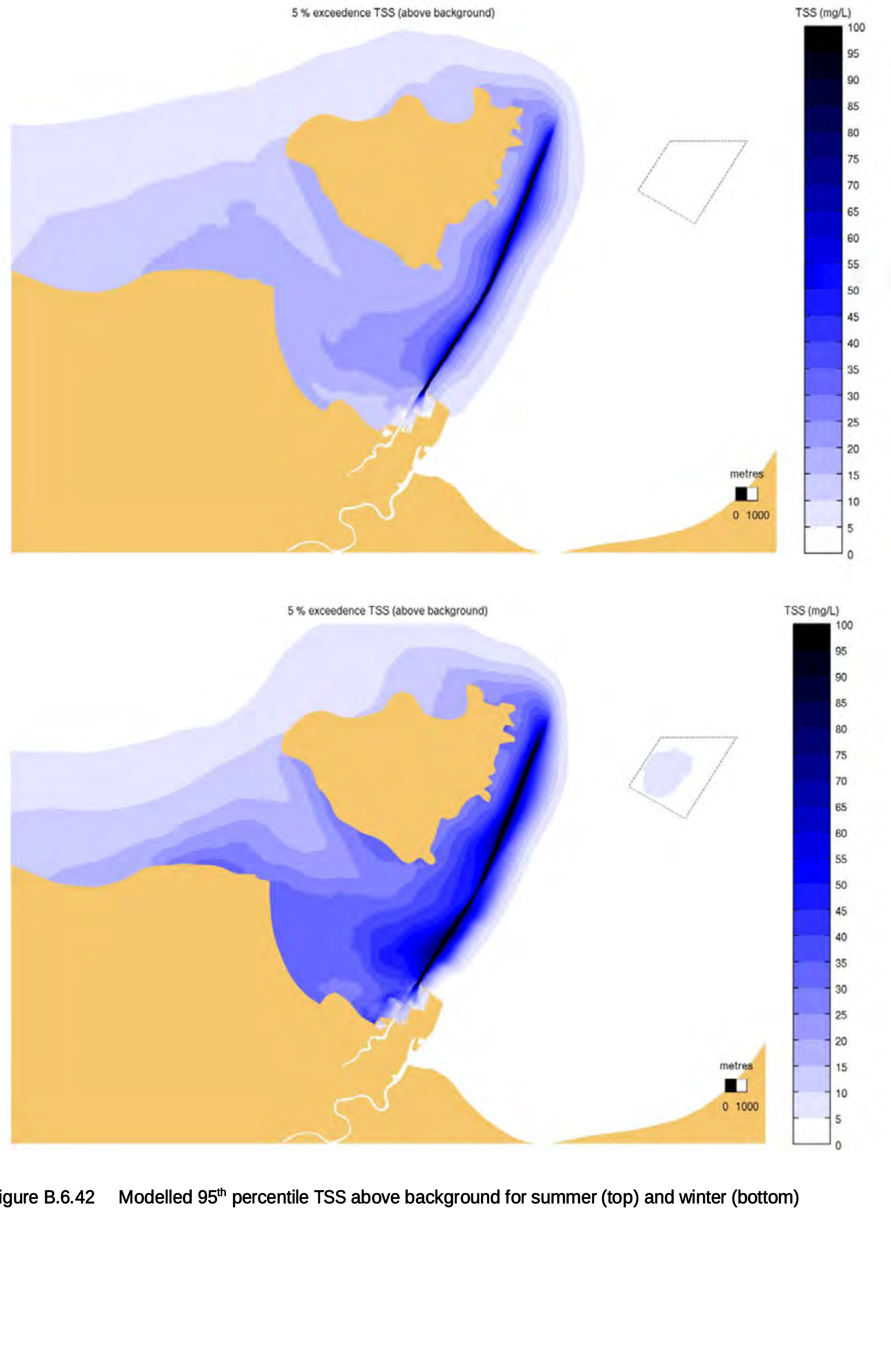
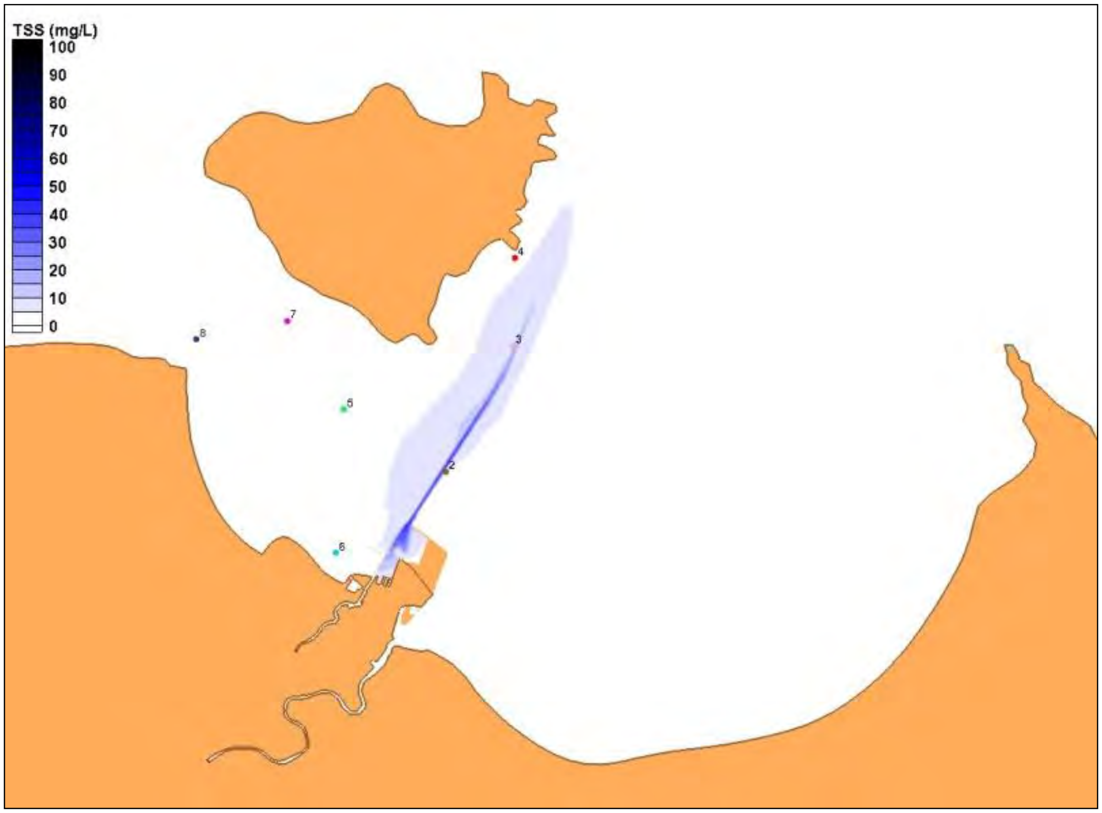


Figure B.6.42 Modelled 95th percentile TSS above background for summer (top) and winter (bottom)



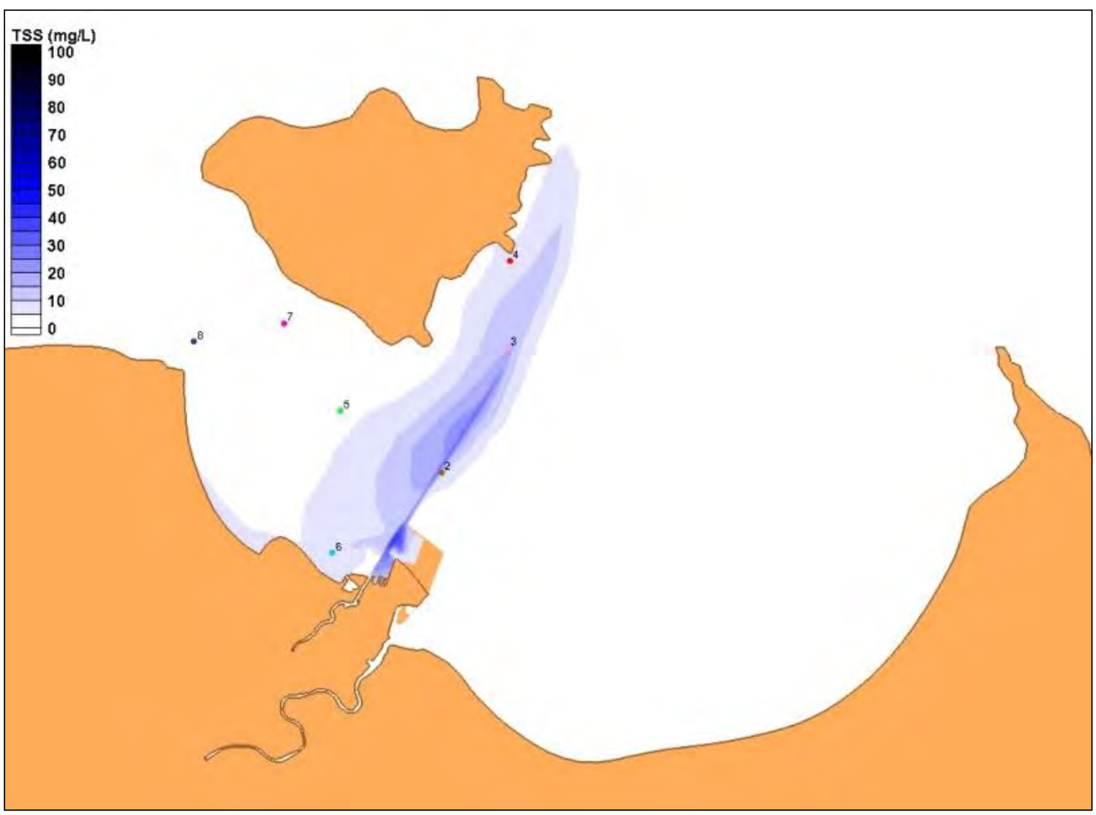


Figure B.6.43 Modelled median TSS above background for summer (top) and winter (bottom)

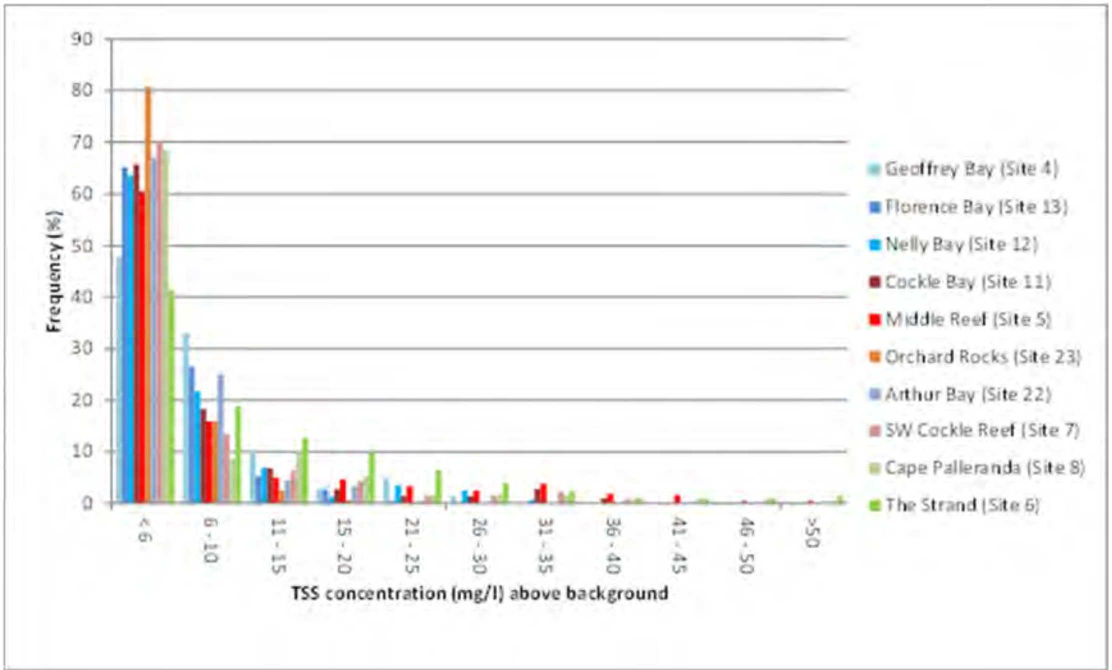
Figure B.6.44 shows the distribution of predicted TSS concentrations (above background) during winter and summer. At reef sites, TSS was $\leq$5 mg/L for more than 45% of the time, and <10 mg/L for more than 75% of the time. The summer simulation indicated that TSS values were consistently lower in summer than in winter at reef and seagrass sites.

Table B.6.13 provides summary statistics showing the number of exceedances of the nominal acute and chronic stress impact criteria discussed above. In terms of potential acute impacts due to highly elevated TSS:

- The predicted TSS levels generated by dredging at reef sites were within the range of background conditions recorded during moderate and rough weather conditions. During such periods corals are expected to be light limited, and may need to draw on energy stores to support metabolism.
- Modelling predicts that while there were periods of high TSS (>20 mg/L) extending > 3 days (maximum 3.8 days), such periods were predicted to occur a maximum of once per fortnight (Figure B.6.45). Based on long term monitoring at Middle Reef and other reef sites throughout Cleveland Bay, high winds can result in long periods of high TSS (1 to 6 days duration) regularly occur once or twice a fortnight, particularly during winter. Therefore, the frequency and duration of high TSS periods due to dredging are consistent with temporal patterns in background TSS.
- As outlined in Chapter B4 (Marine Water Quality), the periods when high TSS due to dredging are elevated generally coincide with high winds. High wind periods also result in background TSS levels that are naturally high, and PAR levels are expected to be at or near zero in deeper reef habitats. During such high wind periods, corals are expected to already be light limited.

While corals are adapted to periodic high TSS values, sustained periods of low to moderate TSS due to dredging and/or background sediment resuspension can result in reduced light and impacts to coral. Modelling predicts that over the total duration of the dredging campaign, for more than 50% of the time TSS will be < 5 mg/L above background at most reef sites. The exception to this was Geoffrey Bay during winter, where the median TSS is predicted to be 5.2 mg/L above background (Table 13; Figure B.6.44). Furthermore, the median TSS values at several reef sites are predicted to be greater than 5 mg/L on 1 to 3 fortnights during the dredge campaign. Such conditions could promote coral stress and possibly colony mortality of some of the more sensitive species (e.g. *Montipora*).

The response of corals to high TSS levels will depends on their condition, which is thought to be mainly a function of ambient water quality conditions in the period before, during and after dredging activities. While the summer period is predicted to result in the smallest dredge plume, corals can experience high levels of natural stress during such periods as a result of (i) thermal stress due to high water temperatures, (ii) low salinity and high turbidity associated with floods. Magnetic Island corals in particular can experience thermal stress and bleaching during summer, and are expected to be more susceptible to impacts from high TSS at this time (Section B.6.4.4).



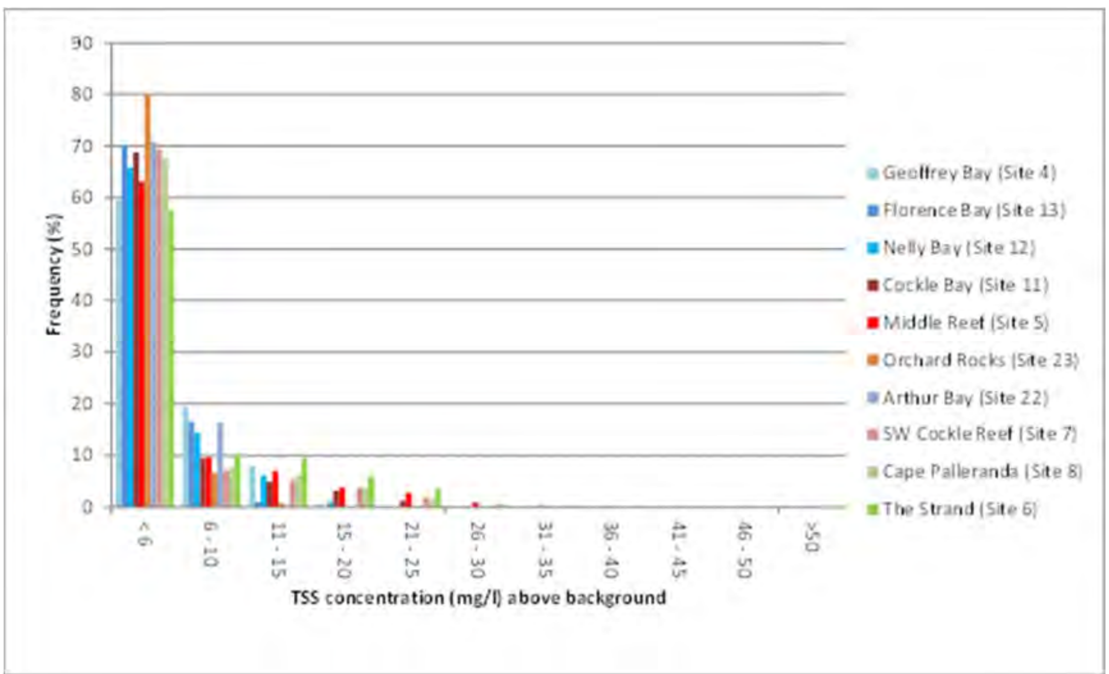
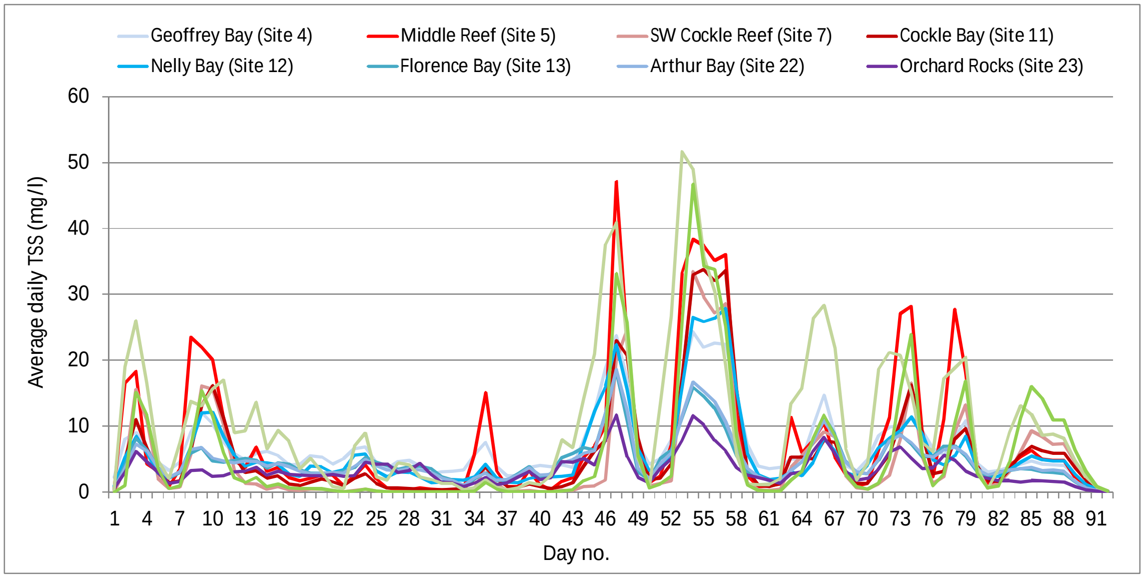


Figure B.6.44 Frequency distribution of predicted TSS (mg/L) concentrations (above background) during winter (upper) and summer (lower)



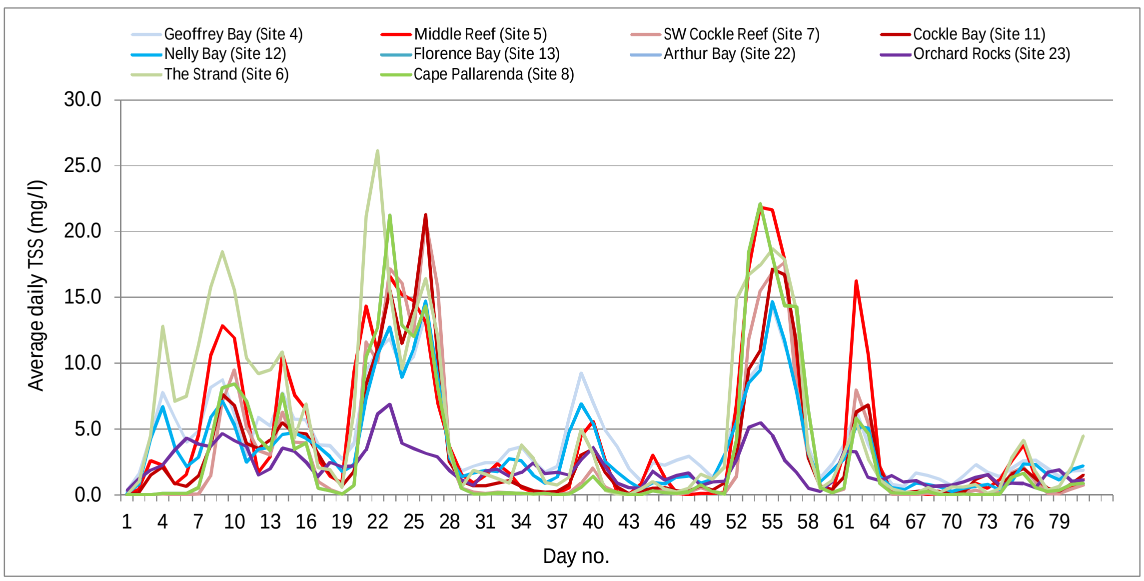


Figure B.6.45 Time series of predicted average daily TSS (mg/L) concentrations (above background) during winter (upper) and summer (lower)

Table B.6.13 Number of exceedances of nominal acute and chronic stress indicators

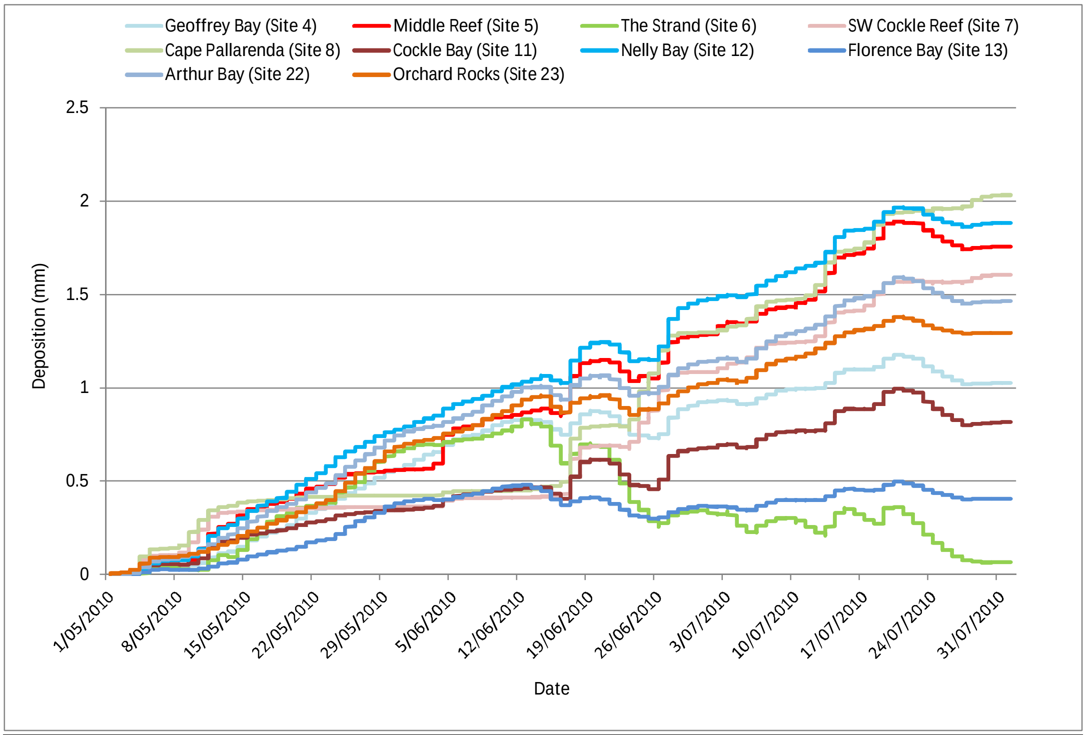
Site	Simulation	Acute stress indicators		Chronic stress indicators	
		TSS of >20 mg/L > 3 days duration > 1 time per month*	95th percentile TSS > McArthur threshold*	Average daily TSS >5 mg/L >50% of the dredge campaign*	Average daily TSS >5 mg/L >50% of any fortnight**
Orchard Rocks	Summer	0	0	0	0
	Winter	0	0	0	1
Florence Bay	Summer	0	0	0	0
	Winter	0	0	0	2
Geoffrey Bay	Summer	0	0	0	2
	Winter	0	0	1 (5.2 mg/L)	3
Nelly Bay	Summer	0	0	0	0
	Winter	0	0	0	2
Cockle Bay	Summer	0	0	0	0
	Winter	0	1	0	1
SW Cockle Bay	Summer	0	0	0	0
	Winter	0	0	0	0
Middle Reef	Summer	0	0	0	1
	Winter	0	0	0	2
Palleranda	Summer	0	0	0	0
	Winter	0	0	0	1
The Strand	Summer	0	0	0	2
	Winter	0	0	1 (7.1 mg/L)	4

Symbols * 0 = not exceeded, 1 = exceeded. ** number represents frequency of exceedances

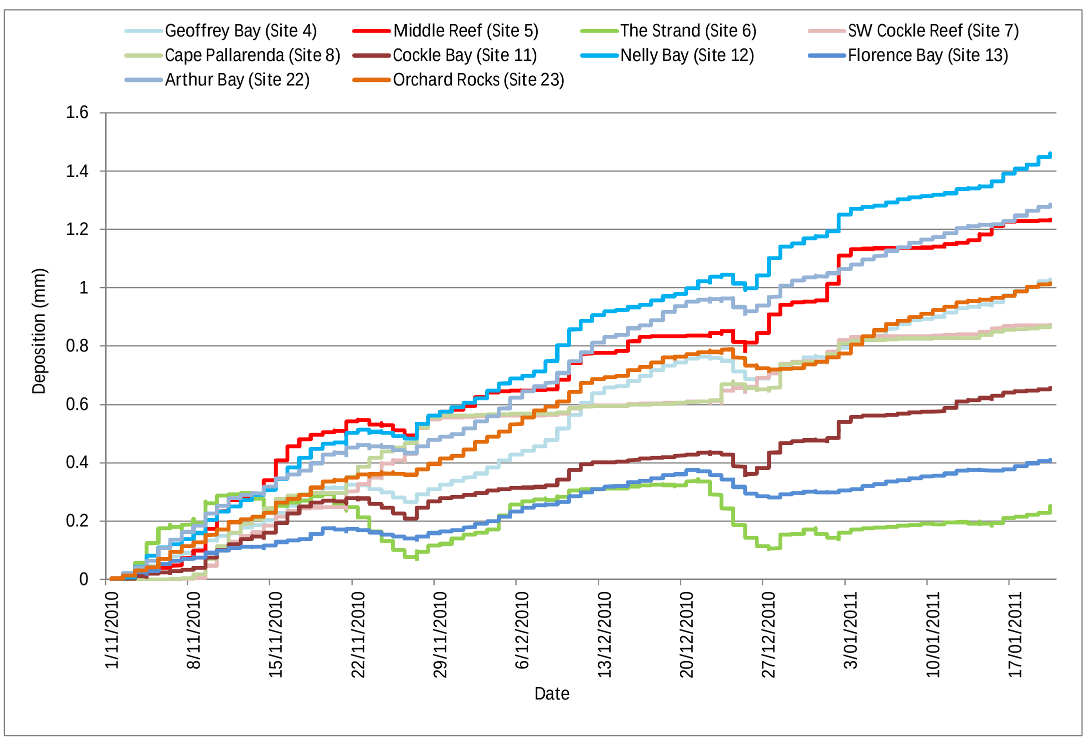
Overall, it is predicted that coral stress and possibly mortality could occur if channel dredging was carried out when corals are under stress from environmental factors.   This is particularly the case for reefs on the north-eastern margin of Magnetic Island, which are predicted to experience low to moderate TSS levels for most of the duration of the dredge campaign for the dredged channel.

Sedimentation

The predicted depth of sediment accumulation in areas containing corals is predicted to range from 0.01 mm to 0.6 mm over a month modeling period (Figure B.6.46). The relatively low sedimentation levels in these areas indicate that tidal currents and waves will tend to resuspend any fine sediment that fall on these areas. These results are consistent with the findings of experimental dredging studies carried out by SKM (1992), which showed that sedimentation of reef slopes were low (mean = 8.5 mg/cm^2/day). Similarly, based on the criteria adopted by DHI (in Chevron 2010), it is predicted that no areas of coral will be undergo broad scale mortality as a result of sedimentation as modelled sedimentation rates are below the limits of the zone of influence.



Winter



Summer

Figure B.6.46 Predicted net deposition (above background) for winter (top graph) and summer (bottom graph) periods

The sedimentation model used in the present study does not account for small small-scale micro-topographical reef features (crevices, fissures etc.), which can represent areas of accumulation that may not be well flushed. It is possible that corals may not be able to remove this sediment through mucus secretion, resulting in patches of coral experiencing reduced growth or mortality as a result of sedimentation.

Potential Impacts (Unmitigated Case)

In the absence of mitigation, there is potential for TSS (and to a lesser extent sedimentation) generated by dredging to cause adverse impacts to corals on the eastern side of Magnetic Island (and possibly Middle Reef). This is especially the case if dredging was undertaken during a period when corals have low resistance due to natural climatic processes.

As discussed in Section B.6.3.5, background temporal patterns in coral community structure shows cyclic patterns that reflect periods of major climate-induced disturbances (i.e. high water temperatures, floods and severe storms/cyclones) and subsequent recovery. These communities have high levels of resilience, as indicated by the apparent stability in community structure over longer timeframes. Coral communities of Cleveland Bay therefore have a high capacity to recover from episodic disturbances.

In recent times, coral recruitment levels have been low at investigated reefs (Middle Reef and Geoffrey Bay), suggesting that recent poor water quality conditions have reduced resilience levels in these communities. Recovery times from any dredging impact are therefore expected to be greater (measured in years) following periods when corals are recovering from large-scale major climatic disturbances (Section B.6.3.5).

Based on these findings, a precautionary approach will need to be adopted in the dredging campaign to reduce the risk on impacts to corals (refer to Mitigation section below).

B.6.4.4.2 Seagrasses

Tolerances

The seagrass species that occur in Cleveland Bay have a relatively high light requirement, typically requiring between 10 and 30% of surface irradiance for survival (Erftemeijer & Lewis, 2006). Specific tolerances to light deprivation vary among seagrass species, as follows:

- *Halophila ovalis* is the most common deepwater species in Cleveland Bay (Section B.6.3.4) and is known to be among the most sensitive species to increased turbidity and associated light attenuation (Longstaff, Loneragan, O'Donohue, & Dennison, 1999). This species can show signs of stress after several days of complete light attenuation and mortality within 30 days of complete attenuation (Longstaff, Loneragan, O'Donohue, & Dennison, 1999).
- Species of *Halodule* appear to be more tolerant to light deprivation that *H. ovalis*, with congener *Halodule pinifolia* surviving up to 3 to 4 months following complete light attenuation (Longstaff, Loneragan, O'Donohue, & Dennison, 1999). However, no information is available for *Halodule uninervis*, which occurs in Cleveland Bay.
- *Zostera muelleri* is present in the nearshore areas of Cleveland Bay and can survive up to a month at low light levels (5% surface irradiance) (Grice, Loneragan, & Dennison, 1996), but requires 30% surface irradiance for long-term survival. With a light attenuation coefficient (Kd) of 0.9 m^{-1} or less, <10 mg/L TSS are required to sustain *Z. muelleri* in Moreton Bay (Abal & Dennison, 1996). Studies of seagrasses in tropical regions have indicated that genera such as *Zostera* have significantly greater light requirements (Grice, Loneragan, & Dennison, 1996; Bach, Borum, Fortes, & Duarte, 1998; Collier, Lavery, Ralph, & Masini, 2009) than other genera found in Cleveland Bay, including the dominant *Halophila* and *Halodule* (Freeman, Short, Isnain, Razak, & Coles, 2008).

Light requirements for seagrass vary seasonally. Charetrand *et al*. (2012) defined two generalised seasons for growth and senescence of seagrass on the east coast of Queensland:

- the growing season defined as July to January, when seagrass biomass and distribution tends to increase in response to optimal growth conditions; and
- the senescent season defined as February to June, when seagrasses retract and rely on stores or seeds to get through wet season conditions, including flooding and poor water quality.

Based on shading experiments carried out in Gladstone Harbour on *Zostera mulleri* (= *capricorni*), Chaterand *et al*. (2012) demonstrated that seagrasses did not heavily rely on light availability during the senescent season. They suggested that seagrasses had shut down or reduced their light requirements during the senescent season, and instead relied on energy stores built during the productive growing season. Chaterand *et al*. (2012) found that during the growing season, *Zostera mulleri* was able to cope with reductions in light over a two week period. Complete light deprivation over continuous 4 and 8 weeks (high shading treatment) periods resulted in significant declines in seagrass biomass.

Dredge plumes are generally episodic features, with a typical pattern of high TSS (and low to zero light) occurring at short intervals over an extended period (Chapter B4 – Marine Water Quality). Chaterand *et al*. (2012) conducted shading experiments to determine the effects of short pulses of low light (shading) conditions over 8, 12 and 16 week periods. No significant declines were observed in the shaded plots relative to controls over the 8 week measurement period. Significant declines in seagrass were recorded over the 12 week period at control and shaded plots, in response to major rainfall events. Notwithstanding this, there were significant differences between control and shaded plots at the 12 week interval which suggested that intermittent shading reduced the resilience of seagrass to major disturbances, such as flooding.

Potential Impacts (Unmitigated Case)

The impacts of high TSS (and associated low light conditions) to seagrass are expected to vary seasonally, in response to physiological light requirements discussed above. During the winter ‘seagrass senescence’ period, seagrass has low light requirements, and therefore major impacts to seagrass as a result of light limitation are not expected if dredging was to be carried in winter. During summer, particularly during calm weather periods, seagrasses require light for growth and reproduction, and are more sensitive to light limitation.

As discussed in Chapter B4 (Marine Water Quality), modelling for the summer period predicts that the 95^{th} percentile TSS level for the overall dredge campaign is expected to be less than 21 mg/L at nearshore seagrass meadows. However, modelling predicts that dredge plumes would result in pulses of high TSS episodes of variable duration, some of which extended up to two days at sites containing nearshore seagrass meadows (i.e. the Strand, Geoffrey Bay, southern Magnetic Island, Middle Reef and Cape Pallarenda).

While seagrass can tolerate light deprivation over a period of up to two weeks, multiple pulses of short to medium duration (i.e. half a day to several days) TSS events could result in reduced condition and biomass of seagrass, particularly if TSS levels are naturally high before, during and following dredging. As discussed for corals, during more quiescent periods between high wind events, ambient TSS levels are lower (and light is higher), allowing seagrass to build energy reserves. Modelling results predict that seagrass meadows on the eastern side of Magnetic Island reefs in close proximity to the dredge channel would experience dredge plumes with relatively low to moderate TSS levels even during these more ‘quiescent’ periods. This is consistent between summer and winter periods (Figure B.6.44). This long duration of low TSS generated by the dredger, together with ambient TSS levels, is expected to result in stress and possibly mortality to seagrass along the eastern edge of Magnetic Island.

Seagrass meadows along the southern margin of Magnetic Island, Middle Reef and Cape Pallarenda are predicted to experience periodic pulses of high TSS resulting from channel dredging. However, between these pulses, TSS levels are predicted to be low (typically <5 mg/L), and extend over periods measured in days. Seagrass surveys carried out in Gladstone Harbour by Chaterand *et al*. (2012) suggest that these periods between high TSS events may allow seagrass to build energy reserves, but that overall condition could still decline over successive, multiple light periods. There will be a need to carry out mitigation strategies to minimize the potential impacts to these seagrass meadows.

On the basis of numerical modelling, it is predicted that turbid plumes will extend over areas where ephemeral deepwater seagrass has previously been recorded (i.e. recorded in 2007, but not in the period 2008 to 2011). The 95^{th} percentile TSS level (above background) for areas within one kilometre of the dredged channel immediate vicinity of the dredge channel is predicted to be >30 mg/L for summer, and a larger zone of effects would be predicted for winter. Focussing on the critical summer growth period, monthly increase in TSS levels above background at potential seagrass meadow sites within one kilometre of the dredge channel (i.e. site 3) is predicted to be approximately double the background median and 80^{th} percentile value. Seagrass meadows in this area are transient features, and when present are likely to be at or near their minimum light requirement. The predicted increase in TSS resulting from the Project is expected to result in the temporary loss of any deepwater seagrass (if present) to the west of the dredged channel, and within one kilometre to the east of the dredged channel.

Overall, it is predicted that seagrass stress and possibly mortality could occur if channel dredging was carried out when seagrass are under stress from environmental factors. This is particularly the case for the following seagrass meadows:

- The north-eastern margin of Magnetic Island, which are predicted to experience consistently low to moderate TSS levels for most of the channel dredging campaign.
- Deepwater seagrass meadows adjacent to the channel. These deepwater meadows have low biomass and represent highly are transient features, and are not known to represent critical habitats compared to nearshore meadows.

Seagrass meadows along the southern margin of Magnetic Island, Middle Reef and Cape Pallarenda are predicted to experience periodic pulses of high TSS resulting from channel dredging, but at lower levels than those at eastern Magnetic Island and around the dredge channel. There will be a need to carry out mitigation strategies to minimize the potential impacts to these seagrass meadows.

Sedimentation

Seagrasses are also sensitive to sedimentation impacts. A review of case studies by Erftemeijer *et al.* (2006) found that the impacts of sedimentation depend on several critical factors such as depth of burial and life history of the species involved. Based on a case-study in the Philippines, *Halophila ovalis* was reported to tolerate sedimentation levels of 20 mm/annum (Vermaat *et al.* in Erftemeijer *et al.* 2006). However, burial experiments by Duarte *et al.* (1997) demonstrated that *H. ovalis* showed higher growth in experimental plots that received 40 to 80 mm of sediment than control plots that did not receive any sediment. It was suggested that under conditions of high light availability, sedimentation may in the long term enhance growth by increasing the availability of nutrients.

Based on sedimentation plots shown in Appendix H1 (Technical Modelling Report), it is expected that the highest rate of sedimentation will occur in close proximity to the dredge channel during both summer and winter periods. Any deepwater seagrass meadows present within close proximity to the dredged channel are predicted to experience deposition rates of 2 to 5 mm/month, which in combination with elevated TSS levels, is expected to result in stress and mortality to meadows (if present).

The nearshore seagrasses around the eastern and southern side of Magnetic Island, as well as between Cape Pallarenda and the Strand, are predicted to experience relatively low deposition rates (<1.2 mm/month). These deposition rates are not expected to result in major impacts to nearshore seagrass meadows.

Recovery

The seagrass species that are most likely to be affected (*Halodule* and *Halophila* spp.) have adaptations that allow relatively rapid growth and recovery following disturbance (Duarte, Terrados, Agawin, Fortes, Bach, & Kenworthy, 1997). The rate of recovery will depend not only on the magnitude of disturbance but also environmental conditions during the 'recovery' period, the species affected and the condition of seed banks in the affected areas (Carruthers, et al., 2002). Post-disturbance recovery of tropical seagrasses is typically measured in years. For example Birch and Birch (1984) examined the recovery of seagrass at Cockle Bay (Magnetic Island) following disturbance by Cyclone Althea. Seagrass recolonised the affected areas shortly after the cyclone (measured in years), however successional changes in the dominance patterns of different seagrass species were observed over time. *Halophila* species were observed to reach a 'steady state' ten years after the cyclone, whereas *Halodule* species were still increasing in abundance (Birch & Birch, 1984). Similarly, monitoring of the post-flooding recovery of seagrass in Hervey Bay found that subtidal seagrasses began to recover in subtidal areas two years after flooding (Coles, McKenzie, & Campbell, 2003). As discussed in Section B.6.3.4, seagrasses at Hay Point were observed to recolonise dredging affected areas within nine months of the completion of dredging (Chartrand, Rasheed, & Sankey, 2008).

Turbidity and sedimentation impacts to seagrass are mostly predicted to occur as a result of dredging of the Platypus and Sea channels, which as discussed above for corals, is at this stage is envisaged to consist of an approximate 11 weeks duration. Seeds of seagrass genera found in the Study Area are known to be able to survive in a dormant condition for at least two to three years and still remain viable (e.g. (McMillan, 1983; Campbell & McKenzie, 2004; Orth, Harwell, & Inglis, 2006) hence recovery via seed banks could occur. Seagrass recolonisation would be expected to occur within several years following the completion of dredging, dependent on the occurrence and magnitude of natural disturbances during this recovery period. It would be expected that seagrass at Magnetic Island would have the lower levels of resilience than nearshore meadows, due to low seed bank densities.

B.6.4.4.3 Mangroves

Mangroves are not sensitive to reduced light as a result of increased turbidity, but are intolerant of high levels of sedimentation. Natural sedimentation rates in mangrove forests vary spatially and temporally, but were reported by Ellison (1998) to be generally less than 5 mm/annum, but could reach up to 10 mm/annum. Excess levels of sedimentation can cause stress to mangroves as a result of smothering and burial of root systems. This can lead to reduced vigour to death, depending on the amount and type of sedimentation, and the species under consideration. The case studies considered by Ellison (1998) recorded mangrove stress or death with sediment deposition depths of 50 to 700 mm. For the dominant mangrove species in the Study Area, *Avicennia marina*, mortality was recorded when sediment depths were in the range of 120 to 500 mm. *Rhizophora* spp. mortality was recorded when sediments depths were 500 to 700 mm.

Ellison (1998) noted that there are insufficient data available to establish specific tolerances, and on the basis of existing literature it is considered that sedimentation levels of up to 50 mm would be generally tolerable by the mangrove communities throughout the Study Area. Above this level of sedimentation, *Avicennia marina* would be most at risk of decreased growth or death, particularly at sedimentation levels above 100 mm. *Rhizophora* trees can be expected to tolerate higher levels of accretion, possibly as high as 200 mm.

Modelling results predict that the Port Expansion Project will not result in high sedimentation rates in areas containing mangrove forests. In this regard, the nearest mangroves to the zone of influence of the nearshore outer harbour area are located at Ross River, and no change from background sedimentation is expected in this area. Some isolated mangroves occur on the eastern side of Magnetic Island, and sedimentation rates in these areas is expected to be low (< 10 mm/14 days). Impacts to mangroves as a result of sedimentation are therefore not expected.

B.6.4.4.4 Benthic Invertebrate Communities

Sessile epifauna communities are represented in both soft sediment and reefal habitats. These assemblages are comprised mostly of filter feeders (sponges, ascidians, gorgonians) and species that entrap their prey (e.g. some soft corals).

At sub-lethal levels of suspended sediment concentrations, some filter-feeders may benefit from the larger amount of suspended organic matter (i.e. food resources) contained in the dredged material, or released from benthic substrates disturbed by the dredger. However, adverse impacts to filter-feeders will occur where suspended sediment concentrations reach levels that lead to interference or blocking of respiratory and feeding structures. Some of these taxa can also be autotrophic (require light for survival), and may therefore be affected by extended periods of low light. There are too few data to quantify tolerance limits and the zone of likely impacts for these species. However, based on modelling results, it would be expected that communities in close proximity to the dredge footprint and adjacent to the DMPA will be most affected.

Sessile epifauna assemblages could also be smothered in areas experiencing high levels of sedimentation, which could lead to stress and eventually mortality. The maximum zone of sedimentation impact is predicted to occur in areas located close to the dredge footprint and adjacent to the DMPA. Although there is little information to determine maximum tolerance limits of sessile species to sedimentation, it would be expected that in the absence of further re-suspension by waves/currents, any sessile epifauna in areas that experience >10 mm/14 days will suffer severe stress or mortality. Modelling does not suggest that such sedimentation levels are expected to occur. Areas likely to be affected by high levels of sedimentation are restricted to the dredge area and immediate surrounds. Most fauna in the dredge area will be removed by dredging, and no particularly sensitive taxa are known or likely to occur in areas immediately adjacent to the channels (noting that these areas regularly experience sedimentation resulting from maintenance dredging).

Many species of infauna species are capable of vertical migration through overlying sediment [e.g. reviewed by (Maurer, et al., 1986)]. In dynamic sedimentary environments, like Cleveland Bay, many benthic infauna species are adapted for vertical migration through the sediment column [e.g. (Smith &

Rule, 2001)]. It is possible that smothering of some less mobile infauna communities could occur in areas that are predicted to experience high levels of sedimentation (i.e. in close proximity to the dredge footprint and adjacent to the DMPA).

Overall, major long-term impacts to benthic communities as a result of turbid plume and sedimentation impacts are not expected on the following basis:

- soft-sediment sessile epifauna and infauna communities in and directly adjacent to the dredged areas (port development area and navigation channel) and DMPA are well represented elsewhere in Cleveland Bay, and are not known or likely to contain unique species;
- a relatively small proportion of the total benthic habitat resource in Cleveland Bay is expected to be affected by dredge plumes and sedimentation; and
- given the dynamic environmental conditions in Cleveland Bay, most species are capable of recolonising disturbed areas relatively rapidly.

B.6.4.4.5 Fish and Nektobenthic Invertebrates of Commercial Significance

Most fish expected to occur in Cleveland Bay have a lateral line system that it used to detect prey, which allow fish to feed in highly turbid waters. Disturbance of the seafloor by dredging and subsequent dredged material placement will result in liberation and entrainment of invertebrates in the water column. This increase in the availability of food resources is expected to lead to an increase in the abundance of fish that feed on invertebrates to the dredging and dredged material placement sites. The increase in small fish could have a localised cascading effect, with piscivorous fish and dolphins also attracted to the dredge and dredged material placement sites. This could therefore result in localised changes to fish distribution and abundance, and potentially higher rates of predation.

Turbid plumes may also result in physiological effects to fish. Jenkins and McKinnon (2006) suggested that very high suspended solid concentrations (e.g. 4000 mg/L) could cause gill blockage and eventually mortality to fish. There are very few documented cases of fish kills resulting solely from turbid plumes, and in any case, such concentrations would only be expected occur only rarely and at highly localised spatial scale (in the immediate vicinity of the dredger).

Blaber and Blaber (1980) consider that turbidity gradients may aid fish larvae in locating estuarine nursery grounds. Although empirical data are lacking, it is possible that the creation of a turbidity gradient during the recruitment period of key species may lead to larvae being attracted to a region where settlement and recruitment rates are normally very low due to lack of suitable estuarine habitat (e.g. lack of seagrass and mangroves).

As discussed in Section B.6.3.9, prawns and portunid (mud and sand) crabs represent key species of commercial significance, and use both nearshore and offshore waters (including parts of the Study Area) as part of their life-cycle. These species primarily inhabit turbid water environments, and are tolerant of a wide range of turbidity conditions. These species are also highly mobile and actively burrow into soft sediments, and are therefore tolerant of high rates of sediment burial. Direct impacts to prawns as a result of high suspended sediment concentrations and sedimentation are therefore not expected.

B.6.4.4.6 Marine Megafauna

The most common cetacean species in Cleveland Bay are the Australian snubfin and Indo-Pacific humpback dolphins (Section B.6.3.7). These dolphin species are capable of successfully foraging in turbid waters. Dolphins often stir up bed sediments when foraging for benthic prey, resulting in limited to no visibility for prey detection. It is thought that dolphins detect prey using echolocation rather than visual cues (Mustoe, 2008; Mustoe, 2006). Dugongs have poorly developed eyesight and rely on bristles on their upper lip, rather than visual cues, to detect seagrass food resources. Therefore, high suspended solid concentrations generated by dredging and dredged material placement are not expected to adversely affect foraging success for cetaceans or dugongs.

Sea turtles generally have good eyesight and rely on visual and olfactory cues to detect prey and other food resources (e.g. (Swimmer, et al., 2005)). Flatback turtles are known to feed in turbid shallow waters (Robin, 1995) and may not be directly affected by turbid plumes generated by dredging and placement. Other species such as green and hawksbill turtles, which feed on seagrass and/or in reef environments, may avoid areas affected by turbid plumes. The key feeding areas for these species (e.g. reef environments around Magnetic Island, Middle Reef and dense shallow water seagrass meadows in nearshore areas) are predicted to be exposed to plumes of highly turbid waters (>30 mg/L), however the frequency, duration and magnitude of such plumes are predicted to be within the range of natural variability. Mitigation strategies to manage impacts to water quality at reef and seagrass sites will reduce the potential for direct impacts to turtles.

The risk of other noise and construction-related disturbance to marine megafauna is discussed in Section B.6.4.7.

B.6.4.4.7 Mitigation and Residual Effects

The DMP (see Chapter C2.1) provides guidance on the mitigation measures that will be adopted to reduce impacts to marine ecosystems of Cleveland Bay and marine megafauna. This includes the following relevant strategies and components:

- Dredging will not be carried out during summer (November to March) when corals, seagrass and possibly other marine species are most likely to be experiencing high levels of stress (i.e. thermal stress, possibly stress associated with flooding) and/or undertaking important life-history functions (i.e. coral spawning and recruitment, seagrass growth). As discussed in Section B.6.3.5, summer periods with high average water temperatures and/or flood events (and associated low salinity and high turbidity) result in stress and mortality of corals and seagrass in Cleveland Bay. Similarly, the late spring and early summer period (together with other less extreme summer periods), represent key periods for seagrass growth and resilience building, and will also be avoided for dredging.
- An environmental valve ('green valve') will be used in overflow pipes of the TSHD to reduce the dispersion of sediments from dredging.
- Overflow levels will be raised to the highest allowable point during sailing from the dredge area to the DMPA to ensure spillage of sediment is reduced.
- Sailing routes will be optimised to reduce the generation of propeller wash.
- A reactive water quality and coral monitoring program will be developed and implemented. Dredging activities will be modified or suspended in the event that monitoring detects exceedance/s of trigger values. The trigger values are based on both sub-lethal effects guidelines (i.e. changes in turbidity relative to background) and direct impact response guidelines (i.e. coral bleaching and/or mortality), which will illicit different management responses. An advisory body will be established that oversees the development and implantation of the reactive monitoring program.

Through the implementation of these controls, the overall residual risk for turbidity and sedimentation are considered to be Medium (Table B.6.20).

B.6.4.5 Change in Habitat and Food Resources for Marine Fauna

The secondary effects of changes to habitat and food resources (refer to Table B.6.10 for locations potentially affected) to marine fauna are considered below.

B.6.4.5.1 Changes to Habitat and Prey for Species of Economic Significance

Two critical considerations when considering the potential impacts of loss or disturbances to benthic assemblages on the foraging of fishery species are: (i) the spatial scale of the impact relative to the total area of habitat available, and (ii) the degree of foraging specialisation exhibited by key fishery species. With respect to loss or changes in prey resource availability, the level of impact will depend on the whether the animal has a highly specialized diet, and whether the area affected contain critical food resources.

As discussed above, the total area of soft sediment habitat loss (approximately 0.2% loss due to reclamation) or disturbed (approximately 0.14% loss due to dredging) by the Port Expansion Project is relatively small (approximately 0.4%) to the total available soft sediment habitat resource (i.e. 22,308 hectares) in Cleveland Bay. Based on habitat assessments and benthic macroinvertebrate community surveys, none of the potentially affected areas are known to support unique benthic macroinvertebrate or benthic habitats, nor are benthic macroinvertebrate communities in these areas considered to be particularly rich or abundant or particularly rich compared to adjacent areas.

Fish species occurring in unvegetated soft sediment habitats are generally recognised as being opportunistic benthic foragers (e.g. Hobday *et al.* 1999). This is demonstrated by how rapidly some fish species occurring in these habitats learn to consume introduced invertebrate species such as bivalves and polychaetes (Hobday, Officer, & Parry, 1999). Similarly, prawns and crabs of economic significance also have a varied diet (Dall, Hill, Rothlisberg, & Staples, 1991; Wassenberg & Hill, 1987).

Key commercial and recreational fisheries species potentially occurring at and adjacent to areas of disturbance can be generally classified as broadly opportunistic species that prey on a wide variety of benthic invertebrates and pelagic fish (Table B.6.14).

There is no empirical evidence to suggest that soft-sediment fish and shellfish populations are ultimately limited by food or habitat resource availability; hence the short-term changes in prey or habitat availability. Given the opportunistic foraging behaviour of the benthic foragers listed above, together with the small proportion of habitat lost, it is not expected that permanent loss or modification of habitat would lead to an overall reduction in populations of species of economic significance.

Table B.6.14 Prey of key harvested species that may overlap spatially with the area of influence of the Port Expansion Project

Species	Prey	Source
Eastern king prawn, Tiger prawn, Banana prawn	Benthic invertebrates – crustaceans and polychaetes	Moriarty (1977)
Blue swimmer crab	Benthic invertebrates - crustaceans, molluscs, echinoderms, polychaetes	Williams (1982), Wassenberg and Hill (1987)
Mud crab	Benthic invertebrates – molluscs, crustaceans, sedentary or moribund fish.	Williams (1997)
Barramundi	Fish and macrocrustaceans (prawns, crabs etc.)	Davis (1987)
Threadfin salmon	Demersal and pelagic fish (e.g. ponyfish, flathead, scats, sardines) and macro-crustaceans	Kailola *et al.* (1993)
Queenfish	A variety of pelagic fish species and cephalopods	Kailola *et al.* (1993)
Whiting	Benthic invertebrates – crustaceans, molluscs, polychaetes.	McKay (1992)

It would be expected that demersal fish, crabs and prawns will avoid areas that have no to highly depauperate benthic macroinvertebrate assemblages as a result of dredging and dredged material placement. This is expected to result in a redistribution of fauna, with animals foraging in other parts of Cleveland Bay until such times as benthic communities recolonise the disturbed area (i.e. measured in months to possibly years).

Longer term changes in habitat conditions (e.g. sediment types, water depths) as a result of dredging and dredged material placement activities, and associated changes to benthic macroinvertebrate communities, are also not expected to lead to major changes to species of economic significance. Mud crabs, sand crabs and demersal fish use a range of soft sediment habitat types. There is no empirical evidence to suggest that these species have a strong association with a particular sediment type. Some correlative preferences for sediment type (i.e. grain size distributions) have been shown for commercial prawn species (e.g. Somers 1994). However, Somers (1994) suggested that other variables that are positively correlated to sediment grain size may be more important than grain size alone. In particular, depth related differences in sediment, and other factors such as the availability and extent of food and nursery habitats (e.g. seagrass, mangrove and benthic faunal communities) could be more important than sediment grain size alone.

B.6.4.5.2 Effects of Soft-sediment Habitat Loss on Marine Megafauna

There are numerous other listed migratory marine mammals that could occur in or adjacent to the Port Expansion Project Area, two of which are relatively common in and adjacent to the Port Expansion Project Area and the DMPA: Australian snubfin dolphin and Indo-Pacific humpback dolphin. GHD (2011c) notes that the two dolphin species are common in nearshore environments throughout Cleveland Bay, and are likely to regularly feed in port area (including the Port Expansion Project Area) Both dolphin species also has important feeding and nursing areas in Cleveland Bay, particularly around Ross River. Both species also occur in the DMPA and around the navigation channels.

The development of port facilities will result in the irreversible loss of soft-sediment subtidal habitat and foraging areas for the two nearshore dolphin species. Although the proportion of subtidal soft sediment habitat lost as result of the proposal is relatively small at even a localised Cleveland Bay wide spatial scale, ongoing studies demonstrate that the Ross Creek and Ross River mouths, together with the Platypus and Sea channels, represent locally important foraging area for both of these nearshore dolphin species. While both species are opportunistic foragers that have a varied diet (Section B.6.3.7.2), it is apparent that these river/creek mouth and channel areas are preferentially used by these species. Both species have also been recorded in the Port Expansion Project Area in low numbers (GHD, 2011c), although it is uncertain whether this was for feeding or transiting between important feeding areas at the mouths of the tidal creeks. Both species also occur elsewhere throughout Cleveland Bay in low to moderate numbers.

The locally important feeding habitats at the mouths of the Ross Creek and Ross River will not be directly affected by the Port Expansion Project. There will be a permanent loss in potential foraging habitat due to the reclamation, however based on observations of dolphins in and adjacent to existing berth and rock-wall areas, it is possible that dolphins may feed in the new harbour basin. Dolphins will also need to swim a greater distance around the Port Expansion Project Area to move between feeding areas at the river mouth (Section B.6.4.2).

The deepening of the Platypus and Sea channels will also temporarily disturb areas frequented by dolphins (species unknown). Seabed habitat surveys show that these channels presently support substrate types similar to that found in adjacent areas, but more depauperate sessile epifauna and infauna communities than adjacent areas. Dredging can liberate benthic fauna and attract fish scavengers, which may in turn attract dolphins. The dredged channels may also provide habitats for other nektobenthic species that form the prey of dolphins.

The capital dredging will slightly increase depths in the existing channel, however the minor changes in habitat conditions (water depths, hydrodynamics, sediment types) are unlikely to result in fundamental changes to benthic community structure in the long term compared to existing conditions. In the short term, it is expected that there will be changes to benthic invertebrate community structure (and most likely fish assemblages), which could influence dolphin feeding patterns in the short-term. It is uncertain whether such short-term effects would be positive (attract dolphins) or negative (dolphins avoid area during and shortly after dredging). It is possible that dolphins would avoid the dredged channel due to dredger disturbance and/or changes in prey, and would need to forage elsewhere either in Cleveland Bay or elsewhere. Whatever the case, this type of disturbance occurs regularly during the annual maintenance dredging campaign, albeit at a smaller scale than the PEP capital dredging.

B.6.4.5.3 Effects of Seagrass Loss on Marine Megafauna

Any temporary loss of seagrass as a result of dredged material placement and turbid plume generation will result in the short-term reduction in food resources for dugong and green turtles. Major impacts to turtles and dugongs are not expected as a result of seagrass loss, as:

- Critical seagrass habitats around Cape Cleveland are not expected to be influenced by dredge plumes;
- Critical seagrass habitats around Cape Pallarenda may experience dredge plumes, however for most of the time, TSS concentrations resulting from dredging are expected to be low. Mitigation measures (winter dredging) will further reduce the risk of impacts to seagrass meadows;
- Seagrass habitats around eastern Magnetic Island, and to a lesser extent southern Magnetic Island, are also expected to be influenced by dredge plumes. These meadows are not known to represent high value marine megafauna feeding habitats compared to nearshore meadows around Cape Cleveland and Cape Pallarenda (Section B.6.3.7). Mitigation measures (winter dredging) will further reduce the risk of impacts to seagrass meadows;
- The seagrass areas most likely to be affected by dredge plumes (and sedimentation) (i.e. deep-water meadows adjacent to the channel) have a sparse cover and low biomass, and occur very intermittently (i.e. recorded in 2007 but not recorded in subsequent annual monitoring). Given the ephemeral nature of these meadows, it is unlikely that local dugong and green turtles populations are critically dependent on these seagrass meadows;

- Dugong and green turtle densities in potentially affected areas are low compared to other areas of Cleveland Bay (Section B.6.3.7); and
- Seagrass is expected to recolonise the affected areas within years of the completion of dredging (Section B.6.4.4).

As identified previously, mitigation strategies and timing of dredging will be managed to reduce the risk of seagrass loss as a result of dredging and dredged material placement activities.

Several marine turtle species feed on reef-associated species (e.g. hawksbill turtle; Section B.6.3.7). Through the implementation of appropriate controls, major impacts to reefs are not expected (Section B.6.4.4). Sea turtles have been noted to feed (in low numbers) along the existing rock walls of the Marine Precinct area (GHD, 2011a), and it is possible the creation of new rock wall habitat may lead to a localised increase food resource availability for some turtles. Given the low utilisation rates of existing rock walls by turtles, it is not expected that the increase in food resource availability will lead to major changes in local abundance.

B.6.4.5.4 Mitigation and Residual Impacts

Mitigation strategies will be implemented to reduce harm to fisheries and seagrass habitats, as described in Sections B.6.4.3 and B.6.4.4.

The loss of soft sediment habitat in the reclamation footprint represents an irreversible impact. As discussed in Chapter B.23.2, an offset package will be developed to offset this habitat loss.

The residual impact rating is low to moderate for both marine megafauna and species of economic significance.

B.6.4.6 Construction Impacts to Marine Megafauna – Vessel Strike and Dredger Operation

Marine animals that swim near the water surface, such as whales, dolphins, dugongs and turtles, could interact with vessels during the construction and operational phases. Large vessels such as the dredger and other vessels are slow-moving, which would provide marine fauna time to evade time the approaching vessel. Smaller, higher speed vessels (e.g. tenders, ferries and other support vessels) represent a higher risk of vessel strike. However, compared with the number of recreational vessels that use the Study Area, construction support vessels would represent a small proportion of the total number of boat movements expected to occur during the construction program. As discussed below, mitigation measures will be implemented to further reduce the risk of vessel strike by the dredge and other construction vessels.

When active, sea turtles must swim to the ocean surface to breathe every few minutes. When resting, they can remain underwater for as long as two hours without breathing. Dr Col Limpus (QPWS) suggests that sea turtles can use navigation channels as resting or shelter areas, and there are recorded incidences of turtles being injured by trailer suction hopper type dredgers. Cutter-suction and back-hoe dredgers pose a low risk to turtles as they do not have trailing suction dragheads (Dickerson, Wolters, Theriot, & Slay, 2004). GHD (2005), citing personal communication from Dr Limpus, suggest that the numbers of turtles captured during dredging across Queensland Ports is decreasing, with an average of 1.7 loggerhead turtles per year being captured across all ports. Furthermore, it was suggested that current research indicates that the impact of dredging on the overall viability of turtle populations is very low compared to the numbers killed by boat strikes, trawling, fishing, ingestion of marine debris and Indigenous hunting.

Given the relatively low numbers of turtles impacted by dredgers compared to other activities, and the use of effective management and operational practices to reduce the potential for turtle capture, it is not considered that dredging will have a significant impact on turtle populations in the Study Area. Best practice dredging techniques will be used to further reduce risks to turtles (see below).

B.6.4.6.1 Mitigation and Residual Impacts

Elements in the DMP (Chapter C2.1) for marine megafauna provide guidance on practical mitigation measures that will be implemented to reduce construction related impacts to marine megafauna. Key components of the DMP element include:

- A lookout will be maintained for cetaceans while the dredge sails between the dredging area and DMPA. In the event that a cetacean (except dolphins) is sighted, vessel speed and direction will be adjusted to avoid impact on the observed individual (within the safety constraints of the vessel).
- Marine mammals (except dolphins which are highly mobile) and turtles observation and response procedures including the application of a 300 m exclusion zone will be implemented during dredging and placement activities. Dredging operations shall be stopped where these fauna are observed within 300 m of the operating dredge until the animals have moved further than 300 m or have not been sighted for 15 minutes.
- Turtle deflectors will be mounted on the draghead of the TSHD.
- Water jets on the draghead will be switched on before the dredge pump is started and will remain on until the dredge pump is stopped to direct sea turtles away from the draghead thus avoiding direct contact.
- Dredge pumps will only be started when the draghead is close to the seafloor (not while lowering pipe).
- The dredge pump will be stopped as soon as possible after the completion of dredging.
- Light levels from the dredging works will be limited to those lights that are necessary for the safe operation of the vessel and the health and safety of those on board.

Taking these considerations into account, the risk of impacts to what was already a low risk activity will be further minimised (low residual risk rating; Table B.6.20).

B.6.4.7 Construction and Operation Impacts to Marine Megafauna - Noise

Noise generated by construction activities has the potential to adversely affect marine megafauna. Three construction activities are of the expected to be key generators of underwater noise:

- Pile driving operations;
- Dredging operations; and
- Dumping of rock for seawall construction.

B.6.4.7.1 Underwater Noise Criteria

Noise exposure from construction activities of the Port Expansion Project has a potential to affect marine megafauna through:

- Physiological damage (e.g. permanent or temporary hearing loss), which can directly impact fauna survival by diminishing their response to danger, or impair functions such as food detection, navigation and communication.
- Adverse behavioural responses such as avoidance, cessation of vocalisation or reproduction, separation of mother and calf, startled response or aggression.
- Masking of biologically important sounds, such as communication, echo-location of prey and navigation.
- Fish mortality has occasionally been reported in close proximity to piling, as physical damage can also occur to non-auditory tissue (e.g. vascular tissue) or air-filled cavities such as swim bladders.
- Each of these effects can adversely influence growth, survival or reproduction. These impacts are generalised effects of extreme noise exposure and are explained in further detail in GHD (GHD, 2012b) (Appendix K3).

GHD (2011d; 2011c) and GHD and Savery and Associates (2011) provide a detailed review underwater noise management guideline levels for the protection of marine megafauna, including cetaceans, marine turtles, dugong, fish and sharks, and these are summarised in Table B.6.15. GHD (2011d; 2011c) found that different marine megafauna species vary in their sensitivities to underwater noise. In summary:

- Dolphins can be classified as 'medium-frequency cetaceans', that produce and use sounds from tens of kHz to 100 kHz for prey location and navigation, and producing and using lower frequency sounds (1kHz to tens of kHz) for communication. Humpback whales can be classified as 'low-frequency cetaceans', producing and using sounds ranging from 7 Hz to 22+ kHz for location of food, navigation and communication.

- Different noise criteria apply to dolphins and humpback whales (Table B.6.15), but can be simplified as an instantaneous exposure guideline of 224 dB Lpeak Re: 1 µPa, and an accumulated sound energy guideline of 183 dB SEL Re: 1 µPa2.s (Mmf or Mlf as applicable to dolphins or humpback whales).
- The auditory frequency range of marine turtles is significantly lower than dolphins and dugong, which are estimated to be in the range of 100 Hz to 1 kHz. This represents a small fraction of the auditory frequency range of mid-frequency cetaceans. However in the absence of recommended damage criteria for marine turtles, GHD (2011d; 2011c) recommended that the same criteria used for dolphins is applicable as a conservative measure.
- Dugongs are estimated to have an auditory range of between 24/34 Hz to 24/27 kHz, based on comparative anatomical studies to humans. It was suggested that hearing sensitivity would likely match the frequency range of dugong vocalisations, which range from 3 kHz to 19 kHz for 'chirp-squeaks', and 500 Hz and 2.2 kHz for 'barks'. GHD (2011d; 2011c) concluded that although dugongs are less likely to have lower overall hearing sensitivity than dolphins, but that temporary threshold shift (TTS) and permanent threshold shift (PTS) criteria for dolphins are appropriate.
- Fish are sensitive to high sound pressures, which can affect auditory structures of fish (soft tissue and otoliths) and swim bladders. Noise management criteria for the avoidance of damage to fish tissue (from the American National Marine Service) are shown in Table B.6.15. Little is known about the auditory sensitivity of sharks, however behavioural responses to pulsed low frequency sounds (up to around 1 kHz) have been recorded. GHD (2011d; 2011c) suggested that the criterion for fish >2 g is applicable to sharks.

Table B.6.15 Criteria for avoidance of underwater noise impacts to marine megafauana (GHD 2011c)

Impact	Unit of Measure	Single or Multiple Pulses	Non-pulses
Cetaceans, dugong, turtle			
Temporary Threshold Shift (TTS) – describing the potential for temporary hearing loss	SPL Re: 1 Pa (un-weighted Peak) 224 dB 224 dB	224 dB	224 dB
	SEL Re: 1 Pa2-s (M-weighted)	183 dB (Mmf) dolphin	195 dB (Mmf) dolphin
		183 dB (Mlf) humpback whale	183 dB (Mlf) humpback whale
Permanent Threshold Shift (PTS) – describes the effect of more severe sudden or cumulative noise exposure, causing permanent loss of hearing sensitivity due to tissue damage in the auditory system	SPL Re: 1 Pa (un-weighted Peak)	230 dB (TTS + 6)	230 dB (TTS + 6)
	SEL Re: 1 Pa2-s (M-weighted)	198 dB (TTS + 15) (Mmf) dolphin (Mlf) humpbacks	215 dB (TTS + 20) (Mmf) dolphin (Mlf) humpbacks
Fish			
All fish	SPL Re: 1 Pa (un-weighted Peak)	206 dB	206 dB
Fish >2 g	SPL Re: 1 Pa2-s (un-weighted)	187 dB	187 dB
Fish < 2g		183 dB	183 dB

B.6.4.7.2 Noise Measurements and Modelling

Noise modelling and measurements have recently been completed for the PEP (GHD, 2012b), Berth 12 Expansion Project (GHD, 2011d) and Marine Precinct Project (GHD & SA, 2011) at the Port of Townsville. The findings of noise assessments from these projects are directly applicable to the Port Expansion Project, and form the basis of this EIS section.

Piling Driving Works

The primary issue with respect to potential noise impacts from the Port Expansion Project is associated with pile driving works during the construction of the berth/wharf structures (i.e. Berths 14, 15, 16, 17, 18 and 19). An estimated 130 (900 mm x 20 mm thick) piles will be installed for each berth. A hydraulic hammer will be used for pile driving, although the size of the hammer is yet to be determined and will be dependent on the contractor awarded construction. It is anticipated that pile driving will occur during daylight hours over a two month period for each berth, and will likely occur sporadically during this time (i.e. not expected to be continuous during this time).

GHD (2011d) undertook underwater noise modelling to assess the potential impacts of pile driving using 900 mm diameter piles, as will be used in the Port Expansion Project. GHD (2011d) found that in the absence of source attenuation measures, the peak pressure 224 dB criteria for the protection of cetaceans, turtles and dugong would be exceeded at distances < 10 m from the driven 914 mm piles, and the 206 dB criteria for sharks would be exceeded at distances up to 20 m.

GHD (2012b) concluded that the potential physiological peak pressure impacts from piling would not extend beyond 10 m from driven steel piles. However, in practice the exclusion zone that is derived from consideration of cumulative sound energy for Temporary Threshold Shifts (TTS) impacts is much larger.

There are a number of available strategies for reducing the potential zone of TTS impact on inshore megafauna species. The most direct method is by implementing source noise attenuation. Implementation of at least 10 dB of source noise control may reduce the potential impacted hazard zone from 250 m to <50 m.

Proven noise mitigation techniques are available for marine driving of 900 mm steel piles that can reliably reduce the sound energy by at least 15 dB at the source across the range of frequencies that overlap the functional auditory range of inshore dolphin species.

With currently available knowledge, the potential area in which the efficiency of bio-sonar function may be reduced by marine impact piling is potentially an order of magnitude larger than that associated with potential TTS effects. Without mitigation this area may be of the order of 5 km radius from the pile where rock walls do not contain the noise. With mitigation (e.g. -15 dB at the source), the potential area in which bio-sonar function may be impacted may similarly be reduced by an order of magnitude, to approximately 500 m. In respect of uncertain bio-sonar impacts, source impact-piling noise control is considered to represent a minimum noise management recommendation for piling operations that will extend over many months. Additionally, staging construction work over a number of periods will likely dilute these effects.

Dredging

Dredging will also form a persistent source of underwater noise associated, and will continue (intermittently) for the life of the construction phase. Underwater noise measurements were carried out for the TSHD ‘Brisbane’ (GHD, 2012b). Results indicated that noise levels were far lower than that generated by pile driving activities.

Noise generated by a TSHD operating over a continual 24 hour period for six months would not pose a risk of TTS from cumulative sound energy exposure. Given that the Project anticipates that the longest period of TSHD use is 11 to 13 weeks, noise impacts are likely to be minimal. An animal would need to remain within 50 m of the dredge for an extended period (comparable to 24 hours) for TTS impacts to arise from this source. At distances less than approximately 500 m from THSD dredging activities, it is possible that elevated levels of dredger noise greater than ambient noise may result in impairment to communication and/or bio-sonar function and associated behavioural displacement. Given the mobile nature of megafauna it is unlikely that any animal would remain stationary near dredging operations to be affected by TTS.

Shipping

Shipping traffic will not pose a risk of TTS impacts to inshore dolphins. However, at distances at approximately 500 m from ship pass-bys, it is possible that elevated levels of propeller cavitation noise greater than ambient noise would result in masking impairment to communication and bio-sonar function.

The duration of potential functional impairment for marine fauna within 500 m of vessel pass-by may be comparable to the transit time ± 500 m either side of the point of closest approach. This could vary depending on speed; 3 minutes at 10 knots, or 10 minutes at 3 knots.

Multiple shipping transits associated with the Project, and other non-port vessel traffic can be expected to result in an accumulated duration of time in any 24 hour period. This would occur as dolphins, if foraging within 500 m of vessel pass-bys, may experience a reduced efficiency of bio-sonar function due to wide frequency spectrum propeller cavitation noise. However, this potential impact is unlikely to be significantly changed by the port expansion due to the relative infrequency of port related vessel movements compared to non-port related vessel movements.

In the longer term, propeller cavitation noise may be reduced by improved propeller design throughout the world-wide merchant shipping fleet. However such improvements are beyond the control and scope of the Project.

Shipping traffic is expected to increase over the life of the Project from 1-2 ship movements per day to approximately 7 movements per day when the port is operating at capacity. This is compared to current timetabling for existing non-port ferry traffic amounting to approximately 52 movements per day.

Placement of Rock Material

GHD and Savery and Associates (2011) undertook sampling of underwater noise during rock wall construction for the Marine Precinct project. Peak pressures from underwater rock tumbling was recorded up to L_{peak} 173dB re: 1µPa at a separation distance of 56m. Backward extrapolation of peak pressure towards the source, by conservative assumption of hemispherical spreading (6dB per halving of distance) indicates a nominal source pressure of around L_{peak} 208dB re: 1µPa@1m. SEL levels for rock-tumbling events were recorded in the range of 137 to 144dB (Mmf) re: 1µPa2.s at 56m. Each event lasted 5 to 7 seconds. This was equivalent to normalised levels at 1m of up to 179dB (Mmf) re: 1µPa2.s.

Rock tumbling events occurred regularly during the measurement period (three per five minute interval), which based on noise measurements, underwater noise was calculated not to exceed 183 dB (MMf) greater than 15 m from the rock tumbling area.

GHD (GHD, 2012b) concluded that megafauna are not at risk of peak acoustic pressure damage from underwater rock-tumbling until they are within the range of direct physical impact from the tumbling rock material. The behavioural response of inshore dolphin to rock-tipping events are unknown, however the response may have similarities to that from impact piling, possibly leading to either cessation of vocalisation or temporary displacement from the Project Area.

Analysis of potential noise masking indicates the possibility of a behavioural displacement response during foraging and communication for the period of rock-tipping works at distances less than 2 km from this activity. There is, however, uncertainty as to whether potential intermittent interruption of bio-sonar and communication functions for approximately 5 seconds from each 100 seconds would be significant (GHD, 2012b).

Assessments of Potential Impacts - Construction

The noise assessments summarised above (GHD, 2011d; GHD, 2012b; GHD & SA, 2011) suggests that in the absence of mitigation measures, there is a potential for temporary auditory impairment to marine megafauna that remain stationary within 1200 m of the driven pile (upper estimate assuming low noise attenuation rate with distance, and 1200 strokes per pile). This distance is highly conservative in this instance as it assumes fauna remain stationary (i.e. close to works) for an extended period (24 hours). However, there is now proven technology available that can attenuate piling noise by 10 to 15 dB at the source, which can potentially reduce the hazard zone from 250 m to less than 50 m (GHD, 2012b).

The marine megafauna species most likely to be encountered directly adjacent to piling operations are turtles, dolphins and possibly sharks, and far less likely dugongs and whales. With the exception of turtles (discussed below), most marine megafauna species are highly mobile and can travel large distances within a 24 hour period, particularly dolphins, whales and dugongs (GHD, 2012a; GHD, 2011d). These species may also exhibit avoidance behaviour to high noise levels (see below).

The most likely impact of construction noise to most marine megafauna species (except turtles – see below) is the temporary avoidance of the affected area. This could result in the following effects:

- Dolphins - As described in Section B.6.3.7.2, the area around the Ross River and Creek mouths (i.e. areas in and adjacent to Port Expansion Project Area) is a locally important feeding area for nearshore dolphin species. Nearshore dolphins are however wide ranging species that also feed and calve elsewhere in Cleveland Bay, and it is unlikely that temporary avoidance of feeding areas near construction activities would result in major, long term impacts to these species. Disruption to communication between individuals could also occur in close proximity to the construction site; however there is insufficient information to quantify impacts. Nevertheless, it is recommended that the use of noise mitigation measures (such as pile head cushions, reduced energy strikes, damped and undamped casings or other options that may be available at the time of construction) be used to limit noise propagation to 183 dB Re:1 µPa2-s at 500 m from the pile (GHD, 2012b).
- Humpback whales – During migrations, humpback whales commonly occur in offshore waters off Cape Cleveland. GHD (2011d) concluded that peak pressures would be of minimal significance (below background) greater than 10 km from piling activities, and therefore impacts to whales occurring in offshore waters are not expected.
- Dugongs – The outer harbour and immediate surrounds (within 1 km) do not contain seagrass food resources for dugongs, and is not known to be a key movement corridor for this species (see Section B.6.3.7.2). Therefore, any avoidance behaviour towards construction noise is unlikely to result in major impacts to feeding and movement patterns of this species. Disruption to communication between individuals could also occur to individuals that occur in close proximity to the construction site, however there is insufficient information to quantify impacts.

Turtles are likely to exhibit a different response to noise than marine mammals. While the outer harbour area is not known to contain large numbers of turtles compared to other parts of Cleveland Bay, turtles are known to feed around the rock walls and dredged channels in the Port area. Turtles often remain stationary for long periods (feeding and resting), and based on observations of turtles exhibiting negligible response in close proximity to marine piling operations, GHD (2011d) suggested that it cannot be assumed that turtles will voluntarily move away from a piling operation. GHD (2011d) argued that due to the physiology of their ear, turtles are less likely to sensitive to noise than marine mammals. However, GHD (2012b) states that adoption of strategies to successfully mitigate potential noise impacts on dolphins will adequately meet those required for the protection of other megafauna species such as turtles and dugong.

Best practice construction and dredging techniques will be used to further reduce risks to marine megafauna (see next below and the Construction and Dredge Management Plans – Chapter C2.2 and Chapter C2.1 respectively).

Assessments of Potential Impacts - Operation

Ships using and transiting the Port of Townsville represent a source of noise to the marine environment. Such noise may be generated by mechanical means (vessels engines, propellers and other machinery), or by water movements on the vessel hull. While ship generated noise is normally unlikely to occur at levels cause acute hearing damage to marine fauna, it may cause subtle but possibly more widespread increases to ambient noise levels. This may include for example, masking of biologically important sounds (e.g. vocalisations), interfering with dolphin sonar signals or altering their behaviour (i.e. noise avoidance).

As outlined in Section B.6.4.9, the number of cargo ships through the Port of Townsville is predicted to increase from 675 ships per annum (~2 ships per day) in 2010 to 1008 ships per annum (~3 ships per day) in 2025, and 1338 ships per annum (~4 ships per day) in 2040 (Figure B.6.47). It is predicted that Port of Townsville vessel traffic volumes (ship calls) will represent approximately 11% of the total vessels from Great Barrier Reef regional ports by 2025.

Specific knowledge on the relative contributions of various noise sources to ambient noise levels is extremely limited, as is information on the effects of noise on marine megafauna in an Australian context. PGM Environmental (2012) noted that the physical structure of the GBR lagoon does not promote conditions for extended noise propagation. In this regard, they note that unlike deep ocean basins where noise can travel long distances and add cumulatively to background levels, the shallow confined waters of the GBR do not promote such extended propagation. Furthermore, PGM Environmental (2012) notes that the significance and detectability of ship-sourced noise is likely to be low due to elevated background ambient noise levels in shallow environments (i.e. from fish, shrimps, waves etc.).

Ship-noise is therefore likely to be limited to the near-field and of a transient nature, and therefore unlikely cause long-term changes to broad-scale ambient levels (PGM Environmental 2012). Major broad-scale changes to ambient noise levels and associated changes to megafauna behaviour patterns or life-history functions are therefore not expected as a result of the project. However, further research is required to assess impacts of ship noise levels at local and broad spatial scales, and to implement ship and navigation management practices to minimise potential impacts.

Mitigation and Residual Impacts

Provided effective management and operational practices are implemented to reduce the potential for noise impacts, it is not considered that the works will have a significant impact on marine megafauna in terms of direct physiological damage. In order to limit pile driving (and dredging) noise impacts to marine megafauna, an exclusion zone (i.e. observation/shut down zone) will be established, such that pile driving activities will halt or cease to commence if marine megafauna are observed within a certain proximity to the works area.

This proximity can be defined by site testing and investigation of noise mitigation measures until the underwater propagation of piling noise at the site can be quantified (e.g. to a radius where the level is less than 183 dB Re:1 μPa2-s).

To reduce the risk of noise impacts during the construction stage, monitoring will be undertaken at marine areas surrounding the construction site before commencement of water-based noise activities (particularly pile driving) for signs of marine megafauna. If megafauna are detected in the area, then works shall be delayed until they have been observed to move away outside a radius as defined by noise testing as above or, if they are no longer observable, 10 minutes after the last sighting within the specified radius.

In addition to the establishment of shut down / stop work procedures if marine megafauna are observed within the exclusion zone, a number of other mitigation measures may also be implemented in order to ameliorate potential impacts to matters of national environmental significance. The following additional mitigation measures are proposed:

(a) Water-based noise activities (pile driving in particular) will be commenced gradually to provide warning to nearby marine megafauna (i.e. ramp-up / soft-start procedure).

(b) Investigation of a range of noise mitigation measures to attenuate underwater noise such that the identified hazard level can be reduced as far as practicable.

The residual construction phase noise risk rating level following mitigation is Low (Table B.6.20).

In terms of management operational phase noise impacts in Cleveland Bay and the wider GBR region, it is noted that shipping activities are largely outside the control of POTL, and is regulated under the Queensland *Transport Operations (Marine Safety) Act 1994* and sub-ordinate legislation. This legislation does not specifically consider the issue of underwater noise to marine megafauna. SEWPAC and the Australian Maritime Safety Authority are also currently identifying appropriate actions for Australia regarding the management of potential impacts from underwater noise.

From a port operator perspective, ship vetting risk assessment processes could be implemented to determine the acceptability of a particular vessel for carriage of products. This process will allow operators to give with preference to ships committed to reducing environmental impacts. Potential mitigation options for noise effects that would be for vessel operators to: undertake regular visual inspection for megafauna, to implement soft-start practices for vessels at port and to report any harmful fauna incidents.

B.6.4.8 Lighting Impacts during Construction and Operation

Lighting systems on the construction equipment (including dredgers and other vessels) and the port facilities (construction and security lighting) will generate light emissions to the marine environment. Marine turtles are particularly sensitive to artificial lighting during nesting and hatching (Witherington, 1992) see Table B.6.5 for nesting and hatching times. In this regard, artificial lighting may disorientate nesting turtles and hatchlings, resulting in turtles aggregating towards the light source (i.e. on the land) rather than moving to the sea. As discussed in Section B.6.3.7, low-density turtle nesting occurs along sandy beaches of Cleveland Bay, including the Strand.

The marine environment adjacent to the port area already receives high levels of light from the existing port facilities, as well as from urban and residential sources along the foreshore of the Strand and Cleveland Bay. Given the already high light glow levels to the marine environment, together with low rates of nesting around the port area, it is not expected that the port expansion will cause major changes to turtle nesting and hatchling movement patterns relative to present day. Mitigation strategies will however be undertaken to further reduce potential impacts (see below).

Artificial light is not considered to have a major effect on foraging patterns of turtles, dolphins or dugongs (Mustoe, 2008). Some fish and invertebrates are attracted to artificial lighting [e.g. (Marchesan, Spoto, Verginella, & Ferrero, 2005)], which could result in highly localised effects on feeding patterns. The port expansion is not expected to result in major changes in foraging patterns of fish compared to existing levels.

B.6.4.8.1 Mitigation and Residual Impacts

While artificial lighting from the port expansion development area is not expected to result in major changes to nesting and foraging activities, mitigation measures will be implemented to further reduce the risk of impacts. In summary, the following will be considered in the Project design:

- Shielding and redirection of the light source. Materials such as aluminium flashing will be used as a shield to direct light away from adjacent waters;
- Use of directional fixtures that point down and away from the water wherever possible; and
- Replace incandescent, fluorescent, and high intensity lighting with the lowest wattage practicable.

Port and construction vessel lighting will be selected on the basis of these considerations, as well as security and safety requirements.

Taking these considerations into account, the risk of impacts to what was already a low risk activity will be further reduced (low residual risk rating).

B.6.4.9 Vessel Strike – Operational Phase

As discussed in Part A of the EIS, the number of cargo ships through the Port of Townsville is predicted to increase from 675 ships per annum (~2 ships per day) in 2010 to 1008 ships per annum (~3 ships per day) in 2025, and 1338 ships per annum (~4 ships per day) in 2040 (Figure B.6.47). Based on forecasts generated by PGM (2012), it is predicted that the total 'probable' number of ships using the GBR will increase from 3947 vessels/year in 2012, to 9243 vessels/year in 2025 and 10,097 vessels/year in 2032.

The increase in ship movements from the Port of Townsville increases the potential for collisions between ships and cetaceans. At most risk are whales, due to their slow speed and habit of swimming near the water surface. As discussed in Section B.6.3.7, the Great Barrier Reef lagoon is a key migratory route and calving area for humpback whales. Modelling of 'environmental suitability' for humpback whales shows that while the Townsville area is not predicted to be a key humpback whale habitat, areas to the south represent important calving areas and migratory routes (Figure B.6.35). These areas of high 'environmental suitability' overlap with shipping lanes in the southern and central Great Barrier Reef lagoon. It is important to note that many of the vessels visiting the Port of Townsville arrive and depart from the north, rather than travelling through the important whale habitats to the south.

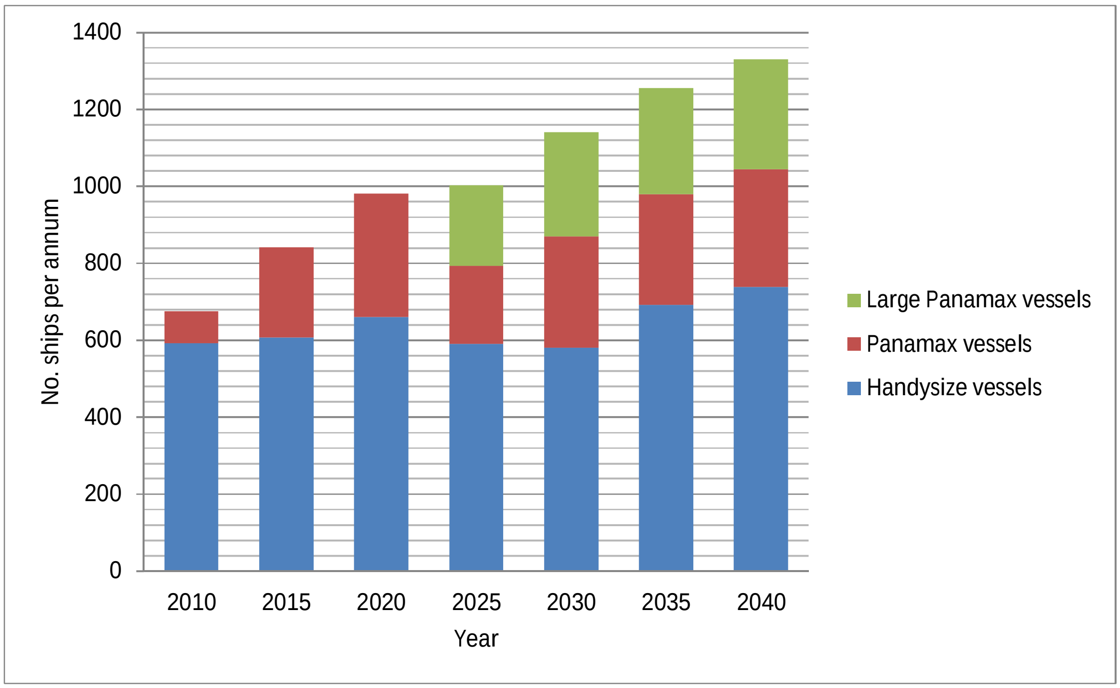


Figure B.6.47 Projected number of cargo ships per annum at the Port of Townsville

The existing impact of ship strikes is unknown, as many incidents are likely to go unreported. Based on a review of records in southern Australian waters, Kemper (2008) concluded that it was not likely to impact whale species at the population level. A review of ship strike records around the world (but not including Australia) found that, in some areas and for small populations, ship strikes are a significant source of mortality (Laist, Knowlton, Mead, Collet, & Podesta, 2001).

B.6.4.9.1 Mitigation and Residual Impacts

Vessel operations in port limits are managed in accordance with the Port of Townsville Port Procedures and Information for Shipping (DTMR, 2012). This includes shipping movements, as well as speed limits around port facilities[7] (6 – 10 knots). The management of vessel movements in the wider GBR region (beyond port limits) is outside the control of the Port of Townsville, and is regulated under the

[7] No speed limits are provided for Cleveland Bay. Ships are to proceed at a speed that complies with Queensland *Transport Operations (Marine Safety) Act 1994*

Queensland *Transport Operations (Marine Safety) Act 1994* and sub-ordinate legislation. This legislation does not specifically consider the issue of vessel strike to marine megafauna.

The International Maritime Organisation (IMO) has prepared a guidance document for use by IMO members (which includes Australia) to address the issue of ship strike (referred to as IMO 2009). The document deals with actions that can be taken at the national level, including gathering information, education and outreach, technological development, and operational measures including routeing and reporting measures or speed restrictions. SEWPAC and the Australian Maritime Safety Authority are currently identifying appropriate actions for Australia that are consistent with IMO (2009).

As the management of issues relating to vessel strike are outside the control of Port of Townville, and management actions at a State and Commonwealth level to mitigate risks have not been fully developed, the residual risk level is considered to be the same as the 'unmitigated risk level'. Based on available shipping information it would appear that vessel strike is unlikely to result in significant impacts to the overall status of whale populations. Impacts at the population level as a result of the Port Expansion Project are not expected.

B.6.4.10 Introduced Marine Pests

In areas containing marine pests, there is a risk that pests could be transferred by the dredger from the dredge site to the DMPA. As discussed in Section B.6.3.8, no marine pest species have been recorded at the Port of Townsville, hence the risk of translocation pest species in the port is low.

There is also a risk that dredging plant (construction stage) and other vessels (operational stage) could translocate introduced marine pests from the port of origin to the Port of Townsville. There are two key vectors for introduced marine pests entering a port: biofouling of the vessel hull, or the release of pests into the marine environment via ballast waters (Hewitt & Campbell, 2010).

Vessel hulls and dredge plant can provide habitat for biofouling marine pest species. In particular, dredgers and associated construction equipment can provide complex habitats that may be difficult to clean and inspect (Hewitt & Campbell, 2010). Species such as black striped mussel (*Mytilopsis sallei*) and Asian green mussel (*Perna viridis*), which have a natural range in South-east Asia, represent key potential risk species for tropical Australian environments (Hayes, Sliwa, Migus, McEnnulty, & Dunstan, 2005).

Ballast water is typically discharged from each ship as it enters port, at the port anchorage areas, and at the berths as it is loaded. Most vessels discharge only a small percentage of their ballast water in outer approach channels to conform to navigational requirements. Most ballast water is discharged alongside the wharf as materials are loaded to balance the trim of the vessel and stresses in the vessel's hull.

As a general rule, it would be expected that ships originating from colder, temperate waters would have a lower risk than those originating from tropical ports. This is because foreign organisms from temperate ports are generally considered to be less likely to survive or proliferate in the warmer waters of the port, particularly with its comparative exposure to strong currents and typically oceanic salinity.

These risks will be managed in accordance with standard mitigation procedures discussed below.

B.6.4.10.1 Mitigation and Residual Impacts

Construction Phase

Management of marine pests will be undertaken in accordance with regulatory agency requirements (most notably AQIS). The Dredge Management Plan (Chapter C2.1) includes requirements for marine pest management and includes the following:

- Ballast water discharge and marine pest inspections occur in accordance with Department of Agriculture, Fisheries and Forestry (DAFF) standards.
- Vessels engaged in the Port Expansion Project construction will be subject to a biofouling risk assessment which may result in hull inspections and cleaning.
- Vessels will be required to maintain satisfactory records of antifoulant treatments, hull cleaning and ballast water treatment.

The residual risk level following the implementation of these risk strategies in classified as low.

Operational Phase

International and domestic vessels using the port are required to comply with national and state biofouling and ballast water management guidelines and requirements to reduce the risk of introductions of marine pest species.

Through the implementation of mitigation measures, the residual risk level for marine pests is low to medium (Table B.6.20).

B.6.4.11 Marine Pollution, Dust and Debris

Potential impacting processes from marine pollution, leaching of anti-foulants from ships, and dust are considered elsewhere in this EIS, particularly Chapter B4 (Marine Water Quality). Through the implementation of appropriate management strategies, marine pollution resulting from construction and operational works is considered to represent a low to medium risk to the marine environment.

Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris is listed as a key threatening process under the EPBC Act. Construction and operational works will generate large quantities of rubbish which could pose a risk to the marine fauna of the Study Area. In particular, plastic bags and packaging could pose a risk to local marine turtles, whales and fish populations.

A variety of waste management strategies will be employed to reduce waste generation and the quantity of plastic wastes entering the marine environment (Chapter B12). Through the implementation of these strategies, the residual risk to marine ecological values is considered to be low to medium (Table B.6.20).

B.6.4.12 Disturbance to the Seabed and Benthic Communities by Anchoring

There are presently no specific designated anchorage areas; however vessels are prohibited from anchoring in the channel and harbour basin areas, as well as a designated area east of Magnetic Island (see Section A.3.6.2.2). Vessels waiting to enter the port generally do so outside Cleveland Bay (i.e. generally north of the DMPA), although there are some limited areas that they can anchor inside the port waters with depth constraints.

In order to improve efficiency and safety for current ship operations, POTL and the Regional Harbour Master were, at the time of preparing the EIS, considering the introduction of designated anchorages. This process is independent of the Port Expansion Project, noting that the increase in vessel traffic resulting from the proposal is not expected to result in a commensurate increase in ships at anchor.

On this basis, it is not expected that the Project will increase the level of direct physical disturbance to the seafloor and associated benthic communities as a result of anchoring. Any impacts resulting from anchoring are expected to be highly localised and at low levels given the low numbers of ships at anchor. Furthermore, no sensitive benthic habitats or communities are known or likely to occur in offshore areas generally used for anchoring. The risk of ship anchoring impacts to marine ecology is therefore considered to be low.

B.6.4.13 Impacts to State Conservation Areas

B.6.4.13.1 Fish Habitat Areas

Fish Habitat Areas (FHA) represent a form of multiple use marine protected area that limits certain activities. The closest FHA to the Project Areas is the Cleveland Bay Fish Habitat Area, which extends across the eastern half of Cleveland Bay (Section B.6.3.2). No construction works will be undertaken in the FHA. The closest works area is the outer harbour, which is located approximately one kilometre to the west of the FHA. Turbid plumes generated by dredging and dredged material placement are not typically expected to extend into the FHA, except perhaps under unusual wind conditions. Any such occurrences are not expected to result in major impacts to fisheries habitat values supported by the FHA. The residual risk rating (pending implementation of dredge management strategies) is low (Table B.6.20).

B.6.4.13.2 Dugong Protection Areas

The entire area of Cleveland Bay is located in the Cleveland Bay Dugong Protected Area, which is a Zone 'A' Dugong Protection Area (DPA). As such, the Port Expansion Project Area, channels and DMPA are located in the Protected Area (Section B.6.3.2).

The Project is not expected to result in long-term changes to seagrass or seagrass habitat, nor construction activities expected to lead to significant changes to dugong populations in the Protected Area. Therefore, it is not expected that the Port Expansion Project will lead to significant changes to the values that underpin the DPA. Refer to Section B.6.4.14 for a discussion on potential impacts to dugongs.

B.6.4.14 Impacts on Matters of National Environmental Significance

B.6.4.14.1 Controlling Provisions

DSEWPaC determined that the Port Expansion Project (the Project) was a controlled action under Section 75 of the EPBC Act (refer to EPBC 2011/5979; 1 July 2011). The following matters of national environmental significance (MNES) were determined to be relevant to the Port Expansion Project:

- World Heritage properties (Sections 12 and 15A);
- National Heritage places (Sections 15B and 15C);
- Wetlands of international importance (Sections 16 and 17B);
- Listed Threatened Species and Communities (Sections 18 and 18A);
- Listed Migratory Species.(Sections 20 and 20A);
- Commonwealth marine areas (Sections 23 and 24A); and
- Great Barrier Reef Marine Park (Sections 24B and 24C).

B.6.4.14.2 World Heritage Properties

The Great Barrier Reef World Heritage Area (GBRWHA) was listed in 1981 as it supports a range of natural heritage values that contribute to the 'outstanding universal value' of the GBRWHA, as described in Section B.6.3.2. The Port of Townsville, including the Port Expansion Project Area, channels and DMPA, is located in the GBRWHA. Therefore, the Port Expansion Project will have direct and indirect effects to marine ecosystems in the GBRWHA during both the construction and operational stages.

The key impacts relate to the irreversible loss of soft sediment habitat due to reclamation, and ongoing impacts associated with day to day operations of the port facility. Temporary impacts to corals, seagrass and benthic fauna could occur as result of dredge plumes, and noise generated by dredging, piling and construction activities is also likely to result in the temporary avoidance of construction areas by marine megafauna and fish. Adverse impacts to ecological values are expected to occur at localised spatial scales (measured in hundreds of metres – in the vicinity of the construction/dredging footprints) and with the exception of reclamation, occur in the short to medium term (measured in months to years). A wide range of mitigation strategies will be adopted to reduce harm to marine ecological values supported by the GBRWHA.

The Port Expansion Project is not expected to result in: (i) the loss of any of the environmental values that contribute to the 'outstanding universal value' of the GBRWHA at even highly localised spatial scales; (ii) no major impacts to the environmental values that contribute to the 'outstanding universal value' of the GBRWHA at a Study Area wide (i.e. Cleveland Bay) spatial scale; and (iii) a change to the natural beauty of the GBRWHA given the existing industrial context of the port area. In terms of EPBC Act Significant Impact Guidelines 1.1 (DEWHA, 2009b), it is not expected that the Port Expansion Project will result in:

- One or more World Heritage values to be lost;
- One or more World Heritage values to be degraded or damaged; or
- One or more World Heritage values to be notably altered, modified, obscured or diminished.

The following describes potential impacts to the GBRWHA.

As described in Section B.6.3.2, the following list of attributes supported by Cleveland Bay and Magnetic Island natural values are considered to contribute to the 'outstanding universal value' of the GBRWHA:

- largest and most complex expanse of living corals;
- unique forms of marine life;

- a diversity of environmental assets such as forests, coral reefs, seagrass beds and mangroves (DSEWPC, 2011a), as well as inter-reefal and lagoonal benthos;
- great diversity of life-forms, including many species of coral, macroalgae, crustaceans, polychaetes, molluscs, phytoplankton, fish, seabirds, mammals and reptiles;
- exceptional natural beauty (DSEWPC, 2011a); and
- habitat and feeding areas for a number of rare, threatened and endemic species (DSEWPC, 2011a), including dugongs and turtle.

The existing integrity of these natural values varies throughout Cleveland Bay, however nearshore areas around Townsville, particularly those in the operational port areas, are generally in a slightly to moderately modified condition. Construction of the present day port facilities, most notably reclamation and dredging of intertidal and sub tidal areas, has resulted in extensive changes to habitats at the mouth of Ross Creek. Furthermore, a range of ongoing port-related pressures continue to affect the environmental values of nearshore areas, including maintenance dredging of berths and channels, and general disturbance associated with day to day port operations. The Port facilities are situated between the mouths of Ross Creek and Ross River, which experiences freshwater flows and ongoing inputs of sediments and contaminants derived from human activities in the catchment (i.e. urban development, agriculture, industrial land uses etc.).

The proposal will have a number of permanent impacts on marine ecological values in and directly adjacent to the works footprint. As discussed in Section B.6.4.2, the Project will result in the removal of 109 hectares of subtidal soft sediment habitat associated with reclamation area and under the breakwaters. Furthermore, capital dredging (deepening) of the outer harbour basin will lead to a change in depth profile and long-term changes to benthic communities. These two areas, which together comprise the Port Expansion Project Area, were found to contain small numbers of benthic invertebrates (dominated by small molluscs, polychaete worms and crustaceans) and no seagrass. Deepening of existing areas of the Platypus and Sea channels will lead to a small change in water depth, which is not expected to lead to major changes in benthic communities in the long term. The Project will also increase the area of hard substrate habitat, potentially leading to a localised increase in the relative abundance of reef associated species around the rock walls.

Impacts to marine ecological values resulting from the Port Expansion Project during construction and operation stages are summarised in Table B.6.3, and include the following:

- Potential primary impacts:
    - Loss of benthic biota and habitat as a result of reclamation, dredging and dredged material placement;
    - Potential harm to fauna as a result of vessel strike;
    - Noise disturbance and fauna displacement resulting from construction activities (dredging, pile driving, rock placement);
    - Potential highly localised changes in the productivity of benthic habitats adjacent to dredge and DMPA as a result of dredging and dredged material placement activities;
    - Lighting impacts to nesting turtles and hatchlings in the vicinity of the Strand;
    - Increase in rubbish entering the marine environment which may increase the risk of entanglement or ingestion by marine megafauna; and
    - Disturbance of benthic habitats in the construction area due to propeller wash or altered hydraulics.
- Potential secondary impacts:
    - Increase in sedimentation in Cleveland Bay due to dredging and placement of dredged material;
    - Increase in turbidity as a result of dredging and dredged material placement leading to mortality and/or stress to benthic fauna, corals and seagrass; and

- Loss of food resources and habitat due to dredging and placement leading to short term avoidance of disturbed area by marine fauna.

These impacting processes are expected to result in a range of short and long term changes to marine ecological attributes and functions. Through the implementation of mitigation strategies summarised in Section B.6.5, and taking into account EPBC Act Significant Impact Guidelines 1.1 (DEWHA, 2009b), significant impacts to the natural heritage values that contribute to the 'outstanding universal value' of the GBRWHA are not expected (Table B.6.16).

Table B.6.16 Criteria listed by the EPBC Act 1999 for a 'significant impact' and the 'likelihood' of impact to World Heritage Values, Commonwealth Marine Waters or Great Barrier Reef

Significance criteria	Assessment
Reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property.	The project will lead to modifications to benthic community structure as a result of dredging and reclamation. These impacts are expected to be highly localised (i.e. in the construction/dredging footprint), and are not expected to result in broader scale long-term impacts to the biodiversity values of Cleveland Bay (Section B.6.4.2).
Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property.	The project will remove 109 hectares of soft sediment habitat as a result of reclamation. Such habitats are well represented throughout Cleveland Bay, and the local vicinity of the Port area. No habitat types are known to be unique to Cleveland Bay, or the areas of disturbance. The Project will not isolate marine habitats, nor will it form a barrier to fauna movements between Ross Creek and Cleveland Bay (Section B.6.4.2).
Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property. Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in the World Heritage property.	Impacts to the abundance of marine flora and fauna species will occur as a result of the project. Such impacts are expected to be highly localised, and in many cases are of a temporary nature. Long term declines in the population status of any species are not expected to occur as a result of the project. No marine flora or fauna species are known to be locally endemic or unique to Cleveland Bay.

B.6.4.14.3 Introduced Marine Pest Management

As discussed in Section B.6.3.8, marine benthic surveys have been undertaken throughout the port area, which includes the Port Expansion Project Area. No marine pests of concern (*sensu* Hayes *et al.* 2005) for the Townsville region were recorded in the survey. A number of cryptic species that may originate from elsewhere were recorded, however these are not considered to represent pests of concern.

As discussed in Section B.6.4.10, marine pests could access the port via two main vectors: on the hull of ships (fouling organisms) or in ballast water. Mitigation strategies will be implemented to reduce the potential for future introduction of marine pest species during both construction and operational stages. These strategies have been prepared in consideration of National and State biofouling and ballast water guidelines for domestic and internal shipping traffic. A Dredge Management Plan has been developed to manage potential marine pest introductions resulting from construction activities (Chapter C2.1).

B.6.4.14.4 National Heritage Places

The GBRWHA is also a National Heritage Place, and impacts have been addressed above. Refer to Chapter B16 for impacts to other natural heritage places.

B.6.4.14.5 Wetlands of International Importance

The Port Expansion Project Area is located >9 km from the Bowling Green Bay Ramsar site (Section B.6.3.2), and will therefore not be directly affected by the works. Furthermore, turbid plumes generated by the Project will, due to the dominant wind patterns operating in the region, be highly unlikely to move towards the Ramsar site (see Chapter B3 - Coastal Processes and Chapter B4 – Marine Water Quality). As outlined elsewhere in this chapter, the proposal is highly unlikely to affect populations of marine fauna that inhabit the Cleveland Bay region, which comprises part of the Ramsar site. It is therefore considered highly unlikely that the proposal will adversely impact on Bowling Green Bay Ramsar site or its supporting values.

Table B.6.17 Criteria listed by the EPBC Act 1999 for a 'significant impact' and the 'likelihood' of impact to the Wetlands of International Significance

Significance criteria	Assessment
Areas of the wetland being destroyed or substantially modified	The reclamation footprint and dredge areas are located >9 km from the wetland. No direct impacts will therefore occur as result of the Port Expansion Project.
A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland	The Project will not affect fluvial flow regimes entering Cleveland Bay. The Project will have highly localised effects to hydrodynamics in the immediate vicinity of the reclamation footprint, which will not alter hydrodynamics of the wetland.
The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected	The Project will lead to modifications to benthic community structure as a result of dredging and reclamation. This is expected to result in highly localised impacts (i.e. in the construction/dredging footprint) to benthic assemblages. Major flow-on effects to marine fauna are not expected. Marine megafauna will be subject to noise disturbance as a result of construction activities, which could lead to avoidance of the immediate construction area. Such impacts will be highly localised and are not expected to result in broader scale impacts to the biodiversity values of Cleveland Bay or the wetland (Section B.6.4.2).
A substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or	The Project will have localised, short term impacts to water quality in the vicinity of the navigation channels and the outer harbour. This is not expected to lead to water quality changes to the wetland.
An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.	The Project will not deliberately introduce invasive species. There is some potential for international ships to incidentally introduce marine pests, which depending on the pest species under consideration could affect communities in Cleveland Bay. Mitigation strategies will be put in place to reduce the risk of introducing marine pests into the marine environment.

B.6.4.14.6 Threatened Species and Communities and Listed Migratory Marine Species

Cleveland Bay supports important habitats for migratory or transient threatened or protected marine fauna, including dugongs, dolphins and marine turtles (Section B.6.3.7). The threatened marine mammals, reptiles (sea turtles) and sharks identified in the protected matters database search have different likelihoods of occurring in the Port Expansion Project Area and areas potentially affected by dredging activities. Based on marine megafauna assessments undertaken by GHD (2009e; 2011c), it would appear that the species with the highest likelihood of occurring in the Port Expansion Project Area would be green turtles and dolphins. Loggerhead, hawksbill and flatback turtles, which are not common in Cleveland Bay (2009e; 2011c), could represent transient visitors to the port area from time to time, but are not known to favour the habitat types found here. The other threatened marine species are not known to favour habitats found in the Port Expansion Project Area and/or have an apparent low abundance in the nearshore environments of Cleveland Bay generally (Section B.6.3.7).

Most EPBC listed threatened species tend to favour offshore areas (e.g. whales, additional turtle species etc.), and could potentially occur in the DMPA from time to time. Humpback whale has been observed in the deeper waters of Cleveland Bay (October to January) as they undertake their annual migration. It is possible that this species would pass through the DMPA and dredged channels from time to time, but is less likely to occur in the Port Expansion Project Area. Green turtles and other turtle species could also occur in the DMPA and navigation channels as they move between feeding areas. The other listed threatened species are not known to favour habitats found in the DMPA and/or have an apparent low abundance in the offshore environments of Cleveland Bay generally (2009e; 2011c) . Marine megafauna species are considered to be especially vulnerable to anthropogenic impacts as they are long lived and slow growing, with a low rate of fecundity.

In terms of (non-threatened) migratory marine species (excluding avifauna), key species include dugongs, cetaceans and saltwater crocodile. Dugongs are abundant in Cleveland Bay, particularly in the dense seagrass around Cape Cleveland. Dugongs are however likely to occur throughout Cleveland Bay as they move between feeding sites (seagrass meadows) in and outside of Cleveland Bay. There is no seagrass in the Port Expansion Project Area, and sparse seagrass occur at the DMPA and adjacent to dredged channels from time to time. It is possible that dugongs could pass through both of these areas, although aerial surveys do not indicate that dugongs have high abundance in these areas (GHD, 2011c).

There are numerous other listed migratory marine mammals that could occur in or adjacent to the Port Expansion Project Area, two of which are relatively common in and adjacent to the Port Expansion Project Area and the DMPA: Australian snubfin dolphin and Indo-Pacific humpback dolphin. GHD (GHD, 2011c) notes that the two dolphin species are common in nearshore environments throughout Cleveland Bay, and are likely to regularly feed in port area (including the Port Expansion Project Area) Both dolphin species also has important feeding and nursing areas in Cleveland Bay, particularly around Ross River. Both species also occur in the DMPA and around the navigation channels.

Estuarine crocodiles are known to occur in Cleveland Bay region, although there are few confirmed records for the Ross River and port area. There are no nesting sites or preferred feeding habitats in the Port Expansion Project Area and surrounds (i.e. typically mangrove lined creeks), and it is not expected that the proposal would interfere with any movements through the site (should it occur). The Project is therefore unlikely to impact on local populations of this species.

The potential effects of individual impacting processes to marine megafauna are considered in earlier sections. Of potential relevance in terms of this proposal are the following impacting processes:

- Loss of habitat due to reclamation and dredging activities (Section B.6.4.2, B.6.4.3, B.6.4.4);
- Loss of habitat (particularly seagrass and reefs) and prey populations due to turbid plume and/or sedimentation impacts (Section B.6.4.4; B.6.4.5);
- Vessel strike (Section B.6.4.9);
- Noise pollution and visual disturbance, resulting in modified foraging and breeding behaviours, and movement patterns (Section B.6.4.7);
- Light pollution and its effects on habitat usage patterns (Section B.6.4.8); and
- Pollution resulting from chemical or oils spills, or inappropriate stormwater management practices (Section B.6.4.11).

Table B.6.20 is a summary of the predicted level of impact of the proposal to marine ecology and other MNES, including threatened and migratory marine species (identified as having a likely or possible occurrence in the affected areas), associated with each of these impacting processes. The potential cumulative effect of these impacting processes on threatened species have also been considered in terms of the matters set out in the Administrative Guidelines on Significance under the EPBC Act, which are summarised in Appendix K1.

Taking into account the matters set out in the Administrative Guidelines on Significance under the EPBC Act (DEWHA, 2009b), nature and condition of Port Expansion Project Area's habitat and the nature of the development, the Port Expansion Project is not expected to result in major, long term changes to population of these species. Successful implementation of mitigation strategy commitments during both construction and operational phases, in combination with those commitments to manage and enhance wader habitat values throughout the remainder of the study site will effectively reduce any potential longer-term impact to regional populations of threatened to a negligible level.

B.6.4.14.7 Commonwealth Marine Areas

The Port Expansion Project Area is located wholly within Queensland State waters, with the existing Offshore DMPA adjacent to the Commonwealth marine area at approximately three nautical miles from the coast. As the Commonwealth marine area does not extend to the direct footprint of the Port

Expansion Project Area or Cleveland Bay, potential impacts on the Commonwealth marine area will be far less than for the GBRWHA, which includes the Port expansion Project Area and Cleveland Bay.

The potential effects of individual impacting processes to marine ecosystems of the Commonwealth Marine Area are considered in earlier sections. Of potential relevance in terms of this proposal are the following impacting processes:

- Vessel strike impacts to marine megafauna (Section B.6.4.9);
- Noise pollution and visual disturbance to marine megafauna (Section B.6.4.7) – construction generated noise is not expected to result in impacts to fauna in the Commonwealth Marine Area. Vessels traversing the Commonwealth marine area during the operational phase will represent a noise ; and
- Pollution resulting from chemical or oils spills (Section B.6.4.11).

Impact significance has been assessed against Significant Impact Guidelines 1.1 (DEWHA, 2009b) for Commonwealth Marine Areas (Table B.6.17). Based on the implementation of appropriate mitigation strategies, the Port Expansion Project is not likely to have a significant impact on the environment in the adjacent Commonwealth marine area.

B.6.4.14.8 Great Barrier Reef Marine Park

The Port Expansion Project Area and DMPA are located outside the Great Barrier Reef Marine Park (GBRMP). However, a small proportion of the existing Sea Channel (adjacent to Bremner Point) intersects the GBRMP in an area zoned as Habitat Protection. The Port Expansion Project will see the deepening of the portion of the Sea Channel in the GBRMP. This portion of the channel has similar biodiversity values as other portions of the navigation channels. The Project is not expected to lead to major changes to the functional or biodiversity values presently supported by in this portion of the channel.

As part of the Project, the Sea Channel will be lengthened, which will extend into the General Use zone of the GBRMP. The channel extension in the GBRMP has a total length of 2.7 km and total area of 24.8 hectares.

Impact significance has been assessed against Significant Impact Guidelines 1.1 (DEWHA, 2009b)for Commonwealth Marine Areas (Table B.6.17) and the GBRWHA (Table B.6.17). Based on the implementation of appropriate mitigation strategies, the Project is not likely to have a significant impact on the environment in the adjacent Great Barrier Reef Marine Park.

Table B.6.18 Criteria listed by the EPBC Act 1999 for a 'significant impact' and the 'likelihood' of impact to the Great Barrier Reef Marine Park or Commonwealth marine area

Significance criteria	Assessment
Modify, destroy, fragment, isolate or disturb an important, substantial, sensitive or vulnerable area of habitat or ecosystem component such that an adverse impact on marine ecosystem health, functioning or integrity in the Great Barrier Reef Marine Park or Commonwealth marine area results.	The Proposal is located in nearshore waters of Cleveland bay and will therefore not directly affect Commonwealth Marine Areas. Dredging will occur in the existing Sea Channel which is partly located in the GBRMP. This area is representative of soft sediment habitat elsewhere in Cleveland Bay, and is not expected to result in major impacts to the values and functions of the GBRMP.
Have a substantial adverse effect on a population of a species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution.	Major impacts to populations and the spatial distribution of whales and dolphins are not expected as result of the Port Expansion Project. Noise generated by construction activities could lead to the avoidance of cetaceans (mainly dolphins) of the immediate area around the construction footprint. Furthermore, dredging will lead to a short term loss of food resources for dolphins in the dredging footprint (and DMPA), which are located outside the GBRMP and Commonwealth Marine Area. Refer to Appendix K1 for discussion.
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological health or integrity or social amenity or human health.	The Project will have localised, short term impacts to water quality in the vicinity of the navigation channels and Port Expansion Project Area. This is not expected to lead to water quality changes to the Commonwealth Marine Area. Turbid plumes generated by dredging of the Sea Channel are predicted to extend into sections of the GBRMP surrounding Magnetic Island. Mitigation strategies will be adopted to reduce the generation of turbid plumes, and to amend dredging practices should turbidity reach levels where unacceptable impacts to adjacent marine environments (including corals and seagrass) could occur. Through the implementation of appropriate mitigation strategies, major long term impacts to marine ecological values of the GBRMP are not expected.
Result in a known or potential pest species being introduced or becoming established in the Great Barrier Reef Marine Park or Commonwealth marine area.	The Project will not deliberately introduce invasive species. There is some potential for international ships to incidentally introduce marine pests, which depending on the pest species under consideration, could affect communities in Cleveland Bay. Mitigation strategies will be put in place to reduce the risk of introducing marine pests into the marine environment.
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.	The Project could lead to accidental discharges of hydrocarbons (e.g. during refuelling) and other contaminants (e.g. during product transport and handling) during construction and operational phases. Mitigation strategies will be implemented to reduce this risk, as described in Section 6.5.
Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.	N/A – refer to Cultural Heritage Chapter.

B.6.5 Mitigation Measures and Residual Impacts

B.6.5.1 Environmental Management Plans (EMPs)

The Dredge Management Plan (DMP) (Chapter C2.1) contains a number of environmental elements which outline controls that will be implemented to reduce harm to marine flora and fauna and their habitats. The DMP will be refined by POTL or its dredging and construction contractors as the Port Expansion Project's design and construction methodology moves into the detailed design phase. The DMP contains the following aspects: Management Objectives, Targets, Actions, Performance Indicators, Monitoring and Reporting, Corrective Actions and Responsibilities.

Table B.6.19 Summary of commitments – marine ecology mitigation strategies

Statement of Commitment	Phase	EIS Section
Refine the DMP to provide guidance on the mitigation measures that will be adopted to reduce impacts to marine flora and fauna.	Planning, Construction	B.6.4.4 C2.1
Capital dredging of the channels will not be carried out during late spring and summer, which are critical periods for the resilience and reproduction of corals and seagrass.	Planning	B.6.4.4
The selection of dredge plant will be based on both environmental and logistical/engineering considerations. In particular, the use of a grab dredger will reduce the disturbance of seabed habitats and turbid plumes in nearshore areas. Furthermore, an environmental valve ('green valve') will be used in overflow pipes of the trailer suction hopper dredger to reduce the dispersion of sediments from dredging.	Planning, Construction	B.6.4.4
Overflow levels in the trailer suction hopper dredger will be raised to the highest allowable point during sailing from the dredge area to the DMPA to ensure spillage of sediment is reduced.	Construction	B.6.4.4
Sailing routes of the dredge will be optimised to reduce the generation of propeller wash.	Planning, Construction	B.6.4.4
A reactive monitoring program including measurements of water quality, coral and seagrass indicators will be developed and implemented. Dredging activities will be modified or suspended in the event that monitoring detects exceedance/s of trigger values. The trigger values are based on both sub-lethal effects guidelines (i.e. changes in turbidity relative to background) and direct impact response guidelines (i.e. coral bleaching and/or mortality), which will illicit different management responses.	Construction	B.6.4.4
Bathymetry survey of the DMPA and immediate surrounds will be undertaken immediately prior to dredging and following dredging to optimise the dredged material relocation activities.	Construction	B.6.4.3
Ensure that works are only undertaken in the approved construction footprints.	Construction	B.6.4.3, B.6.4.2
Implement controls to reduce the potential for underwater noise impacts to marine megafauna. This includes the implementation of an exclusion zone around pile driving activities, the distance of this exclusion zone to be defined by site testing and investigation of noise mitigation measures until the underwater propagation of piling noise at the site can be quantified. Ensure that only one pile driver is operating at any one time, and monitoring.	Planning, Construction	B.6.4.7
Undertake monitoring of marine megafauna during construction to reduce the risk of interactions with construction vessels.	Construction	B.6.4.6
Lighting will be fit for purpose, and will be designed to reduce potential disruption of nesting and hatching of marine turtles.	Planning, Construction, Operation	B.6.4.8
Marine pest management included in DMP to reduce risk of marine pest introductions, to be developed in accordance with AQIS and other regulatory agency requirements.	Construction	B.6.4.10 and C2.1

B.6.5.2 Environmental Monitoring

Environmental monitoring programs form key strategies in the DMP. In summary, POTL is committed to the implementation of two environmental programs:

- A reactive water quality, seagrass and coral health monitoring program (Section B.6.4.4);
- A reactive marine megafauna monitoring and reporting program (Section B.6.4.6 and B.6.4.7); and

The DMP (Section C2.1 of the EIS) provides a description of each of these monitoring programs.

Additionally, as part of proposed offsets for the Project, POTL proposes to contribute towards an Ecosystem Health Monitoring Program (EHMP). The Port's proposed contribution to an EHMP would be focussed on initial establishment and then a financial contribution to annual water quality monitoring and public reporting. Ecosystem health monitoring and research is also proposed for biotic components of the system – namely seagrass, corals, fish and megafauna. Refer to Chapter B23.2 for further information.

B.6.5.3 Residual Impacts

B.6.5.3.1 Residual Impacts Requiring Offsets

Environmental offsets are only applicable when the impacts from a development or action cannot be avoided or reduced and if all other Government standards are met. As such, offsets apply once options and alternatives have been examined, it is not feasible or practicable to design out the impacts and best practice mitigation on the site or with respect to the impacting processes have been applied (e.g. mitigation measures).

Based on the key findings of the PEP EIS Chapters, the key aspects of the Project that require consideration of environmental offsets relate to the following residual impacts from the development:

- Permanent, irreversible impacts will occur as a result of the PEP reclamation and breakwater construction. While there are no seagrass communities (observed as part of current sampling or historically) or rocky reefs present in the footprint of the works, the reclamation and associated breakwater construction will result in the loss of approximately 110 ha of unvegetated soft substrate. These habitats are characterised as having low to moderate biodiversity values but are contained in the core habitat area of the snubfin and other coastal dolphin species.
- Temporary Adverse Residual Impacts. Capital dredging of the outer harbour and the deepening of the Platypus and Sea channels will deepen the seabed from its current bathymetry. The total area of capital dredging in the outer harbour and Channels is estimated to be approximately 220 ha. The areas subject to capital dredging in the nearshore are characterised as having low to moderate biodiversity values; with low biodiversity values present in the offshore channels. The footprint of capital dredging has no seagrass communities (observed as part of current sampling or historically) or rocky reefs present. The capital dredging associated with the PEP are a temporary impact noting that the deeper areas will re-colonise with benthic organisms rapidly following disturbance (months). The benthic assemblages that recolonise these areas will be similar in character to other areas of the port where dredging has previously occurred.
- Permanent Beneficial Residual Impacts. There will be a permanent beneficial impact from the creation of rock wall habitat around the perimeter of the reclamation along the major breakwaters. This has been estimated in the design as creating 10.55 ha of subtidal rock wall habitat and 1.45 ha of intertidal rock wall habitat. The ecosystem services provided by the created rock wall habitat are considered to be significantly greater than the current unvegetated soft sediments they are replacing. Key values include habitat for fisheries of commercial and recreational significance, supplemental feeding habitat for foraging green turtles and opportunistic high tide roosting habitat for migratory and resident waterbirds.

Offsets are proposed in relation to key residual impacts as outlined in Section B.6.5. These offsets are outlined in Chapter B23.2.

B.6.6 Cumulative Impacts

Cumulative and interactive effects described in the preceding sections have considered the interactive impacts associated with the nearshore and offshore expansion works for the Port Expansion Project. As discussed throughout this impact assessment report, fish and marine invertebrates, particularly those of commercial significance, use offshore and nearshore environments at different stages of their life-history. The findings of this impact assessment report takes into consideration the impacts of other (nearshore) components of the study.

In broad terms, the Port Expansion Project will result in:

- Irreversible impacts to habitats associated with reclamation on previous soft sediment habitats, deepening of the port area, and widening, deepening and lengthening of the navigation channel;
- Temporary water quality and ecological impacts associated with the generation of turbid plumes by construction activities and placement of dredged material to sea; and
- Potential impacts to marine species associated with increased marine pollution and vessel movements in the port area during the operational phase.

Together, these key impacting processes will result in localised adverse changes to the ecological health of near-shore environments in and adjacent to the disturbance areas. Mitigation strategies associated with these impacting processes are summarised in Section B.6.6.

Major infrastructure projects currently underway that will be completed when the Port Expansion Project commences include:

- The Townsville Port Access Corridor road, including the construction of a bridge across the Ross River near the port (DTMR project);
- The Berth 12 development adjacent to the Port Expansion Project; and
- Berth 8 in the inner harbour of the port.

These projects are expected to produce a similar range of impacting processes to the marine environment as the Port Expansion Project, albeit resulting in different environmental effects. In summary, these and other major marine infrastructure projects will involve the removal of soft sediment habitat, increase in hard substrate habitat, and short term changes to water quality and disturbance of marine flora and fauna associated dredging and construction operations. Once the new port facilities are operational, vessel traffic, maintenance dredging requirements and potentially pollutant loads will increase, leading to ongoing chronic impacts to the marine ecological values in the vicinity of the port area.

In terms of the cumulative loss of marine benthic habitat (and associated communities), it is noted that the above potential future port expansion projects are located in existing operational port areas and are subject to ongoing disturbance associated with day to day port operations. The subtidal benthic habitats in these areas, like the Port Expansion Project Area, are structurally simple and contain habitat types that are widely represented throughout the nearshore areas of Cleveland Bay.

The subtidal soft-sediment habitats in these potential future development areas occur in and adjacent to important feeding area for nearshore dolphin species (Australian snubfin dolphin, Indo Pacific humpback dolphin) at a Cleveland Bay wide scale. Ongoing studies demonstrate that the Ross Creek and Ross River mouths, together with the Platypus and Sea channels, represent locally important foraging area for both of these nearshore dolphin species.

The cumulative effects associated with the loss and degradation of subtidal soft sediment habitats due to potential future port developments is not expected to result in the loss of any species (and therefore local diversity) from Cleveland Bay. However, measurable adverse impacts to marine biodiversity values at localised (nearshore Cleveland Bay) spatial scales are expected. In particular, proposed future port projects could reduce available foraging area for nearshore dolphin species, possibly resulting in reduced numbers of dolphins visiting the local area. POTL has undertaken a range of investigations to assess marine megafauna usage of the port area and wider Cleveland Bay, which will need to be considered in future port planning and environmental impact assessment studies.

The Port Expansion Project and future port development projects will increase the amount of artificial hard substrate habitat in the port area. Artificial rock walls presently represent a dominant habitat type in the nearshore port area, and provide a range of functional ecological values for a range of reef associated species. The artificial hard substrate habitat created by potential future port development projects (including the Port Expansion Project) will provide similar functional values as existing artificial hard substrate habitats. As reef fish populations are not thought to be habitat limited, the increase in hard substrate habitat is not expected to increase fish population sizes in the region. However, the new (and existing) hard substrate habitat will function as fish aggregation devices, which is expected increase recreational fishing opportunities around the port area.

The potential future port development areas are not known to support seagrass or other high quality foraging habitat for marine megafauna, fish or shellfish of economic significance. However, extensive (albeit patchy) seagrass meadows occur adjacent to navigation channels and the DMPA, which have the potential to be adversely affected by port operations. Rasheed and Taylor (2008) suggest that the structure of seagrasses communities in Cleveland Bay adjacent to port infrastructure are a product of high levels of turbidity generated by natural processes (i.e. primarily wind-induced sediment resuspension) and port activities (e.g. dredging and vessel movements). Long-term chronic (press-type) disturbance to seagrass meadows and corals may occur if inappropriately managed. The Port of Townsville Limited is therefore committed to the long-term support of the an ecosystem monitoring programme to detect and manage any chronic cumulative impacts to seagrass meadows and corals resulting from port activities.

An increase in vessel traffic around the port area during port construction activities may increase the likelihood for boat strike of megafauna, or the avoidance of the area by some species (Section B.6.4.6). A construction vessel management plan will be developed for each project that takes into consideration of cumulative impacts of port construction activities. The plans will include strategies such as speed limits, fauna spotters, and other strategies to avoid and report interactions with marine megafauna.

As discussed in Section B.6.4.9, the number of cargo ships visiting the Port of Townsville is projected to increase from 675 ships per annum in 2010 to 1008 ships per annum in 2025, and 1338 ships per annum in 2040. The increase in ship movements increases the potential for collisions between ships and cetaceans. At greater risk are whales, due to their slow speed and habit of swimming near the water surface. As the management of issues relating to vessel strike are outside the control of Port of Townville, and management actions at a State and Commonwealth level to mitigate risks have not been fully developed, the residual risk level is considered to be the same as the 'unmitigated risk level'. It is noted however that the Townsville region is not known to represent a key humpback whale habitat, and that based on the existing low levels of vessel strike, it is considered unlikely that impacts to whale species would occur at the population level.

Climate change is predicted to result in changes to a range of processes that maintain the ecological character of the Great Barrier Reef and adjacent environments. The impact predictions in previous sections (most notably sections B.6.3.4.3; B.6.3.5.4; B.6.3.7.2; B.6.4.2; B.6.4.4) have considered the potential interactive effects on ecosystem resilience between the project and climate related stressors. In particular, the following climatic processes are expected to have interactive effects with the project:

- Heat stress – which can adversely affect seagrass and corals (e.g. bleaching, mortality), and reduce their resilience to turbid plumes generated by dredging.
- High rainfall and cyclonic events - which can adversely affect seagrass and coral resilience, and therefore their capacity to recover from potential turbid impacts.

As outlined in the previous sections, dredging and placement activities will be carefully managed to minimise the potential for impacts to corals and seagrass, and potential flow-on effects to species that rely on these habitats.

In terms of long term impacts, the main impacting processes resulting from the project are the replacement of soft sediment habitat with artificial rock wall habitat at the reclamation site, and an increase in ship traffic using Cleveland Bay and the wider Great Barrier Reef. It is uncertain how these activities could interact with climate change processes that are likely to have their greatest effects in decades to centuries (e.g. sea level rise, ocean acidification). POTL is committed to undertaking routine monitoring of the health of Cleveland Bay in order to understand and manage potential impacts of their activities.

B.6.7 Assessment Summary

Project activities that have the potential to impact on the environment are summarised in Table B.6.20.

Table B.6.20 Impact Assessment Summary – Marine Ecology

Element	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact*	Risk Rating	Mitigation Measures	Residual Risk
1) Impacts on seagrass	1a. Turbid plumes and sedimentation resulting from dredging of the Sea/Platypus channels (and associated placement) leading to the temporary loss of ephemeral deepwater seagrass (if present)	Moderate	Unlikely (as seagrass is rarely present)	Low	▪ Use of 'green valve' by TSHD to reduce plume dispersion. ▪ Reduce tailwater discharges near sensitive locations. ▪ Alter the timing of dredging to reduce the potential likelihood for turbid plumes to impact on sensitive receptors. ▪ Management of dredge plumes through the implementation of a reactive monitoring program. ▪ Dredging during winter.	Low
	1b. Turbid plumes and sedimentation resulting from dredging of the Sea/Platypus channels leading to the temporary loss of nearshore seagrass around Magnetic Island and western Cleveland Bay	Moderate to High	Possible (if undertaken in summer)	Medium		Low to Medium
	1c. Turbid plumes and sedimentation resulting from dredging of the Sea/Platypus channels leading to the temporary loss of nearshore seagrass around eastern Cleveland Bay	Moderate to High	Highly unlikely	Low to Medium		Low
2) Impacts on corals	2a. Turbid plumes and sedimentation resulting from dredging of the Sea/Platypus channels leading to coral stress and/or mortality, and detectable changes to community structure	Moderate to High	Possible	Medium to High	▪ As for 1a	Medium
	2b. Direct loss of reef habitat due to construction and dredging	Moderate	Highly unlikely	Low	▪ Ensure dredging only occurs in specified dredge footprint	Low
3) Impacts on soft sediment habitats and invertebrate communities	3a. Turbid plumes and sedimentation resulting from dredging channels, berths and harbour basin leading to the temporary, detectable changes to benthos	Minor	Likely	Medium	▪ As for 1a	Low to Medium
	3b. Removal of habitat and fauna through reclamation (irreversible) and capital dredging (temporary) resulting in detectable impacts to soft sediment communities in the wider Cleveland Bay area and/or significant effects to GBRWHA values	High	Highly Unlikely	Medium	▪ An offset package will be developed to offset this habitat loss	Medium

Element	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact*	Risk Rating	Mitigation Measures	Residual Risk
	3c. General disturbance and degradation of benthic habitats in the harbour basin through day to day port operations (maintenance dredging, stormwater discharges, spills etc.) leading to changes in benthic communities in basin area and immediate surrounds	Minor	Likely	Medium	▪ Implementation of stormwater and waste management measures	Medium
	3d. Changes to hydrodynamics and morphology due to operation of new harbour facilities and channels leading to changes in benthic communities in basin area and immediate surrounds	Minor	Likely	Medium	▪ Nil	Medium
	3e. Loss of benthic fauna due to dredged material placement in long-term changes to community structure in and directly adjacent to DMPA	Moderate	Unlikely	Low	▪ Ensuring disposal only occurs in DMPA, and bathymetry surveys to inform placement activities.	Low
4) Impacts of hard substrate habitat	4a. Expansion of rock wall habitat associated with the new harbour facilities	Beneficial	Almost certain	Positive benefit	▪ N/A	Positive benefit
5) Impacts to marine megafauna	5a. Light spill from construction plant and port facilities leading to disorientation of hatchlings or nesting adults	Moderate	Unlikely	Low	▪ Light management procedures to reduce light spill to the marine environment	Low
	5b. Increase in rubbish production increasing the risk of entanglement and/or ingestion of marine debris by turtles and marine mammals	Moderate	Possible	Medium	▪ Waste management procedures implemented by construction contractors and operator	Low
	5c. Increase in noise leading to marine fauna temporarily avoiding affected area (displacement)	Moderate	Likely	Medium	▪ Megafauna management in Dredge Management Plan	Low
	5d. Injury/mortality to marine megafauna (turtles) resulting from the use of dredge plant	High	Possible	Medium	▪ Megafauna management in Dredge Management Plan ▪ Visual checks for megafauna, and implement strategies to avoid interactions ▪ Tickler chains on dredge head ▪ Ensure suction is ceased prior to hoisting the dredge head	Low to Medium

Element	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact*	Risk Rating	Mitigation Measures	Residual Risk
	5e. Loss of food resources and habitat as a result of construction and port facility operation leading to displacement of marine megafauna	High	Possible	Medium	▪ Refer to 1a for turbidity/ sedimentation impacts ▪ Refer to 3b for offsets	Medium
	5f. Increased potential for hydrocarbon or other contaminant spill from vessels or on-site facilities, potentially leading to direct effects to marine megafauna or their prey (construction, operation)	High	Unlikely	Medium	▪ Develop hazardous material handling procedures ▪ Implement emergency response procedures ▪ Spill response training for staff	Medium
	5g. Increase in vessel traffic during construction phase potentially leading to an increase in vessel strike risk or habitat disturbance due to prop wash	High	Possible	Medium	▪ As for 5c ▪ Go slow zones	Medium
	5h. Increase in vessel traffic during operational phase potentially leading to an increase in vessel strike risk or habitat disturbance due to prop wash	High	Possible	Medium	▪ Nil	Medium
6) Impacts on fisheries production	6a. Loss of fisheries habitat associated with reclamation (irreversible) and dredging activities (temporary) resulting in reduced fisheries production	Moderate	Unlikely (at Cleveland Bay wide scale)	Low	▪ Refer to 3b for offsets ▪ Monitoring to assess recovery of benthos and seagrass following dredging activities	Low
	6b. Displacement of economic species due to construction related disturbance resulting in reduced fisheries production	Moderate	Unlikely (at Cleveland Bay wide scale)	Low	▪ Nil	Low
	6c. Increased potential for hydrocarbon or other contaminant spill from vessels or on-site facilities, potentially leading to direct effects to economic species or their prey (construction, operation)	High	Unlikely	Medium	▪ As for 5f.	Medium
7) Marine pests	7a. Increased potential marine pest introductions	High	Possible	Medium	▪ Implement state and Commonwealth biofouling and ballast management requirements	Low - Medium

Element	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact*	Risk Rating	Mitigation Measures	Residual Risk
8) Impacts to GBRMP	8a. Deepening of the portion of the Sea Channel in the GBRMP leading to detectable changes to benthic habitats and communities in the wider GBRMP	High	Unlikely	Medium	▪ Nil	Medium
	8b. Dredge plume impacts to marine ecology in GBRMP	Moderate	Unlikely	Low	▪ Nil	Low
9) Impacts to FHA	9a. Dredge plumes leading to loss of seagrass, and subsequent reduction in the abundance of economic species supported by the FHA	Moderate	High Unlikely	Low	▪ Refer to 1a.	Low
10) Impacts to GBRWHA values (marine ecology)	10a . The key impacts relate to the irreversible loss of soft sediment habitat due to reclamation, and ongoing impacts associated with day to day operations of the port facility. Temporary impacts to corals, seagrass and benthic fauna could occur as result of dredge plumes, and noise generated by dredging, piling and construction activities is also likely to result in the temporary avoidance of construction areas by megafauna and fish. Significant changes to natural values supporting the outstanding universal value of the GBRWHA.	High	Unlikely	Medium	▪ Refer to 1 – 9 above ▪ Impacts to benthos to be offset	Medium with offsets
11) Impacts on Ramsar site	11a. Dredge plumes leading to loss of seagrass, and subsequent reduction in the abundance of marine megafauna supported by the site	Moderate - High	Highly Unlikely	Low - Medium	▪ Refer to 1a.	Low - Medium

(*) a likelihood rating is some circumstances given for both regional (i.e. whole of Cleveland Bay) and local (i.e. impact usually restricted to disturbance area and immediate surrounds) spatial scales. Where regional and local scales are not explicitly stated, the likelihood rating applies to the local spatial scale.

Port Expansion Project EIS

Part B

Section B7 – Terrestrial Ecology

AECOM BMT WBM

B.7 Terrestrial Ecology

B.7.1 Relevance of the Project to Terrestrial Ecology and its Values

This section addresses potential environmental effects and impacts to terrestrial ecology associated with the PEP, specifically in relation to the construction and operation of the new port facilities including land reclamation. It specifically describes:

- the main features of the existing environment in the Project and Study Areas, focusing on important or sensitive ecological resources and the integrity of coastal ecosystems
- potential impacts on the terrestrial environment from the construction and operation of the PEP facilities
- options for avoiding, preventing, reducing or managing identified potential impacts.

In terms of impact assessment, it is noted that the PEP is located in marine waters adjacent to the existing northern breakwater, at least 1 km from any natural terrestrial environment. The port land adjacent to the Project Area has been reclaimed. Siting and design of the PEP has been selected to avoid or reduce environmental impacts to the greatest practicable extent. The mitigation strategies outlined in this chapter aim to mitigate construction and operational impacts to terrestrial ecology associated with the PEP.

As the PEP does not require any vegetation clearing and will not result in the loss of terrestrial habitat (defined as land above the low tide mark), this chapter focuses on the terrestrial environmental values in the Study Area, particularly in terms of migratory and wading shorebirds that use terrestrial habitats. Emphasis is placed on the shorebird habitat associated with the Ross River and along the coastline of Magnetic Island where indirect effects may potentially occur.

B.7.2 Assessment Framework and Statutory Policies

B.7.2.1 Assessment Framework

The Project Area refers to the area bounded by the port expansion footprint and includes the offshore dredging works area as described in Section A1.1 (Introduction) and the reclamation ponds of the eastern reclamation area (Figure B.7.1). The Study Area refers to the broader, predominantly coastal, areas of Cleveland and Rowes bays and the coast of Magnetic Island (Figure B.7.1).

Flora and fauna species, communities and habitats in the Project and Study Areas were defined through desktop analysis of relevant literature, Commonwealth and state online databases, and previous studies. This desktop assessment included consideration of:

- *Townsville Marine Precinct Project Environmental Impact Statement, Terrestrial Ecology Study* (GHD, 2009f)
- *Townsville Marine Precinct Project Environmental Impact Statement, Avifauna Assessment* (Driscoll P. , 2009)
- *The Biodiversity Management Plan for Environmental Reserve 2009-2014 (TPAR)* – a Biodiversity Management Plan (BMP) prepared for the Townsville Port Access Road (TPAR) (DTMR, 2008b)
- *Patterns of Utilisation of the Mouth of the Ross River by Migratory Birds and Sea Turtles* (Maunsell AECOM, 2008b)
- *Vegetation Survey of the Proposed Stuart Bypass and Eastern Access Corridor*, report for Department of Main Roads (Maunsell AECOM, 2008c)

- Environment Protection and Biodiversity Conservation (EPBC) protected matters search tool (Appendix L1) (DSEWPC, 2012g)
- DSEWPC threatened species and community listing advice for various listed species (SPRAT) (DSEWPC, 2012g)
- Directory of Significant Wetlands mapping (DSEWPC, 2012f)
- Department of Environment and Heritage Protection (DEHP) Wildlife Online database (DEHP, 2012f)
- Regional ecosystem (RE) mapping (version 6.0) (DERM, 2012f), high value regrowth mapping (version 2) (DEHP, 2012d), essential habitat mapping (version 3) (DEHP, 2011), biodiversity planning assessment mapping (version 1.2) (DEHP, 2012e); and wetland mapping (version 1.3) (DEHP, 2009)
- Queensland Herbarium Regional Ecosystem Description Database (REDD) (Queensland Herbarium, 2011).

Online database searches were conducted with a 3 km buffer around the land reclamation and dredging works. Ecological reports for previous development in the area undertook significant analysis of historical shorebird data, the results of which have been incorporated into this chapter.

B.7.2.2 Statutory Policies

The following is a summary of Commonwealth and state legislation that is relevant to terrestrial ecological aspects of the PEP. Section A2.6 provides a general discussion regarding this legislation.

- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) is the primary Commonwealth legislation for protecting the environment in relation to Commonwealth land and controlling significant impacts on matters of national environmental significance (MNES). The EPBC Act requires assessment and approval of actions that are likely to have a significant impact on MNES, are undertaken by a Commonwealth agency, or involve Commonwealth land and will have a significant impact on the environment.

  MNES relevant to terrestrial ecology for the PEP relate to:

  - world heritage properties and national heritage places
  - wetlands of international significance (Ramsar wetlands)
  - Commonwealth listed threatened species and ecological communities
  - migratory species.
- *Nature Conservation Act 1992* (Qld) (NC Act) provides a framework for the management of protected areas and the protection of native flora and fauna. Many species of native plants and almost all vertebrate native animals in Queensland are protected wildlife under the NC Act, including birds, reptiles and mammals. The NC Act also provides for the protection of threatened and near threatened flora and fauna species.
- *Land Protection (Pest and Stock Route Management) Act 2002* (Qld) (Land Protection Act) provides a framework to manage pests and address their environmental impacts. Under the Land Protection Act, pests are declared according to three class categories, each with varying obligations for its control. Of particular relevance to the PEP is the management of declared pests identified or predicted to occur in the vicinity of the port.
- *Vegetation Management Act 1999* (Qld) (VM Act) aims to halt broad scale clearing in Queensland and protect mapped remnant and regrowth vegetation from unauthorised clearing. It recognises RE and has a vegetation community focus. RE are located on Magnetic Island and on the mainland north and south of the port (Figure B.7.1).
- *Coastal Protection and Management Act 1995* (Qld) (Coastal Act) protects and manages the coastal zone, including its biodiversity, primarily through coastal management plans. The object of the Act is to coordinate and integrate planning and management of the coastal zone to achieve ecologically sustainable development.
- *Queensland's Coastal Plan 2011* (DERM, 2012a) has been prepared under the Coastal Act and replaces the *State Coastal Management Plan – Queensland's Coastal Policy*. The plan describes how

the coastal zone is to be managed. The plan has two parts: the *State Policy for Coastal Management* and *State Planning Policy 3/11: Coastal Protection* (SPP 3/11). *State Policy for Coastal Management* applies to coastal land and its resources in the coastal zone. The plan applies to management planning, activities, decisions and works that are not assessable development under the *Sustainable Planning Act 2009* (SP Act) and not subject to SPP 3/11. The PEP is assessable under the *Sustainable Planning Act 2009.* It is subject to the SPP 3/11 and *State Policy for Coastal Management* does not apply.

- *State Planning Policy 3/11: Coastal Protection* is a statutory instrument under the SP Act. It protects the resources of the coastal zone by setting out criteria for land-use planning, coastal activities and development assessment decisions in the coastal zone under the SP Act. The Townsville port precinct is located in the coastal zone protected by SPP 3/11; therefore, SPP 3/11 applies to the PEP.

B.7.3 Existing Values, Uses and Characteristics

The Project Area extends seawards from the northern boundary of the port and includes the marine waters north of the Ross River. The port is located in the Brigalow Belt Bioregion. The existing port is surrounded by commercial and industrial developments, the Breakwater Marina, Magnetic Island Ferry Terminal and residential areas to the south at South Townsville. The Project Area is in the Great Barrier Reef World Heritage Area, which extends from the low water mark of the mainland.

While Magnetic Island is located approximately 13 km north of the port, the Sea Channel extension will terminate approximately 1.5 km offshore of the eastern side of the island and extend into the Great Barrier Reef Marine Park (GBRMP). The GBRMP extends from the low water mark on the mainland and excludes an area around the Port of Townsville and shipping channels (Figure B.7.1).

B.7.3.1 Environmentally Sensitive Areas

B.7.3.1.1 World Heritage and Natural Heritage Properties

The entire Project Area is located within the boundaries of the Great Barrier Reef World Heritage Area (Figure B.7.1). The criteria for which the Great Barrier Reef World Heritage Area is listed are predominantly marine and are assessed in Chapter B6 (Marine Ecology). Of relevance to terrestrial ecology are the ‘feeding or breeding grounds for international migratory seabirds’ stated as elements on Great Barrier Reef World Heritage Area listing criteria.

A bird survey of the PEP area, the eastern reclamation area, the revetments that form part of the Marine Precinct Area and eastern reclamation area, and the Ross River Sandspit was undertaken by NRA Environmental Consultants between November 2011 and February 2012 (Appendix L3) to ascertain current usage by resident and migratory shorebirds.

B.7.3.1.2 Wetlands of International and State Importance

The Project Area does not intercept any wetlands. There are several wetlands in the Study Area (Figure B.7.1).

The northern extent of the Bowling Green Bay Ramsar wetland is located more than 9 km to the east of the closest PEP component and extends the length of Cleveland Bay to Cape Cleveland and beyond. The Bowling Green Bay wetland was designated as a Ramsar site in 1993 because of the diverse complex of coastal wetland systems that occur. The area also provides a range of other habitats including inter-tidal seagrass beds, mangrove woodlands and saline saltpan communities on the coast, and brackish to freshwater wetlands inland. This area contains extensive tracts of forest and woodland on the mountainous areas and on the coastal dune systems. This site provides important habitat and foraging opportunities for a range of fauna and flora, including threatened species, breeding birds and a large number of migratory species (DSEWPC, 2012g).

Other wetlands of significance that occur in the Study Area are protected under the *State Planning Policy 4/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments*. These wetlands include the Townsville Town Common, various smaller wetlands to the south of the port and other wetlands associated with Bowling Green Bay. There are also four wetlands identified under the *Directory of Important Wetlands in Australia* in the Study Area. These wetlands are Burdekin-Townsville Coastal Aggregation, Bowling Green Bay and RAAF Townsville. The Townsville Coastal Aggregation wetlands include the length of the coastline stretching from Ross River to Cape Cleveland (with the southern and eastern parts within the Bowling Green Bay Ramsar listed site).

B.7.3.1.3 Protected Areas

There are no terrestrial protected areas in the Project Area. There are several protected areas in the Study Area (Figure B.7.1). Under Queensland legislation, Bowling Green Bay and parts of Magnetic Island are listed as national parks. The conservation parks include Townsville Town Common, Cape Pallarenda, Horseshoe Bay lagoon and Bowling Green Bay . Magnetic Island National Park is located approximately 1 km west of the dredging work for the Sea Channel (Figure B.7.1). All other protected areas are located more than 6 km from the Project Area.

Approximately 55% of Magnetic Island is national park. It is the only large continental island in the Northern Brigalow Belt Bioregion. Magnetic Island National Park protects a range of habitats for fauna and flora including 22 threatened species and several vegetation communities (MICDA & MINCA, 2004). The vegetation on the lowlands of the island includes dune systems, alluvial fans and piedmont deposits, and wetlands. The south-east coastline is characterised by plunging steep rock faces, but also includes bays with beaches and gently sloping offshore sand flats. The south-west coastline is the most complex and contains extensive offshore reef flats, mudflats, seagrass beds, mangroves and hyper-saline clay flats.

The Sea Channel extension extends into the GBRMP.

B.7.3.1.4 Wildlife Corridors

Wildlife corridors link important habitat across large areas and allow for the movement of wildlife in search of food, nesting opportunities and mates. The Project Area does not intercept terrestrial wildlife corridors mapped by the DEHP. State significant corridors extend from just south of the port and from Cape Cleveland, southwards and joining up to link to the Bowling Green Bay National Park.

B.7.3.1.5 East Asian – Australasian Flyway

The EAAF is one of nine major migratory waterbird flyways worldwide. The flyway extends from within the Arctic Circle in Russia and Alaska, southwards through east and south-east Asia, to Australia and New Zealand (EEAF, 2008).

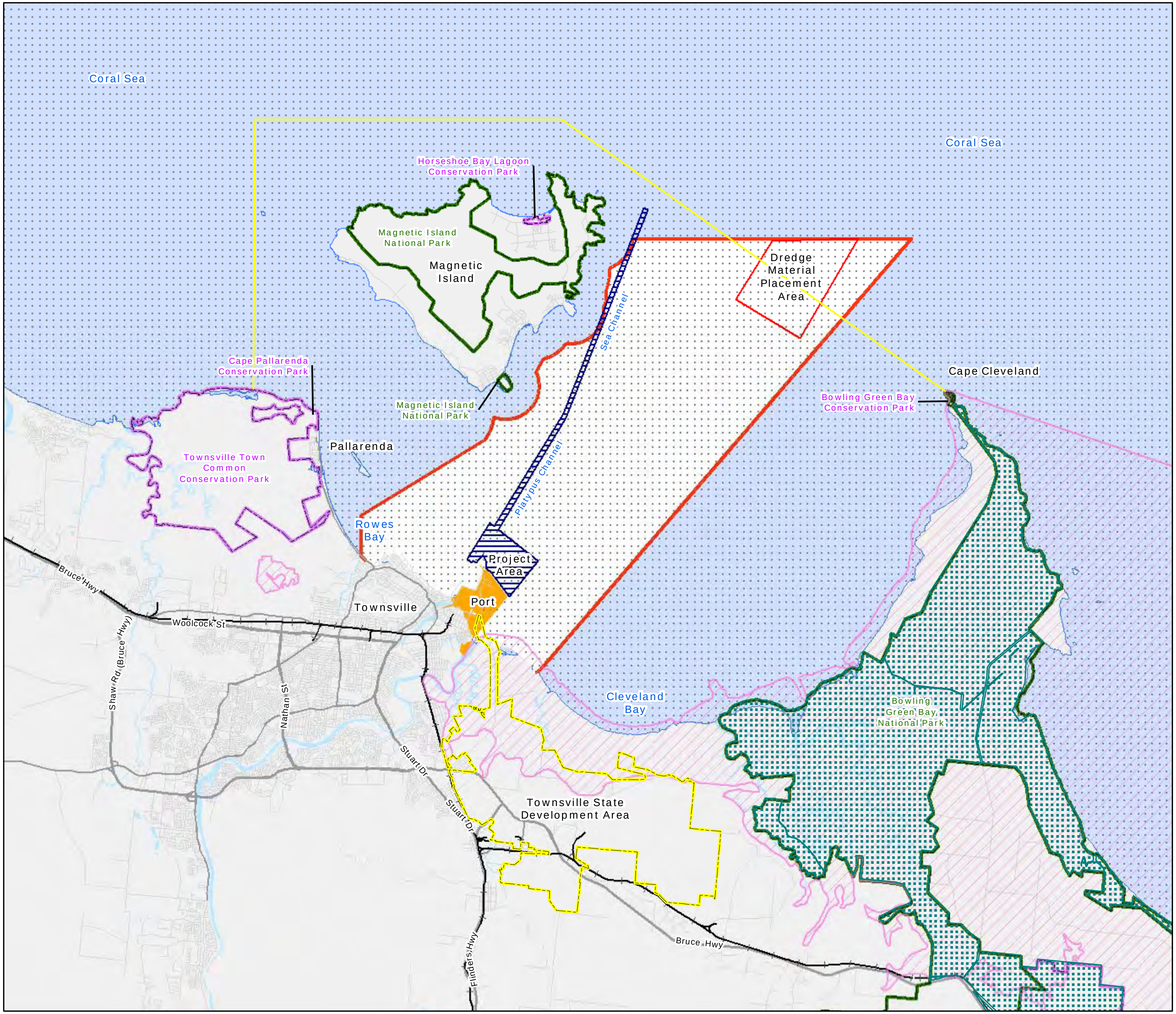
The wetland and mudflat habitats associated with Ross River, parts of Magnetic Island National Park, Bowling Green Bay National Park and Townsville Town Common Conservation Park provide foraging and roosting habitat for migratory shorebirds, including those that use the EAAF. Various other roosting and foraging sites have been identified in the region (Driscoll P. , 2009). The habitat located on the east side of Ross River has been identified as a significant roosting and foraging site for shorebirds, particularly for the number of great knot (*Calidris tenuirostris*), red-necked stint (*Calidris ruficollis*), greater sand plover (*Charadrius leschenaultia*), lesser sand plover (*Charadrius mongolus*), eastern curlew (*Numenius madagascariensis*) and whimbrel (*Numenius phaeopus*) that have been recorded there (Driscoll P. , 2009; Maunsell AECOM, 2008b). Historical information suggests that the east bank of the Ross River supports over 3,000 shorebirds during the migratory season and is regionally significant (Driscoll P. , 2009). Under the *Wildlife Conservation Plan for Migratory Shorebirds* (DEH & NHT, 2006), sites that regularly support 1% of the flyway population are considered important habitat for migratory shorebirds in Australia. Based on previous records of shorebirds and the DEH definition, the east bank of the Ross River would be considered important habitat for the great knot (*Calidris tenuirostris*) and the red-necked stint (*Calidris ruficollis*) (Maunsell AECOM, 2008b). Historic records for the greater sand plover (*Charadrius leschenaultia*) and the eastern curlew (*Numenius madagascariensis*) were just under the 1% flyway estimates, but exceed 1% of the national population estimates (Maunsell AECOM, 2008b; Geering, Agnew, & Harding, 2007).

The protection of shorebird habitat is important for the conservation of shorebirds, particularly migratory birds that rely on these areas to obtain food to support their long migration. Australia is involved in a range of conservation activities to protect shorebirds in Australia and across the EAAF. Australia has signed agreements with three countries, Japan (JAMBA), Korea (ROKAMBA) and China (CAMBA), and two multilateral agreements (Ramsar and Bonn Conventions) to protect migratory species and their habitat. *The Wildlife Conservation Plan for Migratory Shorebirds* was formulated under the EPBC Act (DEH & NHT, 2006), which sets out management actions necessary to support the survival of migratory shorebird species.

PORT EXPANSION PROJECT EIS

Terrestrial Protected Areas Adjacent to the Project Area

Figure B.7.1



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Marine Park Exclusion Area
- Government Reserves
- National Park or Forest
- Bowling Green Bay Ramsar Site
- GBRWHA/National Heritage Place
- Directory of Important Wetland Sites (DIWA) - Burdekin - Townsville Coastal Aggregation (QLD 005)

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_012

B.7.3.2 Vegetation Communities

The works are located in marine waters and will not directly disturb terrestrial vegetation. The existing port land adjacent to the land reclamation was also once reclaimed and is also devoid of native vegetation.

The Study Area contains vegetation that has been mapped as remnant RE by DEHP (Figure B.7.2). RE are vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. RE are protected under the VM Act and are categorised as endangered, of concern or least concern based on the pre-clearing and remnant extent of the vegetation. In addition to the VM Act status, the REDD also lists the biodiversity status of RE. The biodiversity status is based on an assessment of the condition of the remnant vegetation in addition to the criteria used to classify vegetation under the VM Act.

Under the VM Act:

- endangered RE are those that have:
  - less than 10% of the pre-clearing extent remaining or
  - 10% to 30% of the pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha.
- of concern RE are those that have:
  - 10% to 30% of the pre-clearing extent remaining or
  - more than 30% of the pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha.
- least concern RE are those that have:
  - more than 30% of the pre-clearing extent remaining and
  - the remnant vegetation remaining is more than 10,000 ha.

Table B.7.1 identifies the RE in the Study Area. These are located along the coastline of Magnetic Island and the mainland to the south and north of the port.

Table B.7.1 Regional Ecosystems in the Study Area

RE	Location	Short Description	VM Status	BD Status
11.1.1	Horseshoe Bay, south-west coast of Magnetic Island, Cape Pallarenda, south of port, Bowling Green Bay	*Sporobolus virginicus* grassland on marine clay plains	least concern	no concern at present
11.1.2	Horseshoe Bay, south-west coast Magnetic Island	Samphire forbland on marine clay plains	least concern	no concern at present
11.1.4	Horseshoe Bay, south-west coast Magnetic Island, Cape Pallarenda, Bowling Green Bay	Mangrove forest/woodland on marine clay plains	least concern	no concern at present
11.2.1	Horseshoe Bay, south-west coast and parts of east coast of Magnetic Island	*Eucalyptus platyphylla*, *Corymbia tessellaris* woodland on sandy coastal plains	of concern	of concern
11.2.2	Horseshoe Bay, south-west coast and parts of east coast of Magnetic Island, Cape Pallarenda, south of port, Bowling Green Bay	Complex of *Spinifex sericeus*, *Ipomoea pes-caprae* and *Casuarina equisetifolia* grassland and herbland on foredunes	of concern	of concern
11.2.3[1]	Horseshoe Bay, south-west coast and parts of east coast of Magnetic Island	Microphyll vine forest (beach scrub) on sandy beach ridges	of concern	of concern
11.2.5	Cape Pallarenda, south of port, Bowling Green Bay	*Corymbia-Melaleuca* woodland complex of beach ridges and swales	least concern	no concern at present
11.3.11[1]	Horseshoe Bay, north-east coast Magnetic Island, Cape Cleveland	Semi-evergreen vine thicket on alluvial plains	endangered	endangered
11.3.9	Horseshoe Bay, parts of east and south-	*Eucalyptus platyphylla,*	least	no concern

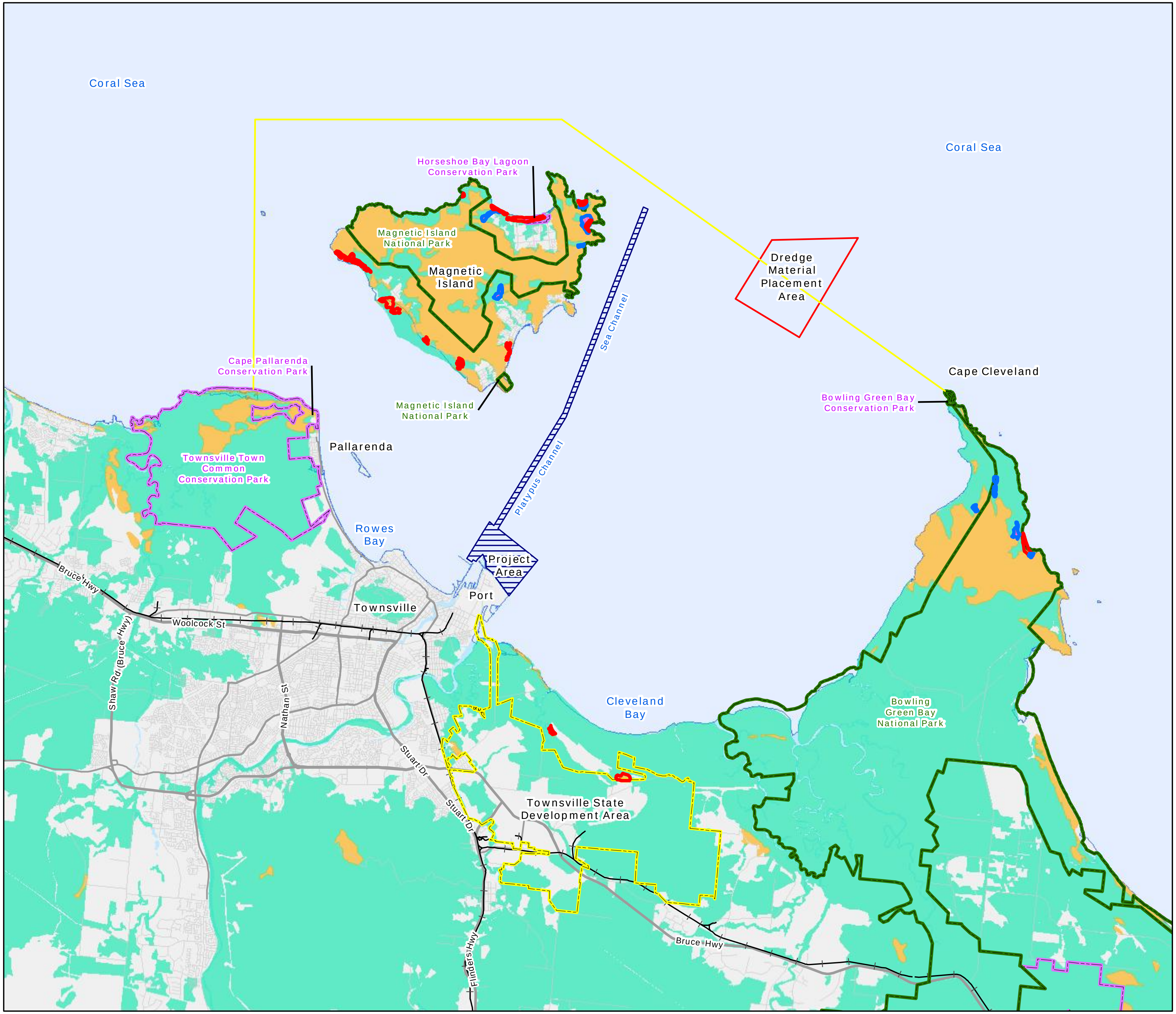
RE	Location	Short Description	VM Status	BD Status
	west coast of Magnetic Island, Cape Cleveland	*Corymbia* spp. woodland on alluvial plains	concern	at present
11.3.25b	Near Horseshoe Bay, south-west part of Magnetic Island	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	least concern	of concern
11.12.4	Several locations on Magnetic Island, Cape Cleveland, near Shelly Beach	Semi-evergreen vine thicket and microphyll vine forest on igneous rocks	least concern	no concern at present
11.12.9	Near Shelly Beach, Bowling Green Bay	*Eucalyptus platyphylla* woodland on igneous rocks	least concern	no concern at present
11.12.12	Various locations along east coast of Magnetic Island	*Araucaria cunninghamii* woodland on igneous rocks (boulder-strewn coastal hills)	of concern	of concern
11.12.16	Significant proportion of Magnetic Island, Cape Pallarenda, Cape Cleveland	*Acacia* spp. low woodland on igneous rocks. Coastal hills	of concern	of concern

1 In Queensland, ten regional ecosystems have been identified that correspond to communities listed under the EPBC Act. Two of these, 11.2.3 and 11.3.11 occur in the Study Area (Figure B.7.2).

PORT EXPANSION PROJECT EIS

Regional Ecosystems

Figure B.7.2



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Dredge Material Placement Area
- Government Reserves
- National Park or Forest

Regional Ecosystem

- Remnant Vegetation Containing Endangered Regional Ecosystem
- Remnant Vegetation Containing of Concern Regional Ecosystem
- Remnant Vegetation that is a Least Concern Regional Ecosystem
- Regional Ecosystem Containing 11.3.11
- Regional Ecosystem Containing 11.2.3

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_013

B.7.3.3 Fauna Habitat Values

As part of the works, the north-eastern revetment will be removed and a north-eastern breakwater will be constructed. The revetment provides habitat for a range of flora and fauna, including algae and invertebrate communities in the inter-tidal zone (Figure B.7.3). This revetment habitat is likely to support aggregation areas and habitat for a range of fish and shellfish species (Chapter B6 (Marine Ecology)); therefore, it may provide foraging opportunities for terrestrial fauna, particularly seabirds. The breakwater is used by shorebirds (such as sooty oystercatcher (*Haematopus fuliginosus*), grey-tailed tattler (*Tringa brevipes*), common sandpiper (*Actitis hypoleucos*), striated heron (*Butorides striata*) and whimbrel (*Numenius phaeopus*)) as a roosting site when it is exposed at appropriate times of the day and for sufficient periods.

Many shorebirds rely on wetlands in their non-breeding season in Australia, generally feeding on invertebrates in exposed inter-tidal mudflats at and around low tide and resting above the mean high water mark at high tide (Spencer, 2010). Roosts are usually open, flat areas with a clear view, easy take-off and landing, with low disturbance and a suitable microclimate so that energy needed to remain thermo-neutral is minimal (Spencer, 2010). The inter-tidal areas of the Project Area, such as the Ross River Sandspit may provide foraging and roosting habitat for a variety of shorebirds and other waterbirds, including threatened and migratory species (Figure B.7.3). In the port, the existing revetment may also provide opportunistic habitat of this type.

Based on previous studies (MICDA & MINCA, 2004; Maunsell AECOM, 2008b; DTMR, 2008b; Driscoll P. , 2009) and available literature, the following habitat types are identified as occurring along the coastline of Magnetic Island and the mainland south and north of the port.

- Tidal and inter-tidal mudflats: This habitat type is sometimes characterised by a samphire forbland or bare ground mudflat and can be found at the mouth of the Ross River and along the south-west coastline of Magnetic Island. This habitat type is a significant foraging resource for resident and migratory shorebirds, providing feeding, and in some locations, roosting opportunities.
- Sandbanks and sandspits: These communities are generally devoid of vegetation and at times are submerged by water. Sandbanks and sandspits in proximity to tidal flats provide safe roosting opportunities for shorebirds at high tide. A significant sandspit is located on the east side of the Ross River. The Ross River Sandspit is defined as one of the top 40 roost sites for shorebirds along the east coast of Queensland because it is regularly frequented by around 2,000 shorebirds (Driscoll P. , 2009; Driscoll P. , 1997, pp. 22:24-36) (Figure B.7.3).
- Grasslands: Marine grasslands are often dominated by *Sporobolus virginicus* or other salt-tolerant grassland species. This habitat generally occurs on the landward side of inter-tidal mudflats and bays. Spinifex complexes and other grassland communities also occur on the foredunes and beach ridges. Grasslands provide shelter, nesting and foraging opportunities for some birds, and a refuge from predators. This vegetation type is known to occur at various locations on Magnetic Island, Shelly Beach, and in proximity to the coast both north and south of the port.
- Mangrove shrubland and tall shrubland: This community occurs in areas that are under tidal influence and are dominated by a range of mangrove species. Mangroves provide food and shelter for vertebrates and invertebrates. Mangrove shrublands occur near Shelly Beach, in a few areas near Pallarenda and Rowes Bay, extensively along the coast to the south of the port, extensively along the south-west coast of Magnetic Island and near Horseshoe Bay. Previous studies have noted a large, permanent flying fox camp accommodating 90,000 to 110,000 flying foxes including little red flying fox (*Pteropus scapulatus*) and black flying fox (*Pteropus alecto*) in the mangroves between Gordon and Stuart Creeks, to the south of the port.
- Permanent freshwater, tidal estuaries and coastal lagoons: There are several waterways draining into Rowes Bay and Cleveland Bay. The freshwater and estuarine habitats associated with the waterways on the mainland (Ross River, Three Mile Creek, Alligator Creek, Crocodile Creek and Cocoa Creek) and on Magnetic Island (Ned Lee Creek, Duck Creek, Chinaman Gully, Peterson Creek and Alma Creek) provide habitat and foraging opportunities for a range of species. An ibis and egret rookery is located approximately 1.5 km upstream of the Ross River and provides habitat for various other birds that use neighbouring areas (Driscoll P. , 2009).
- Eucalypt forest or woodland: Forests and woodlands, given their diverse composition and structure, provide habitat for a range of fauna including birds, mammals, reptiles and amphibians. Several

areas of eucalypt forest and/or woodland occur in the Study Area. Previous studies at the mouth of the Ross River describe the woodland in this area as fragmented, weed infested and disturbed from recreational vehicle users; however, a number of fauna species were identified using this area, including a pair of brown goshawks (*Accipiter fasciatus*) (GHD, 2009f).

- Semi-evergreen vine thicket and vine forest: Vine forest and thickets are floristically and structurally diverse and offer a range of habitat values. This community is particularly important for frugivorous fauna. This community occurs in several locations on Magnetic Island, near Cape Cleveland and Shelly Beach.

PORT EXPANSION PROJECT
EIS

Migratory Bird Habitat

Figure B.7.3

Legend

- Railway Line
- Stage 2 Allignment Proposed Rail Corridor
- Townsville Port Access Road
- Project Area
- Townsville State Development Area
- Existing Port Land
- Sandspit
- Revetments

N

Scale: 1:20,000 (when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_011

B.7.3.4 Species and Communities of Conservation Significance

B.7.3.4.1 Threatened Ecological Communities

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT) are listed as an endangered ecological community under the EPBC Act (DSEWPC, 2012g) and have been mapped in the Study Area. The Project Area does not contain any EPBC Act listed threatened terrestrial ecological communities.

The SEVT community is considered an extreme form of dry seasonal subtropical rainforest and is generally characterised by the prominence of microphyll sized leaves and the frequent presence of swollen-stemmed bottle trees as emergents from the vegetation. Thickets tend to have an uneven canopy with mixed evergreen, semi-evergreen and deciduous emergent trees (McDonald, 2010).

This community originally covered 900,000 ha (between latitudes 19°S and 31°S). By 2003 its extent had declined to 150,000 ha. Widespread clearing, fire, weeds, grazing, vertebrate pests and coastal development are common threats to this community.

In Queensland, ten regional ecosystems have been identified that correspond to EPBC Act listed SEVT. Of these, two regional ecosystems occur in the Study Area, mostly along the south-west coastline of Magnetic Island, Horseshoe Bay, near Cape Cleveland and in small isolated areas along the east coast of Magnetic Island (Figure B.7.2):

- 11.2.3: Microphyll vine forest (‘beach scrub’) on sandy beach ridges
- 11.3.11: Semi-evergreen vine thicket on alluvial plains.

B.7.3.4.2 Threatened Terrestrial Flora and Fauna Species

Five bird species listed as threatened under the NC Act were observed in the Project Area during the latest avian survey (Appendix L3). No other threatened terrestrial fauna have been recorded in the Project Area. No threatened flora species are known to occur in the Project Area. Database and literature searches indicate that various habitats in the Study Area, including extensive wetlands, mudflats, estuaries, sandspits, breakwaters and revetments, vine thickets and forests are suitable for a range of threatened flora and fauna.

Essential habitat for fauna and flora has been mapped in several locations on Magnetic Island and near Cape Pallarenda. The wetlands, mudflats and sandspits in the Study Area are known to provide habitat for several species of land animals.

Table B.7.2 summarises the total number of species identified from the desktop assessment that potentially occur in the Study Area (Appendix L1 contains further details regarding these species).

Table B.7.2 Number of Threatened Terrestrial Species Potentially Occurring in the Study Area

Listing	Birds	Mammals	Reptiles	Plants
Endangered or vulnerable under the EPBC Act[1]	6	5	2	5
Endangered, vulnerable or near threatened under the NC Act	15	4	4	4
Species listed under both Acts	6	3	2	3
Total	15	6	4	6

1 No critically endangered or conservation dependent listed species were detected

An assessment of the likelihood of these species occurring in the Project Area was undertaken based on previous records and habitat available in the Study Area (Appendix L1). Those species that inhabit forested or vegetated areas are highly unlikely to occur in the Project Area. Some coastal species that forage in mangroves, on tidal flats and in the marine environment may occur in the Project Area as flyovers as they travel between habitats. Five of the 31 species were confirmed to use the Project Area and it is possible that a further two species may be present. All seven species are listed under the NC Act only and include:

- coastal sheathtail bat (*Taphozous australis*) – vulnerable
- black-necked stork (*Ephippiorhynchus asiaticus*) (confirmed) – near threatened
- beach stone-curlew (*Esacus magnirostris*) (confirmed) – vulnerable

- sooty oystercatcher (*Haematopus fuliginosus*) (confirmed) – near threatened
- eastern curlew (*Numenius madagascariensis*) (confirmed) – near threatened
- little tern (*Sterna albifrons*) (confirmed) – endangered
- Australian swiftlet (*Aerodramus terraereginae*) – near threatened.

Threatened bird species were recorded in the developed sections of the port, the undeveloped sections of Lot 773 on EP 2211 and the Ross River Sandspit. The little tern (*Sterna albifrons*), beach stone-curlew (*Esacus magnirostris*), eastern curlew (*Numenius madagascariensis*) and sooty oystercatcher (*Haematopus fuliginosus*) either roost, forage and/or breed on the Ross River Sandspit.

B.7.3.4.3 Migratory and Marine Species

Fifty-one migratory and/or marine bird species listed on one or more of JAMBA, CAMBA and ROKAMBA have been recorded in the region based on the desktop assessment (Appendix L1) or during the NRA (2012) surveys (Appendix L3). Twenty-four migratory species were recorded during site surveys in the Project Area (Table B.7.3) (Appendix L3). Given that suitable habitat is available in the Study Area, particularly for migratory shorebirds, it is highly likely that migratory and marine species would occur as flyovers at some point in time. Based on previous records of species and the availability of foraging habitat in the Study Area, the following migratory and/or marine bird species protected under the EPBC Act could occur as flyovers in the Project Area (Table B.7.3).

Table B.7.3 Marine and Migratory Species Recorded or Potentially Occurring in the Project Area

Scientific Name	Common Name	EPBC Act Status		Presence Confirmed [1]
		Migratory	Marine	
Actitis hypoleucos	common sandpiper	Yes	Yes	Port area
Apus pacificus	fork-tailed swift	Yes	Yes	-
Ardea ibis	cattle egret	Yes	Yes	Port area
Ardea intermedia	intermediate egret	-	Yes	-
Ardea modesta	eastern great egret	Yes	Yes	Port and sandspit
Arenaria interpres	ruddy turnstone	Yes	Yes	-
Calidris acuminata	sharp-tailed sandpiper	Yes	Yes	Port and sandspit
Calidris alba	sanderling	Yes	Yes	-
Calidris canutus	red knot	Yes	Yes	Sandspit
Calidris ferruginea	curlew sandpiper	Yes	Yes	Port area
Calidris ruficollis	red-necked stint	Yes	Yes	Port and sandspit
Calidris tenuirostris	great knot	Yes	Yes	Port and sandspit
Charadrius leschenaultia	greater sand plover	Yes	Yes	Port and sandspit
Charadrius mongolus	lesser sand plover	Yes	Yes	Port and sandspit
Charadrius ruficapillus	red-capped plover	-	Yes	-
Charadrius veredus	oriental plover	Yes	Yes	-
Chlidonias leucopterus	white-winged tern	Yes	Yes	-
Coracina novaehollandiae	black-faced cuckoo-shrike	-	Yes	-
Coracina papuensis	white-bellied cuckoo-shrike	-	Yes	-
Egretta sacra	eastern reef egret	Yes	Yes	Port area
Esacus magnirostris	beach stone-curlew	-	Yes	-
Haliaeetus leucogaster	white-bellied sea eagle	Yes	Yes	Port area
Haliastur indus	brahminy kite	-	Yes	-
Haliastur sphenurus	whistling kite	-	Yes	-
Himantopus himantopus	black-winged stilt	-	Yes	-
Hirundo rustica	barn swallow	Yes	Yes	-
Hydroprogne caspia	Caspian tern	Yes	Yes	Port and sandspit
Limicola falcinellus	broad-billed sandpiper	Yes	Yes	-

Scientific Name	Common Name	EPBC Act Status		Presence Confirmed [1]
		Migratory	Marine	
Limosa lapponica	bar-tailed godwit	Yes	Yes	Port and sandspit
Limosa limosa	black-tailed godwit	Yes	Yes	Sandspit
Merops ornatus	rainbow bee-eater	Yes	Yes	Port area
Monarcha melanopsis	black-faced monarch	Yes	Yes	-
Monarcha trivirgatus	spectacled monarch	Yes	Yes	-
Myiagra cyanoleuca	satin flycatcher	Yes	Yes	-
Numenius madagascariensis	eastern curlew	Yes	Yes	Port and sandspit
Numenius minutus	little curlew	Yes	Yes	-
Numenius phaeopus	whimbrel	Yes	Yes	Port and sandspit
Philomachus pugnax	ruff	Yes	Yes	-
Pluvialis fulva	Pacific golden plover	Yes	Yes	Sandspit
Pluvialis squatarola	grey plover	Yes	Yes	Sandspit
Recurvirostra novaehollandiae	red-necked avocet	-	Yes	-
Sterna albifrons	little tern	Yes	Yes	Port and sandspit
Thalasseus bengalensis	lesser crested tern	Yes	Yes	-
Thalasseus bergii	crested tern	-	Yes	-
Threskiornis molucca	Australian ibis	-	Yes	-
Tringa brevipes	grey-tailed tattler	Yes	Yes	Port area
Tringa incana	wandering tattler	Yes	Yes	Predicted
Tringa nebularia	common greenshank	Yes	Yes	Port and sandspit
Tringa stagnatilis	marsh sandpiper	Yes	Yes	Predicted
Xenus cinereus	Terek sandpiper	Yes	Yes	Port area

In 2012, the red-necked stint (*Calidris ruficollis*) and lesser sand plover (*Charadrius mongolus*) were recorded in nationally significant abundances on the port's eastern reclamation area. There were between 500 and 600 individual red-necked stints estimated on two different survey days in January and February 2012, which makes a significant population of this bird species at this site. There was also a significant population of lesser sand plovers recorded in January and February 2012, with approximately 140 birds recorded at the site (Appendix L3).

Driscoll (Driscoll P. , 2009) provides a more thorough synthesis of historical shorebird summer counts and seasonal patterns for shorebirds using the east bank of the Ross River. The abundance and diversity of different species varies according to time of year (i.e. lower outside the over-wintering period) and spatially in the vicinity of the Project Area and its surrounds. Most of the wader species and certain other species (e.g. white-winged tern (*Chlidonias leucopterus*)) listed in Table B.7.3 breed in the northern hemisphere and occur in Queensland mainly from spring to early autumn (Marchant & Higgins, 1993; Higgins & Davies, 1996). Historical counts at the Ross River Sandspit indicated a higher abundance of shorebirds during the summer months between October and January, compared to the winter months (Driscoll P. , 2009; Maunsell AECOM, 2008b). Other non-shorebird species that also occur in these communities include seabirds and waterbirds. Shorebirds tend to dominate with an average of only four non-shorebirds to 100 shorebirds (Driscoll P. , 2009).In some instances, significant numbers of terns, pelicans, egrets, cormorants and birds of prey, such as kites and sea-eagles, have been observed (Driscoll P. , 2009).

Species in Table B.7.3 have been recorded foraging and/or roosting on the mudflat and sandbank habitats in proximity to the Project Area. In the past, shorebirds have also been recorded using man-made environments created by land reclamation (Driscoll P. , 2009). NRA (2012) identified grey-tailed tattler (*Tringa brevipes*), common sandpiper (*Actitis hypoleucos*), striated heron (*Butorides striata*) and whimbrel (*Numenius phaeopus*) roosting on the revetments in the Project Area (Appendix L3).

Further south of the Ross River, between Stuart Creek and Gordon Creek, there is a 45 ha roosting and breeding bird and flying fox colony. Australian ibis (*Threskiornis molucca*) and straw-necked ibis (*Threskiornis spinicollis*) (marine species) are present throughout the year, as are small numbers of eastern great egret (*Ardea modesta*), intermediate egret (*Ardea intermedia*) and little egret (*Egretta garzetta*) (migratory and marine species). During summer, increasing numbers of cattle egret (*Ardea ibis*) visit the site to breed.

B.7.3.5 Invasive Species

Invasive terrestrial fauna species are present in the Project Area (eastern reclamation area and revetments):

- European rabbit (*Oryctolagus cuniculus*)
- domestic cat (*Felis catus*)
- black rat (*Rattus rattus*).

Databases searches and previous surveys (Driscoll P. , 2009; Maunsell AECOM, 2008b) indicate that several invasive flora and fauna species are also known to occur or have the potential to occur in the Study Area. Table B.7.4 identifies the invasive flora and fauna species that are declared under the Land Protection Act that occur in the Study Area. The reserve area to the south of the port contains a total of 50 introduced plant species, including seven declared under the Land Protection Act (DTMR, 2008b).

Invasive species that occur or are likely to occur in the Study Area are presented according to the following classes of action required under the Act:

- Class 1: Subject to eradication from the state. Landowner must take reasonable steps to keep land free of Class 1 pests. No Class 1 species are recorded in the Study Area.
- Class 2: Management requires coordination, subject to measures implemented by local government, community or landowner. Landowner must take reasonable steps to keep land free of Class 2 pests. Thirteen Class 2 pests are recorded in the Study Area.
- Class 3: Management to prevent sale of and spread of pests into new areas. Landowners are not required to control unless in or adjacent to an environmentally significant area. Two Class 3 pests are recorded in the Study Area.

Table B.7.4 Invasive Flora and Fauna Potentially Occurring in the Study Area

Element	Class 2	Class 3
Flora	rubber vine (*Cryptostegia grandiflora*) sicklepod (*Senna obtusifolia*) chinee apple (*Ziziphus mauritiana*) parkinsonia (*Parkinsonia aculeata*) mother of millions hybrid (*Bryophyllum × houghtonii*) prickly acacia (*Acacia nilotica*)	lantana (*Lantana camara*) Singapore daisy (*Sphagneticola triflora*)
Fauna	European rabbit (*Oryctolagus cuniculus*) European fox (*Vulpes vulpes*) domestic cat (*Felis catus*) feral pig (*Sus scrofa*) cane toad (*Bufo marinus*) goat (*Capra hircus*) black rat (*Rattus rattus*)	None

B.7.4 Assessment of Potential Impacts

The potential direct and indirect impacts to terrestrial ecology associated with construction and operation of the PEP are summarised in Table B.7.5.

Table B.7.5 Potential Direct and Indirect Impacts Associated with Construction and Operation of PEP

Phase	Potential direct aspects	Potential indirect aspects
Construction	Removal of revetment/reclamation area ponds	Changed hydrology and sedimentation on mudflats and sand banks Spread of invasive species Noise, vibration and light emissions
Operation	Use by birds of created revetments/ dredge ponds	Light emissions onto adjacent habitats

B.7.4.1 Direct Removal and Creation of Fauna Habitat During Construction

The permanent creation of land will provide opportunistic foraging and roosting potential for migratory and resident shorebirds. Existing reclamation and constructed revetments, including the existing reclamation ponds, are known to support a local population of migratory shorebirds, and species richness in these areas approaches that found in the nearby areas such as the east bank of Ross River (Appendix L3).

The Ross River Sandspit provides natural roosting and foraging habitat for the region, and is the reason that birds are attracted to the area. Birds that might use the space around the port may be temporarily displaced to the primary roosting site on the Ross River Sandspit during construction of the new revetments. This impact will be temporary, as a new and longer revetment will be constructed (Table B.7.6). The removal of the existing north-eastern revetment will remove existing habitat and is likely to affect shellfish and fish aggregations nearby. The lower inter-tidal and subtidal area of the revetment currently supports abundant algal and invertebrate communities (Chapter B6); therefore, removal of the existing revetment may reduce foraging resources available to shorebirds. The sooty oystercatcher, among other species is known to use the revetment for roosting. The impact is not likely to be significant to any regional populations in the long term.

It is likely that known listed species visiting the Project Area show fidelity to roosting habits, although some individuals may use roosts opportunistically. This short-term loss in roosting area poses a low risk as the magnitude of the impact is minor, even though it is possible that fauna may occasionally seek to re-use a site. In these cases, birds may be displaced to other roosts, which are abundant in the region.

Birds will be able to use newly-created revetment and reclamation ponds associated with PEP. The seaward side of the revetments will have a frontage length of 2,912 m as compared to the existing revetment’s total length of 1,296 m; resulting in a net gain in revetment habitat. The new revetment will provide similar habitat opportunities and marine communities are likely to establish on the revetment over a period of a few years (Chapter B6 (Marine Ecology)).

The eastern reclamation area and Marine Precinct reclamation ponds are currently at various stages of reclamation and include areas below final fill level. Currently, some reclamation area ponds fill with shallow water and then dry out, simulating the natural inter-tidal cycle and promoting the growth of aquatic invertebrates that tends to attract birds to the site. The site contains suitable foraging habitat in high tides and, in the migratory season, acts as a secondary roost for shorebirds. The lower-lying reclamation pond areas provide transitional habitats and the opportunistic use by birds is predicted to occur throughout the PEP reclamation process, particularly for foraging. Stage A development (Berths 14 and 15) will consist of a partially filled cell and four settlement ponds covering approximately 75 ha. Stage B development (Berth 16) will consist of a partially filled cell and three settlement ponds covering approximately 50 ha. Stages C and D development (Berth 17, 18 and 19) will consist of a partially filled cell and a settlement pond covering approximately 25 ha. Over the construction stages, the pond area will increase from 11 ha to 75 ha and the operational port will consist of approximately 25 ha of reclamation pond habitat (Table B.7.6) until the site is completely developed at the completion of Stage D. This space would make available and extend the overall area of opportunistic foraging areas for birds.

Table B.7.6 Existing and proposed direct changes to potential bird habitat

Habitat Types	Existing Port	PEP Construction	Total	Activity
Reclamation/ settlement ponds	10.6 ha	50 to 75 ha	Approximately 25 ha[1]	Creation of new reclamation ponds as existing ponds are filled
Revetment	1.3 km	2.9 km	2.9 km	Replace revetment that is removed

1. Up to the point the site is completely developed by 2040

B.7.4.2 Potential Indirect Impacts from Changed Hydrology and Sedimentation

Increased sedimentation and sediment mobilisation associated with the dredging works has the potential to affect suspended sediments in parts of Cleveland Bay. Changes in sediment deposition could alter shoreline habitats available to birds. The tidal mudflats used for foraging would become less favourable if increased sedimentation adversely impacted benthos.

The Ross River Sandspit located approximately 1 km south of the port could potentially be adversely impacted if PEP altered hydrology and sediment significantly. According to the sediment dispersion modelling undertaken by BMT WBM as part of the EIS (Chapter B3 (Coastal Processes), B4 (Marine Water Quality), and B5 (Marine Sediment Quality)), under the worst-case scenario, the PEP is unlikely to change the sediment deposition patterns of the area to the south of the port, specifically the Ross River Sandspit. This area, near the mouth of the Ross River, is naturally subject to variable background sedimentation processes and is a turbid system. There are no expected changes to the magnitude of tidal flow velocities, so scouring and erosion will not occur there. The foraging and roosting shorebird habitat in proximity to the Ross River will not be indirectly impacted by increased sedimentation (accretion or loss) as a result of the PEP.

Modelling undertaken of dredging effects indicate that above background suspended sediment concentrations (increase between 5 to 15 mg/L in the worst-case scenario) may occur along the north, east and south coasts of Magnetic Island. Inter-tidal areas along the Magnetic Island coastline could be temporarily exposed to deposition rates of between 5 to 20 mm/month over the course of the dredge campaign of approximately 13 weeks. This sedimentation may temporarily impact inter-tidal benthos on which shorebirds forage.

On the shores of Magnetic Island, mangroves provide shelter and feeding habitat for shorebirds and other fauna. Dredge sediment modelling indicates that the coastline of Magnetic Island (Cockle Bay, Picnic Bay, south of Arthur Bay, and Horseshoe Bay) may be exposed to increased sediment deposition rates (under the worst-case scenario). In other situations, grey mangrove (*Avicennia marina*) have shown signs of stress and/or death at rapid sedimentation levels between 50 to 700 mm, while mangrove (*Rhizophora* spp) are more tolerant with mortality recorded at sediments depths over 500 mm (Ellison, 1998). The predicted deposition rates from PEP dredging would not approach these reported effect levels and is unlikely to adversely impact mangrove communities on Magnetic Island (Chapter B6 (Marine Ecology)). Mangroves are unlikely to be significantly impacted to the extent they would reduce in productivity and effect roosting or foraging habitat available for avian fauna.

B.7.4.3 Spread of Invasive Species

The movement of vehicles and machinery to and from the PEP under construction and during operations has the potential to introduce and disperse weed (seeds and propagules) into the Project Area, as well as along the access route through parts of Townsville.

Several declared weeds are known to occur in the region and many undeclared weeds are probable, particularly in the area to the south of the port along the Eastern Access Corridor and along the Townsville Port Access Road. Poor weed management practices would make dispersal of weeds more prevalent from known locations into new areas at the port or en route to and from other locations, such as quarries used for sourcing rock and fill. Weeds are rapid colonisers and the creation of land will provide an opportunity for weed establishment.

Port of Townsville Limited (POTL) is responsible for the management of port land. Other land lies outside of POTL's control (e.g. state-controlled roads, including the Townsville Port Access Road corridor, is managed by the Department of Transport and Main Roads, and local roads by Townsville City Council).

An EMP will cover POTL's weed control commitments and actions. Like the Townsville Port Access Road, the provision for new rail infrastructure through the Eastern Access Corridor would be subject to separate development approvals and will require the proponent to manage the risk of weeds within the rail corridor.

Although the construction of the PEP has the potential to contribute to the weed load, this impact is considered to pose a minimal risk in and around the port as the impact does not risk effects on native vegetation or natural terrestrial habitats, even though the establishment of weeds on reclaimed PEP land during construction is possible. Straightforward preventative and corrective actions are available to manage undue risks from terrestrial weeds as part of the EMP.

Common feral animal species are known to occur on port land and the current port Operational EMP and Pest Management Plan will be implemented to control vermin.

B.7.4.4 Noise and Vibration Emissions During Construction

Elevated noise and vibration during the construction phase may potentially disturb native fauna in their natural habitats (e.g. shorebirds foraging and roosting on the Ross River Sandspit). High average counts of shorebirds on the east side of Ross River have been recorded during the summer months (Driscoll P. , 2009; NRA, 2012) suggesting that these areas may be most at risk at those times. Although birds are highly mobile, a constant disruption to foraging, breeding or roosting behaviours means that birds may waste energy relocating, particularly for migratory birds that require these resources for their long migrations.

The Marine Precinct area has industrial noise sources such as forklifts, cranes, vehicles, gantries and maintenance activities. The current vibration levels are lower than 0.10 mm/s. Shorebirds are known to occur in the eastern reclamation and near the sandy beach adjacent Benwell Road near the Marine Precinct, often in significant numbers, despite this existing commercial activity. Construction activities, such as piling and rock breaking, are predicted to produce noise 25 dB higher than the average ambient noise levels and will occur intermittently over the works campaigns over a 20-year period. While noise may have the effect of dissuading bird visitation to a site, there is no evidence that past and current port activities have that effect, which suggests that birds acclimatise to such conditions.

B.7.4.5 Light Emissions During Construction and Operation

Artificial night-time light, while essential for worker and shipping operational safety, has the potential to affect migratory birds through behavioural disturbance and disorientation. In general, as birds fly, they can be disoriented by and drawn towards light pollution from urban and industrial areas, which often leads to their collision with structures resulting in injury or mortality. Artificial light may have an influence on calling, foraging and habitat selection behaviours. A study of roosting at Roebuck Bay on the south Kimberley coast, WA, found that migratory waders typically avoid roosting where exposed to artificial lighting. The light cues a response in waders that they may be detectable by predators (Rogers, Piersma, & and Hassell, 2006). Rogers et al. (2006) also concluded that 'feeding areas are only of use to waders if they are associated with acceptable roosts'. The association between roosts and forage areas is important when considering the extent of effects. Further details on the likely zones of light spill in relation to the PEP and known bird habitat are given in Appendix L2.

Roosting sites may be affected by light emissions from the PEP. If roosting sites are disturbed, it is likely that waders will move to other suitable roosting sites that are known to be productive and nearby in the region. Birds are also presently known to roost in close confines to the operational port. That is, the sooty oystercatcher, among other species, is known to use the existing revetment for roosting; it appears to be acclimatised or unaffected to the current levels of light without being deterred from the port area. This supports the conclusion that the risk of an impact from light spill is very low on migratory bird populations.

Given the bulk of the PEP infrastructure will be to the north-east of the known bird habitats and recent modelling of light spill indicates that lux levels will not exceed natural levels in the critical habitats, the Project will not significantly impact existing populations of migratory waders (Appendix L2).

Bats and other nocturnal fauna in habitats close to shore may also be affected behaviourally by light spill as they forage near shores. The PEP alleviates that potential risk by constructing and operating on port land seaward of the existing natural shorelines.

B.7.4.6 Matters of National Environmental Significance

B.7.4.6.1 Great Barrier Reef Marine Park

The Sea Channel extension extends into the GBRMP. Impacts to the GBRMP are assessed in Chapter B6 (Marine Ecology).

B.7.4.6.2 World Heritage Area

The criteria for which the Great Barrier Reef World Heritage Area is listed are predominantly marine and are assessed in Chapter B6 (Marine Ecology). Of relevance to terrestrial ecology are the ‘feeding or breeding grounds for international migratory seabirds’. Impacts such as loss of roosting and feeding habitat, light spill and changed hydrology and sedimentation have been addressed above. No significant impacts are expected to the values of the world heritage area from the PEP.

B.7.4.6.3 Wetlands of International Importance

Bowling Green Bay (a Ramsar wetland) will not be affected by the PEP. It is over 9 km from the disturbance area and hydrological and sedimentation changes are not predicted south of the PEP. A management plan protects this site and does not impose any obligations on the PEP.

B.7.4.6.4 Listed Threatened Species and Ecological Communities

No threatened terrestrial fauna listed under the EPBC Act have been recorded in the Project Area. No threatened flora species are known to occur in the Project Area. The Project Area does not contain any threatened terrestrial ecological communities.

B.7.4.6.5 Migratory Species

Twenty-four migratory bird species were recorded during site surveys in the Project Area (Appendix L3). There is unlikely to be a significant impact on migratory bird species by the PEP (Appendix L1).

B.7.4.6.6 Commonwealth Marine Areas

Impacts to the marine environment are assessed in Chapter B6 (Marine Ecology).

B.7.4.6.7 National Heritage Places

The Great Barrier Reef was one of fifteen Australian world heritage places included in the National Heritage List on 21 May 2007. The assessment of the world heritage area applies to the national heritage place.

B.7.5 Mitigation Measures

The following section addresses mitigation measures and considers applying no, partial and complete mitigation. Distinguishing between none and partial mitigation is problematic, since most impacts proposed are indirect and difficult to measure. Complete mitigation is recommended for the potential impacts from the Projects construction and operation.

B.7.5.1 Create Additional Revetment and Reclamation Pond Areas

B.7.5.1.1 Partial and/or no Mitigation

Mitigation in the form of revetments and reclamation of land is considered in B.7.5.1.2. There may be residual impact on migratory and seabird species diversity and/or abundances if the additional land created in the PEP is not accepted as suitable habitat. This is considered very unlikely as the existing artificial habitat is almost the same as the new artificial secondary habitat, which is expected to be used as birds, migrate through the coastal plain towards other habitat areas.

B.7.5.1.2 Complete Mitigation

The provision of additional revetments and open reclamation areas from dredge sediment containment will compensate for the temporary loss of opportunistic shorebird roosting and foraging areas, respectively. There may be no residual impact on migratory and seabird species diversity and/or abundances as additional land in the PEP will create artificial secondary habitat, which is able to be used as birds migrate through the coastal plain towards the Ross River and Bowling Green Bay coastal complexes.

B.7.5.2 Reduce Suspended Sediment and Sedimentation from Dredging Releases

B.7.5.2.1 Partial and/or no Mitigation

As the tide recedes, birds move from their roosting site to forage on exposed mud banks. Large numbers of birds moved in to forage on exposed mud banks to the south-east of the sand spit, however, large numbers have been observed moving closer to Ross River to forage. Sedimentation impacts on marine fauna and flora and their habitats and mitigating the potential indirect impacts to the terrestrial values associated with inter-tidal habitats is crucial.

Without any sedimentation and turbidity management plan, dredging will have impacts on intertidal habitats which are foraging areas for migratory species. Complete list of mitigation measures is being suggested to be incorporated into the POTL's ongoing long-term sediment quality monitoring. Only complete mitigation measures are being suggested, since the risk of sedimentation is eminent to consider partial mitigation.

B.7.5.2.2 Complete Mitigation

The potential indirect impacts associated with increased sedimentation will be managed through a dredge management plan and reactive monitoring program. The plans include details on the objectives, performance criteria, implementation strategies and required monitoring. These measures are discussed in detail in Chapter B4 (Marine Water Quality) and B5 (Marine Sediment Quality) and include a:

- Sedimentation and Turbidity Management – Dredging and Placement Plan
- Preliminary Sediment Sampling and Analysis Plan, which provides guidance for sediment sampling and analysis procedures to be undertaken to assess the suitability of dredge sediments for ocean placement
- Contaminated Sediment Management – Dredging, Handling, Treatment and Land Disposal Plan

POTL's ongoing long-term sediment quality monitoring will be amended to incorporate new operational areas.

These measures have been designed to mitigate sedimentation impacts to marine fauna and flora and their habitats and for mitigating the potential indirect impacts to the terrestrial values associated with inter-tidal habitats where periods of exposure are much less frequent.

B.7.5.3 Noise, and Vibration During Construction

B.7.5.3.1 Partial and/or no Mitigation

During construction, noise, light and vibration will have an indirect impact on migratory waders if not mitigated for. Disturbance from noise with partial or no mitigation measures in place may influence calling and foraging behaviours and also habitat selection.

B.7.5.3.2 Complete Mitigation

The Construction EMP will include measures to reduce noise, vibration and accidental exposures to fauna during both construction and operations. The following general measure will be incorporated into the plan:

- keep equipment in good working condition and implement general good site working practices to reduce noise and vibration.

B.7.5.4 Light Emissions During Construction and Operation

B.7.5.4.1 Partial and no Mitigation

Artificial light emissions have the potential to affect migratory waders through two broad mechanisms: behavioural disturbance and disorientation. Waders typically avoid roosting where exposed to sources of artificial lighting, as the light cues a response in waders that they may be detected by predators. It is suggested that lights may cause either disorientation or attraction, causing injury or mortality if birds fly into structures. Therefore, light spills onto the surrounding area need to be reduced through consideration of lighting design, and light source shields.

B.7.5.4.2 Complete Mitigation

The Construction EMP and Operational EMP will both include measures to reduce light spill from the PEP footprint, such as:

- shield light sources and/or redirect away from adjacent foreshore environments
- manage lighting and, in particular, lighting design to reduce light spill from the site in accordance with Australian Standards.

B.7.5.5 Avoid Introduced Weeds and Pests at the Reclamation Site

B.7.5.5.1 Partial and/or no Mitigation

Potential threats on the conservation of Waders may include: loss of habitat by threatening processes such as introduced pests. Construction vehicles are prone to disperse seeds of declared weeds and fill material imported to the site is prone to lead to weed dispersal. Feral animals are also a direct threat to bird populations.

B.7.5.5.2 Complete Mitigation

The Construction EMP and Operational EMP will both contain measures that reduce spreading weeds and pests to and from the reclamation and constructed land area such as:

- thoroughly wash down machinery and vehicles according to accepted industry standards before moving to the construction site or leaving for the last time
- limit vehicles traversing through known weed infested areas such as the reserve to the south of the port to existing roads
- ensure fill material imported to the site is free from weeds
- appropriately control weeds and feral animals (cat, rat, pig, rabbit, fox, cane toad) that establish on port land during construction and operations as per the Pest Management Plan.

Monitoring of weed presence on port lands, and subsequent weed control, should be undertaken according to the current port Operational EMP.

B.7.6 Cumulative Impacts

The following existing and proposed developments have been identified in proximity to the Project Area and to be of relevance to coastal ecology of terrestrial biota:

- the Townsville Marine Precinct – a commercial marine facility (Stage 1 complete and operational)
- Berth 12 – a new bulk handling berth adjacent to the existing Berth 11 (approved – construction not yet commenced)
- minor channel improvement works to increase the bend radius at the junction of the Platypus and Sea channels and minor channel widening between beacons P14 and P16 (approved – commenced July 2012)
- various berth modifications and rationalisation in the existing inner harbour, either underway or proposed, such as the reconstruction of Berths 4, 8 and 10A (approved – commenced 2012)
- development and construction associated with the Townsville State Development Area to the south of Ross River (applications not yet submitted)
- construction in the Eastern Access Corridor; the Department of Transport and Main Roads are currently constructing the Townsville Port Access Road, which includes the construction of a bridge across the Ross River (due for completion in 2012)
- ongoing operation of the port.

The projects described above are assessed under separate environmental and planning approvals and will implement appropriate management measures to reduce their impacts to terrestrial ecological values. Cumulatively, these projects may impact terrestrial ecological values at differing scales and locations, both directly and indirectly. These cumulative impacts will increase the intensity of use in areas surrounding the port. In assessing cumulative impacts on terrestrial ecological values, particular emphasis should be placed on the shorebird habitat on the east side of the Ross River and the heightened threatening processes introduced by developments in the region.

Impacts on birds that may act cumulatively in concert with the PEP impacts include:

- risk of changed sedimentation on:
  - shorebird habitat (foraging and roosting habitat)
  - seabird foraging inter-tidal habitat
- increased noise sources (from road and rail traffic) along newly formed corridors (Townsville Port Access Road and the Eastern Access Corridor), potentially disturbing roosting shorebirds, especially at night-time
- more frequent noise and vibration events from combined emissions from the different projects and operations concurrently
- disturbance on roosting and foraging of fauna due to increased lighting in the near-shore coastal zone
- dispersion of weeds as encroachment from newly developed areas and access to areas become readily available to people, vehicles and domestic animals.

The potential impacts are greatest to shorebird roosting and foraging areas, which can be reduced through appropriate mitigation measures and avoidance of direct impacts to these known areas. The PEP is unlikely to contribute significantly to the cumulative direct impacts. Increased port activity and the indirect effects on shorebird habitat may result in stress on populations of significant migratory species and reduced populations.

B.7.7 Assessment Summary

As the Project primarily involves dredging and reclamation works in a marine environment, the terrestrial ecological values in the Project Area are limited. The Project is expected to:

- not have any impact on listed terrestrial non-avian species
- have a limited risk of impact on terrestrial bird species, which can be summarised as:
  - a temporary loss of area opportunistically used by some birds, associated with revetment removal in early Stage A
  - a medium to long-term increase in the opportunity for birds roosting and foraging directly on port lands (revetment and reclamation ponds) during the PEP construction staging.

Port Expansion Project EIS

Part B

Section B8 – Climate & Natural Disaster Risks

AECOM BMT WBM

Part B

B.8 Climate and Natural Disaster Risks

B.8.1 Relevance of the Project to Climate and Natural Disaster Risks

The purpose of this chapter is to assess the implications of potential climate change and natural hazards for the Port Expansion Project (PEP, the Project). This chapter addresses Section 5.1 (climate, natural hazards and climate change) of the state Terms of Reference (ToR) (CG, 2012) and Section 5.10 (relevant impacts) of the Commonwealth Environmental Impact Statement (EIS) Guidelines (DSEWPC, 2012h), which outline the matters relating to climate change and natural hazards that must be addressed by the EIS. As such, the chapter:

- identifies the relevance of climate change and natural hazards for the Project; for the purposes of this assessment, natural hazards are considered to be cyclones, storm surge, flooding and bushfire
- discusses of the applicable legislation and policies
- presents historic and projected climatic conditions and natural hazard data for the Project location, and supplements this with the most appropriate alternative data when local data are not available
- provides an assessment of the potential climate change and natural hazard impacts on the Project and assesses the risks of these impacts
- outlines measures and commitments to mitigate the highest priority risks in the construction and operation/maintenance phases of the Project, including longer term adaptation strategies and actions.

Climate change is a change in the average pattern of weather over a long period of time. Port of Townsville Limited (POTL) is proposing to expand the port to address current capacity constraints and accommodate forecast growth in trade over a planning horizon to 2040. Changes in climate and natural hazards are projected over this time period. Design, construction, operation and maintenance of the expansion will need to take into account these changes to avoid any significant adverse impacts.

Climate varies naturally on many timescales; however, recent observed changes in climate are unusual when compared to climatic records going back up to 20 centuries. Climate science has shown that the changes in climate of the past 50 years are ‘very likely’ (more than 90% in probability) due to the observed increase in greenhouse gases from human activities, predominantly the burning of fossil fuels and clearing of natural vegetation (IPCC, 2007). The Intergovernmental Panel on Climate Change (IPCC) reported evidence from all continents and most oceans showing that many natural systems are being affected by regional climate changes. Warming of the climate is unequivocal, as is now evident from the following observed changes:

- increased ocean acidification, reducing the capacity of oceans to store carbon
- increased average sea level and sea surface temperatures
- increased melting of permafrost releasing methane (a greenhouse gas) into the atmosphere
- increased number of natural hazard events, including more extreme rainfall events resulting in flooding and severe tropical cyclones
- increased severity of drought and bushfires
- increased frequency of hot days, hot nights and heat waves (DERM, 2010d)

These changes will result in changes to local and regional conditions that need to be considered to ensure the port is able to continue to operate effectively and efficiently in a changing climate. The projected changes to climate for the Townsville region include:

- increase in average temperature and number of days over 35C
- decrease in average rainfall
- increase in potential evaporation
- increase in average wind speed

- increase in number of severe tropical cyclones
- increase in sea level
- increase in frequency and height of storm surge
- increase in drought conditions (DERM, 2010d).

Port operations are at risk of climate change impacts for a number of reasons:

- they will be conducted over a long period during which climatic changes are likely to occur
- their coastal location make them vulnerable to sea level rise, storm surge and extreme events
- they rely on shipping movements that are vulnerable to climatic changes such as storm surge and extreme events
- they transport some goods for which demand or supply is climate sensitive (e.g. agricultural crops)
- they rely on land-based transport infrastructure for movement of goods that are managed by others and can be climate sensitive
- they are vulnerable to disruptions in water and electricity supply (IFC, 2011).

A study showed that the economic cost increases from climate change impacts on ports in Queensland would result in an 8% increase to productivity costs, 13% increase to capital expenditure and 9% increase to operational expenditure by 2070 (Maunsell, 2008d).

B.8.2 Assessment Framework and Statutory Policies

This section outlines the methodology used to identify the potential impacts and risks associated with the expansion in regards to climate change and natural hazards. A desktop assessment was undertaken and included the steps and activities outlined in Table B.8.1.

Table B.8.1 Climate Change and Natural Hazards Assessment Methodology

Steps	Activities
Collation and analysis of current climatic conditions and historical climate data for the Study Area.	Information from the Bureau of Meteorology (BOM) was gathered to develop an understanding of current climatic conditions. Trend data was gathered showing observed changes over time. Where available, data on the frequency and timing of extreme weather events has been included.
Collation and analysis of the most current and relevant future climate change projections for the Study Area.	Climate change projections, specifically for the North Queensland region, were assessed as a basis for determining the vulnerability of the Project to future climate change. Where regional projections were not available, information was supplemented by the most current national and/or global projections.
Identification of potential impacts on the construction, operation and maintenance of the PEP from current and future climatic changes.	Potential impacts were identified and a risk-based assessment undertaken to determine those risks of highest priority for mitigation measures.
Identification of mitigation measures to address high priority climate change and natural hazard risks.	Measures for the construction, operation and maintenance phases of the Project were identified to reduce the Project's vulnerability to current and future climate change and natural hazards. This includes consideration of relevant climate change parameters in the design of the PEP as well as longer term adaptation measures.

The following legislation and policies are relevant to the assessment and management of climate change and natural hazards associated with the Project:

- *Queensland Coastal Plan* (DERM, 2012a): the plan incorporates the *State Policy Coastal Management* and the *State Planning Policy 3/11: Coastal Protection*[1]. The *Queensland Coastal Plan*

[1] State Planning Policy 3/11 Coastal Protection was replaced by the Queensland Government on 8 October 2012 by the *Draft Coastal Protection State Planning Regulatory Provision: Protecting the Coastal Environment*. The Draft SPRP will operate for 12 months unless earlier repealed. Due to the release of the Draft SPRP at such a late juncture in the preparation of the PEP EIS, the

will be given effect under the *Coastal Protection and Management Act 1995* (Coastal Act). For development not subject to an existing development commitment, the plan requires adoption of the following minimum assessment factors for coastal hazard risk assessments as outlined in the Queensland Coastal Hazards Guideline (DERM, 2012):

- a planning period of 100 years for coastal development
- adoption of the 100-year ARI (average recurrence interval) extreme storm event or water level
- projected sea level rise of 0.8 m by 2100 due to climate change (relative to 1990 value)
- increase in cyclone intensity by 10% (relative to maximum potential intensity) due to climate change.

The PEP has a nominated design life of 50 years. An end of life planning period of 2070 has been applied to the Project, as the design life of the port will not reach 2100. Projected sea level rise for 2070 as outlined in the *Queensland Coastal Hazards Guideline* is 0.5 m. This figure has been adopted for the design of permanent structures. The assessment factor of increase in cyclone intensity by 10% has not been included in the concept design of structures because of the depth limited conditions for extreme waves at the site.

- *State Planning Policy 1/03: Mitigating the adverse impacts of flood, bushfire and landslide*: this policy aims to ensure that the natural hazards of flood, bushfire and landslide are adequately considered when making decisions about development (DLPG & DES, 2003). The Project Area is not identified as steep land or a bushfire prone area in the *Townsville City Plan 2005* (TCC, 2005a), meaning the landslide and bushfire obligations of the state planning policy are not triggered. The state planning policy addresses riverine flooding, which is of low risk for the Project Area, with the *Townsville Regional Flood Hazard Assessment Study* (TCC, 2005c) indicating the site is not at risk of Q50 or Q100 inundation. Inundation from storm surge events is of greater risk and is addressed through the *Queensland Coastal Plan*.
- *Climate Q: toward a greener Queensland* (DERM, 2009b): this is the Queensland government's climate change strategy containing a number of initiatives to improve understanding of local climate change impacts. It does not contain specific obligations relevant to the Project.
- *Local Disaster Management Plan* (2011) – this plan has been developed by the Townsville Local Disaster Management Group under the *Disaster Management Act 2003*. The plan indicates that the Port of Townsville is vulnerable to damage from high seas and likely be closed during the approach of a severe cyclone (TCC, 2011d).
- *Emergency Response Plan; Cyclone Emergency Response Procedure*: this procedure has been developed to ensure the maximum protection of people and assets of the port community against the effects of tropical cyclones. The procedure details the preparatory steps to be taken by POTL employees to ensure readiness in the event of a cyclone, the actions to be taken when a cyclone threatens the Port of Townsville, and the recovery activities necessary to resume normal operations as soon as possible after the cyclonic event has passed.

B.8.3 Existing Values, Uses and Characteristics

B.8.3.1 Current Climate

Townsville is situated on the Queensland coast, approximately 280 km south from Cairns and 1,400 km north from Brisbane. Townsville's climate is tropical and characterised by seasonal high temperatures and high humidity, pronounced wet and dry seasons, rainfall occurring in high-intensity tropical storms between November and April, and occasional tropical cyclones.

---

various chapters and assessments contained within the EIS address SPP 3/11 as required by the approved Terms of Reference for the Project under the *State Development and Public Works Organisation Act 1971*. If required and still in place at the time of preparation, the EIS Supplement will address the Draft SPRP to the extent required by the Coordinator General.

B.8.3.1.1 Temperature

The annual mean maximum temperature in Townsville from 1940 to 2011 was 28.9C° and annual mean minimum temperature was 19.8C (BOM, 2011f). Trend data from 1950 to 2010 indicates that the annual average mean temperature from 1940 to 2011 is increasing by 0.10 to 0.15C° each decade (BOM, 2011c). Similarly, trend data from 1950 to 2010 indicates an increase of 0.05 to 0.10C° per decade to the annual average maximum temperature (BOM, 2011b) and an increase of 0.20 to 0.25C per decade to the annual average minimum temperature (BOM, 2011d).

Changes in average temperature conditions can have a significant effect on temperature extremes. The mean number of days above 35C each year for Townsville from 1940 to 2011 was 3.4 days (BOM, 2011f). By comparison, the mean number of days above 35C° each year from 1981 to 2010 was 4.3 days (BOM, 2011g). This indicates that the average mean number of days above 35C° has been increasing over time.

B.8.3.1.2 Wind Speed

Wind speed is defined as the average speed over a ten minute period at a height of 10 m above the surface. The annual mean 09:00 wind speed for Townsville from 1940 to 2011 was 11.2 km/h and the annual mean 15:00 wind speed was 20.9 km/h over the same period (BOM, 2011f). By comparison, the annual mean 09:00 wind speed for Townsville from 1981 to 2010 was 13.1 km/h and the annual mean 15:00 wind speed was 22.4 km/h over the same period (BOM, 2011g). This indicates that there has been a small average increase in wind speed in Townsville over time.

B.8.3.1.3 Rainfall and Potential Evaporation

The average mean annual rainfall in Townsville from 1940 to 2011 was 1,153.7 mm (BOM, 2011f). Wetter conditions generally occur between November and April and the majority of intense wet season rainfall can be attributed to bursts of monsoon rains. Minimal rainfall occurs in dry season months. Although Townsville's rainfall varies greatly from year to year, trend data for the annual mean rainfall in Townsville from 1950 to 2010 indicates a decrease of 50 mm per decade (BOM, 2011a).

Potential evaporation is a measure of the evaporative power of the atmosphere. The potential evaporation rate assumes that there is an unlimited supply of water to evaporate and gives an indication of the change in the evaporative power of the atmosphere. The annual mean potential evaporation in the Townsville-Thuringowa region from 1972 to 2000 was 2,025 mm (CSIRO & BOM, 2007). The annual mean potential evaporation for the region is higher than the average mean annual rainfall, causing soil moisture depletion and amplifying the impacts of reduced rainfall.

B.8.3.1.4 Tropical Cyclones

Tropical cyclones occur in Queensland between November and April; however, the risk of a cyclone is greatest between January and March. A tropical cyclone is defined as a tropical depression of sufficient intensity to produce sustained gale force winds of at least 63 km/h. A severe tropical cyclone produces sustained hurricane force winds of at least 118 km/h.

Approximately 5.7 tropical cyclones occur in the Townsville-Thuringowa region each decade (1907-2006) (QOCC, 2009). There is considerable decade-to-decade variability in cyclone numbers, ranging from none (1917 to 1926) to six (1967 to 1976) (QOCC, 2009). Of these tropical cyclones, approximately 52.6% make landfall; however, there is also considerable variability in those that reach landfall ranging from 20% (1907 to 1916) to 80% (1957 to 1966) (QOCC, 2009).

In some areas of Australia there is a tendency for tropical cyclones to be less common in El Niño years and more common in La Niña years due to changes in broad scale wind patterns and water temperatures. This pattern is not evident for the Townsville-Thuringowa region (QOCC, 2009).

B.8.3.1.5 Storm Surge

Storm surge is a local rise in sea level caused by the combined action of severe surface winds on the ocean and decreased atmospheric pressure above the ocean surface. The current height of the 100-year ARI storm surge above the expected highest tide for the Townsville region is 0.4 m (Astorquia, Hardy, Harper, & Mason, 2004). The height of storm surge above the expected highest tide is not a true indication of the potential level of inundation as it does not include wave setup that adds elevation to the surface of the water during a storm event.

B.8.3.1.6 Ocean Changes

Sea level is influenced by natural climate variations, such as El Niño and decadal oscillations, in addition to climate change. Global sea levels increased by an average of 3.1 mm per annum from 1993 to 2003, compared with an average increase of 1.8 mm per annum from 1961 to 2003 and 1.7 mm per annum during the 20th century (CSIRO & BOM, 2007). By comparison, Australia recorded an average 1.2 mm per annum increase of sea level during the 20th century (Church & White, 2006).

The increase in sea level for the Townsville region (data collected at Cape Ferguson is located 31 km from Townsville) was 3.6 mm a year from 1991 to 2010 (NTC, 2010). There is no specific sea level rise data for the Townsville region prior to 1991. As data from Cape Ferguson continues to build, the sea level trend estimates will become more indicative of long-term trends.

Oceans absorb carbon dioxide from the atmosphere naturally, acting as a buffer for increasing atmospheric carbon dioxide. It has been estimated that oceans have absorbed half of the anthropogenic emitted carbon dioxide from the atmosphere to date (Sabine, et al., 2004). Increasing concentrations of atmospheric carbon dioxide due to the production of greenhouse gases leads to an increase in carbon dioxide in the ocean (McNiel, Matear, Key, Bullister, & Sarmiento, 2003). As concentrations of carbon dioxide in the ocean increase, the ability of the ocean to absorb carbon dioxide declines (Sarmiento, Lequere, & Pacala, 1995). As carbon dioxide enters the ocean, it combines with water to form a weak acid, making the ocean more acidic. The pH of the ocean is determined by the concentration of atmospheric carbon dioxide rather than a degree of warming.

B.8.3.1.7 Drought

Drought conditions are a result of exceptionally hot years, exceptionally low rainfall years and exceptionally low soil moisture years. An exceptional year is defined as one in which a variable (such as mean temperature, rainfall or soil moisture) falls in the highest or lowest 5% of years for that variable (Hennessy, et al., 2008). Exceptionally hot years in Queensland between 1900 and 2007 occurred once every 21.9 years and affected 4.6% of Queensland (Hennessy, et al., 2008). Exceptionally low rainfall years in Queensland between 1900 and 2007 occurred once every 18.1 years and affected 5.5% of Queensland (Hennessy, et al., 2008). Exceptionally low soil moisture years in Queensland (1957 to 2006) occurred once every 16.5 years and affected 6.5% of Queensland (Hennessy, et al., 2008). Serious rainfall deficiencies were most recently experienced in Townsville during the period between March and June 2008. The region has not experienced a sustained period of rainfall decline since this time (BOM, 2011e).

B.8.3.2 Projected Changes to Climate

Climate change is a global phenomenon, the precise effects of which are unknown. The time lag between cause (atmospheric greenhouse gas emission concentrations) and effect (changes to climate) indicate that climate change would likely be experienced during the design life of the Project as a result of current emission concentrations in the atmosphere.

Global greenhouse gas mitigation measures may reduce the long-term (2070 and beyond) effects of climate change; however, the climatic changes for 2030 and 2050 have a high potential to occur because they are largely a result of emissions that are already in the atmosphere. The effects of climate change increase over time and the design of the PEP will take into account the projected changes to the climate to ensure that the design life of the infrastructure is optimised.

The IPCC has defined a number of different emissions scenarios that are used to drive global climate models to produce climate change projections. The emission scenarios are based on a range of driving forces of future greenhouse gas emissions, including changes in demographics, technology and economics. The global climate models simulate the earth’s climate system using a complex set of mathematical rules that describe the physical processes of the atmosphere, ocean, land and ice. Climate models are currently considered to be the best tools for projecting changes to climate.

The climate change projections for Australia released by CSIRO and BOM in 2007 are based on the IPCC’s emissions scenarios and global climate models. The emission scenarios used for these projections are B1 (low emission scenario), A1B (mid-range scenario) and A1FI (high emission scenario). The range for 2050 and 2070 in the discussion below is a result of the difference between a low emission scenario and a high emission scenario. These projections are currently the best available information for the Townsville region.

Given that the port has a design life of 50 years and will not be operational in its current form in 2100, climate change projections are given for 2030, 2050 and 2070, but not 2100. Where data specific to the Townsville region are not available, data for Queensland have been used. Additional sources of data from specific studies on climatic variables have supplemented the CSIRO and BOM data as appropriate.

B.8.3.2.1 Temperature

The projected changes to average temperature for the Townsville-Thuringowa region are an increase of 0.9C° by 2030, an increase of 1.1 to 1.9C° by 2050 and an increase of 1.6 to 3.0C° by 2070 (CSIRO & BOM, 2007).

The projected changes to number of days over 35C° for the Townsville-Thuringowa region is an increase of 3 days by 2030, an increase of 4 to 12 days by 2050 and an increase of 8 to 36 days by 2070 (CSIRO & BOM, 2007).

B.8.3.2.2 Wind Speed

The projected changes to the annual average wind speed for the Townsville region is an increase of 1.3% by 2030 and 2.2 to 4.3% by 2070 (Hennessy, Webb, Ricketts, & Macadam, 2008).

B.8.3.2.3 Rainfall and Potential Evaporation

The projected changes to average rainfall for the Townsville-Thuringowa region is a decrease of 2 mm by 2030, decrease of 3 to 5 mm by 2050 and a decrease of 4 to 7 mm by 2070 (CSIRO & BOM, 2007).

The projected changes to potential evaporation for the Townsville-Thuringowa region is an increase of 3 mm by 2030, an increase of 4 to 7 mm by 2050 and an increase of 5 to 7 mm by 2070 (CSIRO & BOM, 2007).

Projections of heavy rainfall amounts (defined as the heaviest 1% of 24-hour rainfall) are highly uncertain. Projections for the Townsville region for 2070 (based on a high emissions scenario) show a 1% increase in intensity with an uncertain range of –30 to +20% (Hennessy, Webb, Ricketts, & Macadam, 2008).

B.8.3.2.4 Tropical Cyclones

Recent studies have indicated that fewer tropical cyclones will occur along the east coast of Australia but an increased proportion of these will be severe tropical cyclones. Abbs et al (2006) projected a 9% decrease in the frequency of the total number of tropical cyclones off the east coast of Australia by 2070.

Projections of the increase of the total number of severe tropical cyclones by 2050 ranges from 22% (Leslie, Karoly, Leplastrier, & Buckley, 2007) to 56% (Walsh, Nguyen, & McGregor, 2004), and 140% by 2070 (Abbs, et al., 2006). Projected southward shifts due to increases in sea surface temperatures in the primary regions of cyclone development could also result in a greater cyclone impact in the Townsville region (Abbs, et al., 2006; Leslie, Karoly, Leplastrier, & Buckley, 2007).

The Queensland government has nominated an increase in cyclone in intensity of 10% by 2100 for planning purposes (DERM, 2010d).

The variations in the number of severe tropical cyclone projections are due to the limited ability of global climate models to represent cyclone behaviour and a lack of good observational data to distinguish between natural variability and climate change (Hunt & Watterson, 2009). As global climate models improve so will their ability to simulate tropical cyclones, increasing the level of certainty with regards to projections of tropical cyclones.

B.8.3.2.5 Storm Surge

Relatively moderate levels of sea level rise are projected to cause large increases in the frequency of storm surges. Higher mean sea levels will enable inundation and waves from storm surges to penetrate further inland, increasing flooding, erosion and damage to infrastructure. Storm surge inundation would be 100 times more frequent in low-lying areas of Townsville if there was a 0.5 m rise in sea level (ACECRC, 2008). The Antarctic Climate and Ecosystem Cooperative Research Centre study was conducted at a national level, and no further detail is available specific to the Study Area to date.

Storm surge frequency is also influenced by the occurrence of tropical cyclones. According to Astorquia *et. al.* (2004), the Townsville region is projected to experience an increase of 0.05 m in storm surge by 2050 compared to the current 100-year ARI events due to changes in tropical cyclone behaviour alone.

In addition, the height above highest astronomical tide of a 100-year ARI storm surge plus tide will be approximately 0.6 m by 2050 (Astorquia, Hardy, Harper, & Mason, 2004). This is an increase of approximately 0.2 m from the current height of a 100-year ARI storm surge plus the expected highest tide.

B.8.3.2.6 Ocean Changes

According to the IPCC (2007), global sea level is projected to increase by 0.2 to 0.6 m by 2100 (depending on the emission scenario used) with a possible additional 0.1 to 0.2 m increase from melting ice sheets from Greenland and Antarctica. Global climate models indicate that mean sea level rise on the east coast of Australia may be higher than the global mean sea level rise (CSIRO & BOM, 2007). A report prepared by the University of New South Wales in 2009 presented data and modelling forecasts indicating that the IPCC 2007 projections were likely to be underestimates and that a sea level rise of 0.5 to 1.4 m was more indicative (Allison, et al., 2009).

According to the CSIRO Mark 3.0 model for a 2070 mid-range emission scenario, the Townsville region will have a 0 to 0.1 m increase above the global average sea level rise projection (CSIRO & BOM, 2007). This equates to an increase of 0.45 m by 2070 for the Townsville region. This is only a mid-range emission scenario projection and a high-range scenario would indicate an increase in sea level higher than 0.45 m.

For planning purposes, the *Queensland Coastal Plan* applies 0.5 m as the projected sea level rise for 2070 and 0.8 m as the projected sea level rise by 2100 (DERM, 2012a).

Increases in ocean acidification are expected throughout Australia. The observed average pH in the Study Area was 8.1 during the 1990s. This is projected to decrease by 0.16 to 0.17 to a pH of approximately 7.9 by the 2070 using the CSIRO Mark 3.5 model under the A2 scenario (Poloczanska, et al., 2007). The future pH in the ocean will be determined by the concentration of atmospheric carbon dioxide rather than a particular degree of warming. The capacity of the ocean to keep on absorbing carbon dioxide is unknown, which could also influence the pH level.

B.8.3.2.7 Drought

Temperature, rainfall and soil moisture contribute to drought conditions. Temperature projections for Queensland indicate a significant increase in the frequency and extent of exceptionally hot years from an average of one in every 22 years affecting 4.6% of Queensland in 2010 to one in every 1.7 years affecting 62.2% of the state in 2040 (Hennessy, et al., 2008).

Rainfall projections for Queensland indicate minimal change to the frequency and extent of low rainfall years (Hennessy, et al., 2008).

Soil moisture projections for Queensland indicate a slight increase in the frequency and extent of exceptionally low soil moisture years from an average of one every 16.5 years affecting 6.5% of the state in 2010 to an average of one every 12.6 years affecting 7.4% of the state in 2040 (Hennessy, et al., 2008). Drought projections specific to the Townsville region are not available.

B.8.3.3 Summary of Current and Projected Climatic Conditions

Table B.8.2 provides a summary of the data presented in Section B.8.3.1 and B.8.3.2.

Table B.8.2 Summary Table of Current and Projected Climatic Conditions for the development proposal

Climate Variable	Units	Current Conditions Data Period	Current Conditions	2030	2050	2070	2100
Temperature							
Average annual mean temperature	°C	1971 to 2000	23.3	+0.9	+1.1 to 1.9	+1.6 to 3.0	-
Annual number of days over 35 °C	days	1940 to 2011	4	+3	+4 to 12	+8 to 36	-
Wind Speed							
Average annual wind speed	km/h	1940 to 2011	11.2 (09:00) 20.9 (15:00)	+1.3%		+2.2 to 4.3%	-

Climate Variable	Units	Current Conditions Data Period	Current Conditions	2030	2050	2070	2100
Rainfall and Evaporation							
Average annual mean rainfall	mm	1971 to 2000	813	–2	–3 to –5	–4 to –7	-
Average annual evaporation	mm	1971 to 2000	2,025[2]	+3	+4 to 7	+5 to 11	-
Heaviest rainfall			-			+1% (–30 to +20%)	
Tropical Cyclones							
Frequency of tropical cyclones per decade		1907 to 2006	~5.7[3]	-	-	–9%	-
Number of severe tropical cyclones per decade		1907 to 2006	~2.9[3]	-	+22 to 56%	+140%	-
Maximum potential intensity			-	-	-	-	+10%
Storm Surge							
Height of the 1 in 100 year storm surge above the expected highest tide	m		0.4	-	0.6	-	-
Ocean Changes							
Sea level rise	mm	1991 to 2010	3.3 [4]	-	-	+500 [1]	+800 [1]
Ocean acidification	pH	1990s	8.1 [6]			7.1	
Drought							
Frequency of exceptionally hot years	years	1900 to 2007	22 [7]	-	1.7 years	-	-
Extent of Queensland experiencing exceptionally hot years	%	1900 to 2007	4.6[7]	-	62.2	-	-
Frequency of exceptionally low soil moisture years	years	1900 to 2007	16.5 [7]	-	12.6	-	-
Extent of exceptionally low soil moisture years	%	1900 to 2007	6.5[7]	-	7.4	-	-

1 Relative to 1990 levels

B.8.4 Assessment of Potential Impacts

This section presents potential impacts of climate change and natural hazards to the PEP, along with an assessment of the risk of the impacts identified. The risk assessment has considered the magnitude and likelihood of each impact and a risk rating has been generated based on **Table B.8.3** below.

Table B.8.3 Risk assessment matrix

		Magnitude				
		Negligible	Minor	Moderate	High	Very High
Likelihood	Highly Unlikely/Rare	Negligible	Negligible	Low	Medium	High
	Unlikely	Negligible	Low	Low	Medium	High
	Possible	Negligible	Low	Medium	Medium	High
	Likely	Low	Medium	Medium	High	Critical
	Almost Certain	Low	Medium	High	Critical	Critical

Where practicable, POTL will work cooperatively with government, other industry and other sectors to address climate change adaptation options.

B.8.4.1 Construction Phase

Table B.8.4 is an initial assessment that identifies climate-related impacts to the Project at the construction stage. The table seeks to identify the most relevant impacts to each climate change parameter listed in Table B.8.2. The risk rating for each impact in Table B.8.4 is an unmitigated risk level. Section B.8.5 identifies mitigation that has or will be applied to treat those risks that have been identified by the initial assessment as being ‘medium’, ‘high’ or ‘critical’.

Table B.8.4 Potential impacts and assessment of risks for construction based on climatic changes without mitigation

Change in Variable	Potential Impacts to Construction of the PEP	Magnitude Rating	Magnitude of Impacts	Likelihood of Impact	Overall Risk Rating (Before Mitigation)
Temperature ▪ Increase in average annual mean temperature ▪ Increase in annual number of days over 35 °C	Extreme temperatures stop construction work	Moderate	Potential worker health impacts. Potential disruptions to construction activities.	Likely	Medium
	Machine, vehicle and equipment breakdowns	Minor	May lead to some increase in maintenance and replacement costs. Unlikely to significantly increase current requirements.	Possible	Low
	Increase in power outages and higher energy costs	Moderate	Potential disruption to construction activities.	Unlikely	Low
Wind speed ▪ Increase in average annual wind speed	High wind causing equipment stoppages during construction due to safety concerns	Minor	Impacts are likely to be temporary and localised.	Unlikely	Low
Rainfall, evaporation and drought ▪ Decrease in average annual mean rainfall ▪ Increase in average annual evaporation ▪ Increase in rainfall intensity ▪ Increase in frequency and extent of exceptionally hot years and exceptionally low soil moisture years	Reduced availability of water for construction	Minor	Impacts are likely to be temporary and localised.	Unlikely	Low
	Increased dust generation from reclamation areas and any unsealed roads	Minor	Impacts are likely to be temporary and localised.	Possible	Low
	Increased evaporation of water in the reclamation area	Minor	Impacts are likely to be temporary and localised.	Possible	Low
Tropical cyclones and storm surge ▪ Increase in number of severe tropical cyclones ▪ Increase in storm surge frequency and height	Delays in Project construction due to a tropical cyclone event	Moderate	Potential impact on supply of materials and equipment/machinery. Delays are likely to be temporary and localised.	Possible	Medium
	Injury or death of staff during a tropical cyclone event	Very High	Potential risk to staff safety and wellbeing during severe cyclone event.	Highly unlikely/rare	Medium
	Loss or degradation of the marine environment due to damage or movement of construction materials	Moderate	Potential increase in loss or degradation of sea grass and corals.	Possible	Medium

Change in Variable	Potential Impacts to Construction of the PEP	Magnitude Rating	Magnitude of Impacts	Likelihood of Impact	Overall Risk Rating (Before Mitigation)
	and machinery				
Ocean changes ▪ Increase in sea level ▪ Change in ocean chemistry	Accelerated corrosion of port infrastructure materials from ocean acidification	Minor	Potential increase in replacement costs of materials.	Highly unlikely/rare	Low
	Overtopping and structural integrity of structures and temporary works	Minor	Potential for inundation of construction work area.	Highly unlikely/rare	Low

B.8.4.2 Operations and Maintenance Phases

Table B.8.5 is an initial assessment that identifies climate-related impacts to the Project at the operation and maintenance stages. The table seeks to identify the most relevant impacts to each climate change parameter listed in Table B.8.2. The risk rating for each impact in Table B.8.5 is an unmitigated risk level. Section B.8.6 identifies mitigation that has or will be applied to treat those risks that have been identified by the initial assessment as being 'medium', 'high' or 'critical'.

Table B.8.4 Potential impacts and assessment of risks for operations and maintenance based on climatic changes without mitigation

Change in Variable	Potential Impacts to Operation of the PEP	Magnitude Rating	Magnitude of Impacts	Likelihood of Impact	Overall Risk Rating (Before Mitigation)
Temperature ▪ Increase in average annual mean temperature ▪ Increase in annual number of days over 35 °C	Expansion and more rapid breakdown of concrete joints, protective cladding, coatings, sealants, timber and masonry	Minor	May lead to some increase in maintenance costs. Unlikely to significantly increase current maintenance requirements.	Unlikely	Low
	Accelerated deterioration and increased corrosion of marine structures (wharves, breakwaters and revetments) and foundations	Minor	May lead to some increase in maintenance costs. Unlikely to significantly increase current typical maintenance requirements. To be considered further in detailed design.	Possible	Low
	Increase in power outages and higher energy costs	Moderate	Potential supply chain disruptions are likely to occur on a short-term basis. Long-term increases in electricity costs will be factored into port operational costs.	Possible	Medium
Wind speed ▪ Increase in average annual wind speed	High wind causes stoppages restricting lifting operations and shipping movements	Moderate	Potential supply chain disruptions that could be important on regional or local scale, especially when the port reaches capacity in later years.	Unlikely	Low
	Altered sediment transport patterns due to shifts in wind-driven currents	Moderate	Possible change to maintenance dredging requirements.	Unlikely	Low

Change in Variable	Potential Impacts to Operation of the PEP	Magnitude Rating	Magnitude of Impacts	Likelihood of Impact	Overall Risk Rating (Before Mitigation)
Rainfall, evaporation and drought ▪ Decrease in average annual mean rainfall ▪ Increase in average annual evaporation ▪ Increase in rainfall intensity of specific events ▪ Increase in frequency and extent of exceptionally hot years and exceptionally low soil moisture years	Reduced availability of potable water supplies for operations	Minor	Impacts are likely to be temporary and localised.	Unlikely	Low
	Reduced drainage system capacity and functioning during extreme events	Minor	Impacts are likely to be temporary and localised. Projections show only a small potential change in extreme rainfall and are highly uncertain.	Unlikely	Low
	Flood damage to port infrastructure from Ross River events	Minor	Impacts are likely to be temporary and localised. Projections show only a small potential change in extreme rainfall events and these are highly uncertain.	Unlikely	Low
Tropical cyclones and storm surge ▪ Increase in number of severe tropical cyclones ▪ Increase in storm surge frequency and height	Accelerated sediment transport patterns and infill of channels associated with cyclones/coastal storms	Moderate	Potential increase in maintenance dredging frequency as a result of increased sediment movement and infill. Restrictions on the navigability of the channels for long periods could impact at a regional or local scale.	Possible	Medium
	Increased incidents of stormwater inundation and flooding of low-lying land	Moderate	Impacts may lead to damage of equipment and possible wash away of cargo. May lead to increase in maintenance, repair and replacement costs of port infrastructure. Potential for damage to be greater than current maintenance requirements. May lead to increased insurances.	Likely	Medium
	Extreme wave climate and increase in storm surge water levels leading to overtopping of marine structures and inundation of the PEP	Moderate	Potential for inundation of the PEP with possible impacts on cargo and cargo handing areas.	Likely	Medium
	Extreme wave climate and increase in storm surge water levels leading to damage of marine structures	Moderate	May lead to damage and increase in maintenance of marine structures as a result of higher water levels and larger waves.	Likely	Medium
	Longer port downtimes and potential port closures from tropical cyclone events	High	May lead to supply disruptions, reductions in port throughput and decreased productivity. Could impact on berth availability. Potential increase in ship queuing and delays in berthing and cargo handling. Potential supply chain disruptions (road/rail) that	Possible	Medium

Change in Variable	Potential Impacts to Operation of the PEP	Magnitude Rating	Magnitude of Impacts	Likelihood of Impact	Overall Risk Rating (Before Mitigation)
			could impact at a state or national level.		
	Loss or degradation of the marine environment due to increased sedimentation and pollution	Moderate	Possible overtopping of marine structures and inundation of the PEP due to more extreme wave climate and storm surge levels. Potential increase in loss or degradation of sea grass and corals.	Likely	Medium
	Extreme wave climate leading to re-suspension of dredge spoil	Moderate	Potential increase in maintenance dredging frequency as a result of spoil movement. Potential increase in loss or degradation of sea grass and corals.	Likely	Medium
Sea level ▪ Increase in sea level ▪ Change in ocean chemistry	Accelerated corrosion of port infrastructure from ocean acidification	Moderate	May lead to increase in maintenance, repair and replacement costs for port infrastructure.	Unlikely	Low
	Overtopping and risk to structural integrity of marine structures	Moderate	Potential for inundation of the PEP with possible impacts on cargo storage areas. May lead to damage and increase in maintenance of marine structures due to higher water levels and larger waves reaching harbour. May also increase insurance costs.	Likely	Medium

B.8.5 Mitigation Measures and Residual Impacts

For impacts that were assigned a risk level of 'medium' or above, recommended mitigation and adaptation measures that could reduce the potential risk over the life of the Project were identified. The impacts assigned these higher levels of risk were related to the effects of:

- increase in average annual mean temperature
- increase in annual number of days over 35C°
- increase in number of severe tropical cyclones
- increase in storm surge frequency and height
- sea level rise.

B.8.5.1 Construction Phase

Table B.8.6 outlines the recommended measures for managing impacts identified as having a ‘medium’ or above risk rating for the construction phase of the Project. The preferred adaptation strategies will largely be the responsibility of the construction contractors.

Table B.8.5 Recommended measures for managing impacts identified as having a medium or above risk rating for construction

Change in climatic variable	Potential impact to construction of the PEP	Risk rating (before mitigation)	Preferred adaptation strategy	Alternative adaptation strategy	Risk rating (after mitigation)
Temperature ▪ Increase in average annual mean temperature ▪ Increase in annual number of days over 35C°	Extreme temperatures stop construction work	Medium	Develop stop-work procedures for extreme heat days. Ensure appropriate personal protective equipment (PPE) is provided and staff are educated on managing heat stress	Monitor incidences of heat stress and adjust practices if number of incidences increase	Low
Tropical cyclones and storm surge ▪ Increase in number of severe tropical cyclones ▪ Increase in storm surge frequency and height	Delays in Project construction due to a tropical cyclone event	Medium	Include contingencies in Project construction schedule due to impacts from tropical cyclone events	Re-assess Project construction schedule after a tropical cyclone event has occurred	Low
	Injury or death of staff during cyclone events	Medium	Develop and implement emergency response and evacuation procedures for the site in accordance with relevant legislation, POTL Cyclone Emergency Procedure and in consultation with Townsville’s Local Disaster Management Group Train staff in emergency procedures	Ensure appropriate emergency equipment is available on site, consistent with existing procedures Ensure suitable site access for emergency vehicles consistent with existing procedures	Low
	Loss or degradation of the marine environment due to damage or movement of construction materials and machinery	Medium	Implement appropriate procedures for handling and storage of construction materials and machinery during events.	Assess impacts on the marine environment after a tropical cyclone or storm surge event has occurred.	Low

B.8.5.2 Operations and Maintenance Phase

Table B.8.7 outlines the recommended measures for managing impacts identified as having a medium or above risk rating for the operational phase of the Project.

Table B.8.7 Recommended measures for managing impacts identified as having a medium or above risk rating for operations

Change in climatic variable	Potential impact to operation and maintenance of the PEP	Risk rating (before mitigation)	Preferred adaptation strategy	Alternative adaptation strategy	Risk rating (after mitigation)

Change in climatic variable	Potential impact to operation and maintenance of the PEP	Risk rating (before mitigation)	Preferred adaptation strategy	Alternative adaptation strategy	Risk rating (after mitigation)
Temperature ▪ Increase in average annual mean temperature ▪ Increase in annual number of days over 35C°	Increase in power outages and higher energy costs	Medium	Monitor the number of power outages and consider preventative measures, such as upgrades, if this number trends upwards over time.	Track the number of power outages.	Low
Tropical cyclones and storm surge ▪ Increase in number of severe tropical cyclones ▪ Increase in storm surge frequency and height	Altered sediment transport patterns and infill of channels associated with cyclones/coastal storms	Medium	Undertake channel assessment after cyclone events to identify maintenance requirements in a timely manner consistent with existing procedures.	POTL to address the need for maintenance dredging frequency if infill of shipping channels and berth occurs, affecting port operations and access.	Low
	Increase incidents of stormwater inundation and flooding of low-lying lands	Medium	Stormwater infrastructure and overflow drainage paths to be designed for increased cyclone intensity. Water sensitive operational areas to be filled to an elevation to avoid flooding and predicted storm surge levels.	Undertake inspection of port infrastructure condition after cyclone events to identify maintenance in a timely manner consistent with existing procedures.	Low
	More extreme wave climate and increase in storm surge water levels leading to overtopping of marine structures and inundation of the PEP	Medium	Account for predicted wave climate and water levels in design of marine structures (wharves, breakwaters and revetments). Limit overtopping design criteria for marine structures to capacity of associated drainage infrastructure.	Undertake inspection of port infrastructure's condition after cyclone events to identify maintenance in a timely manner consistent with existing procedures.	Low
	More extreme wave climate and increase in storm surge water levels leading to damage of marine structures	Medium	For wave climate and water levels for design of marine structures (wharves, breakwaters and revetments) consider projections for sea level rise and increase in intensity of cyclone events.	Undertake inspection of port infrastructure condition after cyclone events to identify maintenance in a timely manner consistent with existing procedures.	Low
	Potential longer port downtimes and potential port closures from tropical cyclone events	Medium	Amend and activate the port contingency and continuity plan to include the PEP to ensure an appropriate response to supply disruptions and any cargo backlogs due to cyclone (i.e. increase in operational workforce to cope with short-term backlog). Evacuate ships prior to cyclone events	Undertake channel assessment after cyclone events to identify maintenance requirements in a timely manner consistent with existing procedures.	Low

Change in climatic variable	Potential impact to operation and maintenance of the PEP	Risk rating (before mitigation)	Preferred adaptation strategy	Alternative adaptation strategy	Risk rating (after mitigation)
			consistent with existing procedures.		
	Loss or degradation of the marine environment due to increased sedimentation and pollution	Medium	Account for predicted wave climate and water levels in procedures for handling and storage of materials.	Continue quarterly sediment quality monitoring.	Low
	Extreme wave climate leading to re-suspension of dredge spoil	Medium	Undertake channel assessment after cyclone events to identify maintenance requirements in a timely manner consistent with existing procedures.	POTL to address the need for maintenance dredging frequency if infill of shipping channels and berth occurs, affecting port operations and access.	Low
Sea level ▪ Increase in sea level	Overtopping and risk to structural integrity of marine structures over the life of the assets	Medium	Incorporate sea level rise predictions in the design wave climate and water level. Adopt the 2070 allowance of 0.5 m sea level rise for the design of permanent structures, noting that revetments and breakwaters can be raised if the port's life extends beyond the 50 year design life.	Undertake inspection of port infrastructure condition after cyclone events to identify maintenance in a timely manner consistent with existing procedures.	Low

B.8.6 Assessment Summary

Predictions of increased occurrence of severe tropical cyclones, resulting in increased storm surge frequency and height will potentially result in a number of impacts for the PEP. Impacts requiring mitigation actions were identified for factors such as increased temperature, increased number of days over 35°C and rising sea level. POTL has existing procedures in place for addressing emergency situations at the port, which will continue for the PEP; for example, ensuring appropriate emergency equipment and suitable site access for emergency vehicles is available, undertaking channel assessments and inspections of the condition of port infrastructure after cyclone events and evacuation of ships prior to cyclone events. In addition to these existing mitigation measures, a range of preferred mitigation measures were identified for these impacts including:

- developing stop-work procedures for extreme heat days and ensuring appropriate PPE is provided to staff, who are educated on managing heat stress
- allowing contingencies in the Project construction schedule due to impacts from tropical cyclone events
- developing and implementing emergency response and evacuation procedures
- training staff in emergency procedures
- monitoring the number of power outages and considering preventative measures such as upgrades if this number trends upwards over time
- undertaking a channel assessment after cyclone events to identify maintenance requirements
- designing stormwater infrastructure and drainage channels and outlets for increased cyclone intensity and limiting overtopping design criteria for marine structures to the capacity of associated drainage infrastructure
- elevating water sensitive operational areas to avoid submersion during predicted storm surge events
- account for predicted wave climate and water levels in procedures for handling and storage of materials.
- amending Cyclone Emergency Procedure to incorporate the PEP and activating as necessary
- ensuring wave climate and water levels for the design of marine structures (wharves, breakwaters and revetments) consider cyclone and sea level rise projections(covering the 50 year design life of the expansion)
- implement appropriate procedures for handling and storage of construction materials and machinery during cyclone and storm surge events
- amending the Port Contingency and Continuity Plan to include the PEP and activating as necessary.

Upon implementation of the identified mitigation measures, the climate change and natural hazard impacts for the Project were re-assessed and rated as a low risk.

Table B.8.6 Residual Risk After Mitigation Measures Applied

Project Phase	Change in Climatic Variable	Potential Impact	Residual Risk Rating
Construction	Increase in average annual mean temperature Increase in annual number of days over 35°C	Extreme temperatures stop construction work	Low
	Increase in the number of severe tropical cyclones Increase in storm surge frequency and height	Delays in Project construction due to a tropical cyclone event	Low
		Injury or death of staff during cyclone events Loss or degradation of the marine environment due to damage or	

Project Phase	Change in Climatic Variable	Potential Impact	Residual Risk Rating
		movement of construction materials	
			Low
Operation	Increase in average annual mean temperature Increase in annual number of days over 35 °C	Increase in power outages and higher electricity costs	
	Increase in the number of severe tropical cyclones Increase in storm surge frequency and height	Altered sediment transport patterns and infill of channels associated with cyclones/coastal storms	Low
		Increase incidents of stormwater inundation and low land flooding	Low
		More extreme wave climate and increase in storm surge water levels leading to overtopping of marine structures and inundation of the PEP	Low
		More extreme wave climate and increase in storm surge water levels leading to damage of marine structures	Low
		Longer port downtimes and potential port closures	Low
		Overtopping and structural integrity of marine structures	Low
		Loss or degradation of the marine environment due to increased sedimentation and pollution	Low
		Extreme wave climate leading to re-suspension of dredge spoil	Low

Port Expansion Project EIS

Part B

Section B9 – Air Quality

AECOM BMT WBM

B.9 Air Quality

B.9.1 Relevance of the Project to Air Quality

The construction works for the Townsville Port Expansion Project (PEP) will include a number of activities that will generate dust emissions that could adversely affect local air quality if not managed appropriately. This chapter addresses the air quality elements presented in Section 5.7 of the *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement;* Section 5.10(b) of *Guidelines for an environmental impact statement for the Port of Townsville Port Expansion Project, Queensland (EPBC 2011/5979/GBRMPA G34429.1);* and potential impacts on outstanding universal value or matters of national environmental significance.

B.9.2 Assessment Framework and Statutory Policies

This section describes air quality values as defined by the *Environmental Protection Act 1994* (EP Act), the *Environmental Protection (Air) Policy 2008* (EPP (Air)) and *State Planning Policy 5/10: Air, Noise and Hazardous Materials* (SPP 5/10).

B.9.2.1 Legislation

The EP Act defines an environmental value as:

a) *a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or*

b) *another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.*

The EPP(Air) specifies four categories of environmental values:

a) *the qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems;*

b) *the qualities of the air environment that are conducive to human health and wellbeing;*

c) *the qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and*

d) *the qualities of the air environment that are conducive to protecting agricultural use of the environment.*

SPP 5/10 refers to the air environmental values (particularly human health, wellbeing and amenity) described in the EPP (Air).

B.9.2.2 Ambient Air Quality Objectives

The EPP (Air) sets ambient air quality objectives for priority air pollutants in Queensland.**Error! Reference source not found.** Table B9.1 presents air quality objectives for contaminants included in this assessment and the environmental values the criteria were specifically developed to protect. The objectives for the contaminants listed in the EPP (Air) are not applicable to air emissions experienced in a workplace that are emitted from that workplace, i.e. the objectives do not apply to the construction site itself.

Airborne particles are commonly differentiated according to size based on their equivalent aerodynamic diameter. Airborne particulates considered by this assessment were total suspended particulates (TSP which encompass all particles with a diameter of less than or equal to 50 micrometres (µm) and PM10 particulates which encompass (particles with diameters less than or equal to 10 µm. $PM_{2.5}$ particles have not been included in the modelling due to low expected emissions from the operations. A more detailed discussion of all particulate fractions assessed by this study has been included in Section B9.3.2.

Table B.9.1 EPP (Air) Ambient Air Quality Objectives

Pollutant Type	Averaging Period	EPP (Air) Criteria	Environmental Value	Units
TSP	1 year	90	Health and wellbeing	µg/m³
PM_{10}	24 hours	50 [1]	Health and wellbeing	µg/m³

1 5 days allowable exceedences per year. On this basis, the sixth highest predicted 24-hour concentration has been compared with the criterion.

These criteria are designed to provide a level to meet the health and wellbeing environmental value. In addition to the airborne pollutant assessment criteria referenced above, the following NSW Environmental Protection Authority criteria (DEC, 2005) were also used for assessment:

- deposited dust (dustfall) of an increase of 2 g/m²/month over existing levels and a total dustfall of 4 g/m²/month;
- Average annual PM_{10} criterion of 30 µg/m³.

The purpose for the inclusion of the criteria from NSW was that there were no equivalent criteria able to be referenced in Queensland.

B.9.3 Existing Values, Uses and Characteristics

This section provides:

- an inventory of air emissions expected from the Project during construction activities
- prediction of dust concentrations and an assessment of the resultant impact at sensitive receptor locations associated with the expected worst-case construction activities (although worst-case, these emissions are expected to still represent an realistic possible scenario i.e. all emissions modelled could feasibly occur at the same time)
- discussion of the air quality-related operational aspects of the port.

B.9.3.1 Proposed Project

B.9.3.1.1 Construction

As outlined in Chapter A.1, the Project involves the following main port infrastructure components that relate to activities that have the potential to generate air pollutant emissions or that may present a potential risk to surrounding sensitive areas:

- land reclamation, predominantly through the placement of dredged material
- construction and development of new breakwater and revetment structures
- development of new internal bunds to facilitate effective land reclamation
- construction of new wharf structures
- construction of new road and rail infrastructure in the Project footprint and connection to the Eastern Access Corridor (currently under construction)
- installation of new services infrastructure.

The new berths and reclamation areas will be developed in a staged manner in response to demand from increase in throughput or the advent of new trades. The expansion may be developed on a sequential berth-by-berth basis or in stages involving the development of multiple berths.

B.9.3.1.2 Operation

The trade forecast (Chapter B19) for the port predicts that the major components of port traffic by 2024/2025 may be coal exports (24%); nickel ore imports (24%); magnetite exports (16.5%); fertiliser exports and imports (10.5%) and other mineral concentrate exports (such as copper, lead and zinc; 9.5%). While the particular trades to be handled through the PEP are not defined, dry bulk and bulk liquid trades are expected to be prevalent. All traded product will be handled, stored and shipped by third party operators and tenants within POTL lands.

Vessel operations are expected to occur on a 24 hours per day, 7 days per week basis, with an estimated 1,300 vessels per year expected to use the facilities during the peak operational stage. Emissions from the vessels are expected to be minimal once in port with the main engines off and small scale generators in operation for ship board power in operation. On this basis, shipping emissions have not been considered by this assessment.

In the operational phase of the PEP traded products will be stored in enclosed sheds or covered stockpiles, conveyors would be covered, and rail wagons controlled to the degree practicable (either through veneering, covering or other control methodology).

Due to the implementation of newer technology, the PEP operational activities would be expected to contribute much less to air quality impacts than the existing port activities given the expected operational requirements to be imposed on new port developments i.e. enclosed stockpiles, enclosed conveyors, sealed roads and actively managed exposed areas (by sealing, hydromulching or managing the dust from reclaimed areas).

Detailed air quality assessments, specific to the development proposals of individual future lessees, may be undertaken and submitted for approval as part of future development applications will be on a case by case basis). The process and requirements of future port tenants are explained more fully in Chapter A.2.

B.9.3.2 Particulates of Potential Concern

Particulate matter can be emitted from natural sources (bushfires, dust storms, pollens and sea spray) or as a result of human activities such as combustion activities (motor vehicle emissions, power generation and incineration), excavation works, bulk material handling, crushing operations and unpaved roads.

Airborne particles are commonly differentiated according to size based on their equivalent aerodynamic diameter. Particles with a diameter of less than or equal to 50 micrometres (μm) are collectively referred to as total suspended particulates (TSP). TSP primarily causes aesthetic impacts associated with coarse particles settling on surfaces (deposited dust), which also causes soiling and discolouration. These large particles, however, can cause some irritation of mucosal membranes and can increase health risks from ingestion if contaminated. Particles with diameters less than or equal to 10 μm (known as PM_{10} or fine particles) tend to remain suspended in the air for longer periods than larger particles, and can penetrate into human lungs. Particles with a diameter less than 2.5 micrometres ($PM_{2.5}$) have not been assessed as significant quantities of these sized particles are not expected to be generated by the reclamation, dredging, filling activities of ship power generation when in port. On this basis, $PM_{2.5}$ particles have not been discussed further by this report.

Exposure to particulate matter has been linked to a variety of health effects, such as respiratory problems (such as coughing, aggravated asthma, chronic bronchitis) and non-fatal heart attacks. Furthermore, if the particles contain toxic materials (such as lead, cadmium, zinc) or live organisms (such as bacteria or fungi), toxic effects or infection can occur from the inhalation of the particulates. Material brought on site as part of the reclamation process will be tested to ensure levels of contaminants are below levels of concern. On this basis, the risk of adverse impacts from contaminants in windblown dust is considered to be low and is not considered further by this study. It should be noted that further environmental assessments will be undertaken as products and tenants come on-line.

B.9.3.3 Potential Air Quality Emission Sources (Construction)

Fugitive dust arises from the mechanical disturbance of granular material exposed to the air. Common sources of fugitive dust include vehicles and plant moving over unpaved/unsealed roads, storage piles of rock, soil and/or aggregate, and heavy construction operations. The dust generation process is caused by two basic physical phenomena:

- pulverisation and abrasion of surface materials by application of mechanical force through implements (wheels, blades, etc.)
- entrainment of surface particles by the action of turbulent air currents, such as wind erosion of an exposed surface by wind (typically speeds over 19 km/h (approximately 5.3 m/s)).

Dust emissions in this assessment are based on area based emission rates and are not influenced by slight differences in wind speed.

Emission factors used for the generation of vehicle based emissions e.g. wheel generated dust, take into account engine emissions i.e. diesel fuel PM_{10} emissions. As such separate sources for engine emissions have not been considered, but have been included through their contribution to the non-vehicle based emission factors.

B.9.3.4 Background

B.9.3.4.1 Existing Environment and Environmental Values

Project Area and Surrounding Land Use

The Port of Townsville is located at Benwell Road, South Townsville in Queensland and is bounded by Cleveland Bay to the north and east and a combination of commercial and residential land immediately to the south and west. The nearest residences are located adjacent to the port's southern boundary, along Archer Street, South Townsville.

Background Air Quality

The Department of Environment and Heritage Protection (DEHP) operate a network of air quality monitoring stations throughout Queensland. A monitoring station located at the Townsville Coast Guard[1], a site adjacent to the western boundary of the port, collects PM_{10} data. A station located at Pimlico, approximately 6 km to the south-west of the Project Area, measures meteorological data and PM_{10}. Continuous monitoring of TSP using a tapered element oscillating microbalance is also conducted at Coast Guard.

Table B.9.2 summarises the background data collected at the Coast Guard monitoring site in 2011. As shown, the adopted criteria were met for TSP and dustfall.

Table B.9.2 Summary of Background Pollutant Levels (Coast Guard Site)

Pollutant	Averaging Period	Adopted Criteria	Average Concentration
TSP	1 year	90	43.6 µg/m³
Dustfall	1 year	2[1]	1.4 g/m²/month

1 Dustfall is also measured at Pimlico. As the Coast Guard site average concentration was higher, it was used as a conservative ambient dust concentration for the assessment

As PM_{10} particles present a higher respiratory risk than dust, long-term data were sought for the Townsville area. Data from the Port of Townsville Limited (POTL)-operated monitoring site (near Berth 10) were obtained. These covered from 1994 to 2011. The last five calendar years of monitoring data were analysed and the results are presented in Table B.9.3. Data from 2008, which were the highest annual time series concentrations for the past five years, were adopted for this assessment.

The 70th percentile level was chosen for use as a typical level as it was more representative of long-term ambient concentrations. As the 70th percentile ambient PM_{10} concentrations were less than the 24-hour EPP (Air) criterion for PM_{10}, they were considered to be protective of health and wellbeing.

Table B.9.3 PM_{10} Tapered Element Oscillating Microbalance Monitoring Data (µg/m³) (POTL Site)

Year	Annual Average PM_{10}	24-Hour 70th Percentile PM_{10}	Number of Exceedences of 24-Hour Criterion per Year
2007	19.8	22.8	2
2008[1]	21.4	24.7	3
2009[2]	20.3	23.2	6
2010	18.7	21.3	0
2011	15.4	19.7	0
Adopted Value	21.4	24.7	-

1 As 2008 represented the highest background PM_{10} concentration, it was adopted for the modelling of the effects of the PEP proposal.

2 These data exclude the elevated concentrations measured around 24 September 2009 when a large dust storm swept over Australia's eastern seaboard.

[1] Note that POTL also has a particulate monitoring station at the Coast Guard location which measures PM10, TSP and dust deposition. For consistency with DEHP reporting, the results for the DEHP data has been considered as the primary background monitoring data.

Receptors

A number of receptor locations were chosen in order to make an assessment of potential air quality conditions modelled for the effect of the PEP development. The locations of receptors (such as schools, residences and public buildings) used in this assessment are provided in Table B.9.4 and shown on Figure B.9.1. As the emission sources from the PEP construction will typically emit pollutants at a low height (generally at ground level), adverse air quality effects would occur relatively close to the point of emission. As such, the receptors were chosen based on their proximity to the Project Area. Mixing, dispersion and advection of ground level pollutants in the air column would lower concentrations at distances further from the point of origin.

Receptors have been chosen based on their proximity to the port rather than any expected area of concern or specific problem receptor location. The receptors to the south of the port were selected as a ‘picket line’, which have been used to represent expected worst-case construction emissions.

Table B.9.4 Potentially Sensitive Receptors

Site ID	Modelled Receptor Location	Approximate Distance from PEP(km)	Receptor Type
Site 1	Jupiters Townsville Hotel and Casino	1.7	Commercial
Site 2	Breakwater Quays	1.8	Residential
Site 3	55 Macrossan Street, South Townsville	1.9	Residential
Site 4	29 Hubert Street, South Townsville	2.0	Residential
Site 5	Corner of The Strand and Gregory Street, North Ward	2.8	Residential
Site 6	72 The Strand, North Ward	3.3	Residential
Site 7	corner of The Strand and Howitt Street, North Ward	3.9	Residential
Site 8	Townsville CBD	2.8	Commercial
Site 9	corner Archer and Ross Streets, South Townsville	2.0	Commercial
Site 10	Pallarenda	8.8	Residential
Site 11	North Ward Sports Grounds	3.4	Public Space

PORT EXPANSION PROJECT EIS

Modelled Receptor Locations

Figure B.9.1

Legend

- Modelled Receptor Locations
- Railway Line
- Project Area
- Townsville State Development Area
- Existing Port Land

N

Scale: 1:50,000 (when printed at A4)

0 0.5 1 2

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_109

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010
Base Image - ESRI 2012

Climate and TerrainTownville is located in the tropics, but experiences considerable variation in rainfall from year to year, and typically experiences less rainfall than other tropical areas. The wet season months (November to April) are typically hot and humid, with bursts of monsoonal rains occurring between late December to early April and the occasional cyclone. South-easterly trade winds and mostly fine weather, warm days and cool nights are typical of the dry season months (BOM, 2012b).

Meteorology in the Project Area and surrounds is affected predominantly by proximity to the ocean. The area is a flat coastal plain adjacent to the ocean.

The Bureau of Meteorology (BOM) collects meteorological data at Townsville Airport. This monitoring location is approximately 7 km to the west of the Project Area. The meteorological data collected from the BOM site (Table B.9.5) include hourly records of temperature, wind speed and wind direction. It has been shown in other studies (Appendix E3) that the port wind patterns differ slightly to those at the airport. The location of the surface wind file for the dispersion modelling was at the Project Area (as extracted from the air pollution model).

The long-term average temperatures range from 13.6 °C to 26.0 °C in the dry season to 24.1 °C to 31.5 °C in the wet season. Average humidity varies between 66 % at 09:00 and 58 % at 15:00 over the whole year. The Townsville Airport BOM rainfall data show, on average, that the wettest month is February, during the wet season, with an average rainfall of 307.6 mm for the month. From November to April the weather in Townsville is warm, humid and windy with high rainfall and storms. These conditions facilitate the dispersion of pollutants in the air, while the rain absorbs gases and mitigates the generation of particulate matter, decreasing particulate generation and removing it from the air. In the dry season, from May to October, there is less rain and the wind is not as strong, so there is less potential for dispersion of pollutants and the lower potential for the generation of windblown dust. Despite the lower potential for wind-generated dust under low wind speed conditions, lower rainfall during the dry season has the potential to result in drying out of port areas, which may increase the potential for windblown dust. In addition, the region’s topography, amount of sunshine and prevailing wind conditions during the dry season mean that ground level pollutant concentrations may be higher during these months than during the wet season.

The most recently posted long-term average wind roses for the BOM site are provided in Figure B.9.2. Overall, the wind roses indicate that there is a diurnal pattern in the wind directions, illustrated by the inland winds (primarily from the south-east) in the morning with a shift to sea breezes (from the north-east quarter) in the afternoon.

The wind speed in Figure B.9.2 are in km/hr. The wind speed referenced in the model are in metres per second (m/s). To calculate m/s multiply the km/h value by 0.27.

The data from the BOM station is only for comparison purposes to determine whether there are any general trends observable in the data. Data for the dispersion model was prepared using a prognostic model centred on the port area and would be expected to differ to the long-term data for the airport, which is inland from the port. General trends are expected to be the same i.e. diurnal coastal wind re-circulation.

Table B.9.5 Summary of Long-Term Meteorological Data Collected At Townsville Airport BOM Station (1940 to 2011)

Statistic		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Mean temperature (°C)	Maximum	31.3	31.1	30.7	29.6	27.6	25.6	25.1	26	27.7	29.4	30.7	31.5	28.9
	Minimum	24.3	24.1	22.9	20.6	17.6	14.6	13.6	14.7	17.4	20.7	22.9	24.1	19.8
Mean wind speed (km/h)	09:00	10.9	9.7	10.2	10.7	8.8	8.3	7.9	10	13.7	15.7	15.1	13.5	11.2
	15:00	19.9	18.5	19.6	20.6	19.4	18.1	19.9	21.9	23.6	23.5	23.1	22.2	20.9
Mean relative humidity (%)	09:00	71	75	71	68	66	65	65	63	60	60	63	66	66
	15:00	65	67	63	60	56	52	51	52	53	55	58	60	58
Rainfall (mm)	Mean	276.5	307.9	186.3	66.6	32.4	20.5	13.8	16.4	10.9	24.9	60.2	131.7	1,153.7

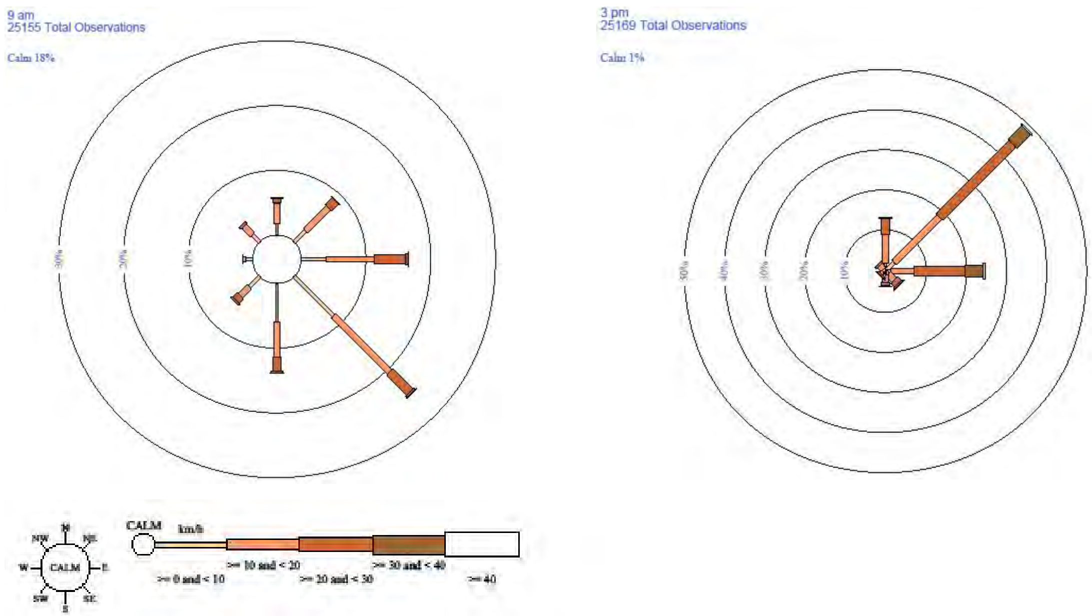


Figure B.9.2 Long-Term Wind Roses for Townsville Airport, BOM Site, 09:00 and 15:00 (BOM, 2010a)

B.9.3.5 Dispersion Modelling (Construction Phase)

B.9.3.5.1 Model

The CALPUFF (ASG, 2012) air dispersion model was used in the air quality impact assessment. CALPUFF is a non-steady-state, three-dimensional Gaussian puff model developed for the US Environmental Protection Agency for use in situations where basic Gaussian plume models are not effective, such as coastal areas with re-circulating sea breezes. Input parameters used in the CALPUFF dispersion modelling are summarised in Table B.9.6. Further details of the modelling inputs are provided in the following sections.

Table B.9.6 CALPUFF Input Parameters

Parameter	Input
CALPUFF version	6.262 2010
Modelling domain	25 x 25 km
Modelling grid resolution	1 km
Number of sensitive receptors	11
Terrain data	Included in CALMET
Building wake data	Not included in model
Dispersion algorithm	PG (rural, ISC curves) and MP Coeff. (urban)
Hours modelled	8,760 hours (365 days)
Meteorological data period	1 January 2009 to 31 December 2009[1]

1 Refer Section B.9.3.5.2 for discussion of why 2009 data has been used

B.9.3.5.2 Meteorological Data

Meteorological data for the period January to December 2009 used in the dispersion modelling were developed using a combination of prognostic data generated by the air pollution model with inputs from measured data from the Townsville Airport BOM monitoring station. These data were generated in order to represent meteorological conditions at the Project Area.

The 2009 data set was selected for the dispersion modelling based on the particulate monitoring data set outlined in Section B.9.3.5.2. While 2008 had the highest long-term 70th percentile background concentration, the 2009 data had the highest number of 24-hour average PM_{10} exceedences and was selected as the year to be modelled (as the individual 24-hour results are more important when assessing a facility contemporaneously).

When using a single year of meteorological data as input into a dispersion model, it is necessary to demonstrate that the data are representative of the long-term meteorological conditions at the Project Area and of long-term regional behaviour. The main features of the generated data set and a comparison with measured meteorological data are provided in Appendix M1. The generated meteorological data set was considered representative of long-term meteorological conditions and expected regional behaviour; therefore, is suitable for use in this assessment.

B.9.3.5.3 Modelling Scenarios

The construction works for the PEP are expected to be undertaken in four stages (Stages A to D). The different stages were reviewed in light of the assumptions described above. Stage A was determined to represent the worst-case construction scenario for dust generation, with greater numbers of plant and equipment and a greater area undergoing construction compared to the other stages. Additionally, the Stage A works will occur first and will be located closest to sensitive receptors. As such, this stage was chosen for assessment by modelling. The Stage A works are shown in Figure B.9.3. Details of dust-generating plant and equipment proposed for each construction stage are described in Table B.9.7. Stage A has been assessed from Table B.9.7; other development stages are included for reference purposes only.

Following an analysis of the dust-generating sources contributing most to the overall dust emissions, it was identified that haul road emissions were the most significant contributor to generated dust. Three scenarios were developed to allow further analysis of the potential benefit that reducing road-generated dust may have on the overall air quality conditions.

The three modelling scenarios in this assessment were:

- Scenario 1: dust sources for Stage A as defined in Table B.9.7 with haul roads unsealed. The haul roads are assumed to run from the boundary of the existing sealed section of road to the centre of the Project Area. The distance of the unsealed haul road was 1.5 km (3 km round trip per vehicle).
- Scenario 2: dust sources for Stage A as defined in Table B.9.7 with half of the internal haul roads sealed to a degree whereby negligible dust is emitted. This assumed a haul road distance of 750 m and assumed that the initial entry road onto the PEP had been sealed.
- Scenario 3: dust sources for Stage A as defined in Table B.9.7 with all of the internal haul roads sealed to a degree whereby negligible dust is emitted. This scenario assumed that a common sealed roadway is established in the PEP.

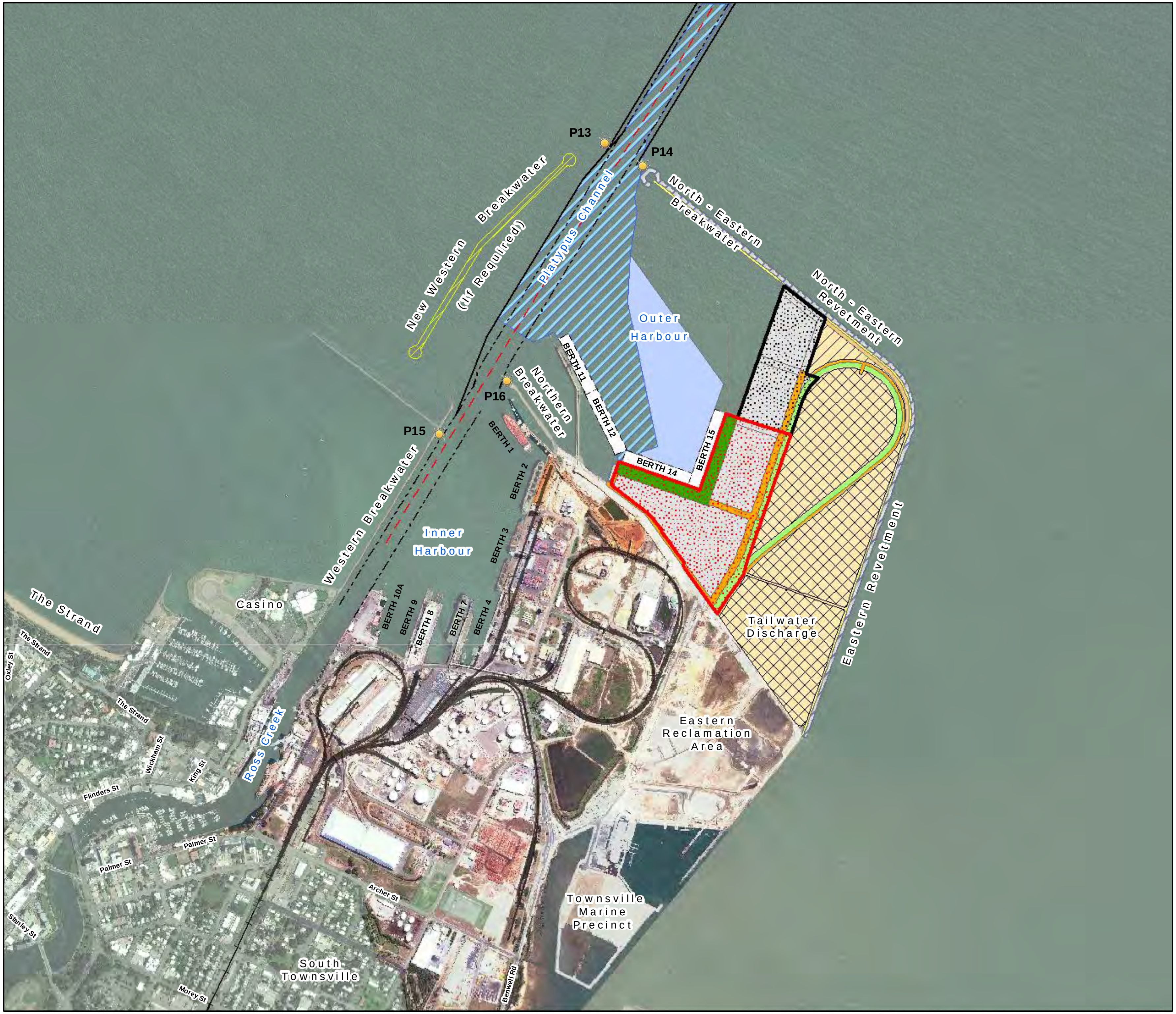
In addition to the limitation on the haul road distance investigated by Scenarios 1 to 3, a number of mitigation measures were also applied to the dispersion model. These measures were:

- road watering for unsealed roads
- wind barriers at the edge of the active areas and haul roads
- watering of bulldozer activities on friable soil (where wet soils are being spread, watering is not required)
- areas which are not to be worked for long periods of time are to be sealed to prevent the generation of dust; for example, using one of a variety of methods such as hydromulching, chemical sealing etc.

PORT EXPANSION PROJECT EIS

Stage A Construction Works

Figure B.9.3



Legend

- Navigation Beacon
- Railway Line
- Channel Centre Line
- Existing Channel Limits
- Access Road and Service Corridors
- Berths
- Deepening Channel and Basin Areas
- Filled Cell
- New Channel and Basin Area
- New Wharf
- Partly Filled Area
- Perimeter Access Road "2 Way"
- Railway Corridor
- Revetment
- Settlement Pond
- Western Breakwater
- Area Under Construction (20ha)
- Exposed Ground (12ha)

N

Scale:1:20,000 (when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_113

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
PEP Layout - AECOM 2012

Table B.9.7 Construction Works Particulate Emission Sources

Works and Activities	Location	Equipment	Stage A		Stage B		Stage C		Stage D	
			Duration (weeks)	Number	Duration (weeks)	Number	Duration (weeks)	Number	Duration (weeks)	Number
Main breakwater and perimeter revetments (24/7 activity)										
Delivery of breakwater and revetment core material and armour	Perimeter	Trucks	90	50 (300 trips/day)	N/A	N/A	N/A	N/A	40	2 (6 trips/day)
Handling and placing rockfill	Perimeter	Excavator	90	3	N/A	N/A	N/A	N/A	40	2
Trimming/level finish surface [1]	Perimeter	Bulldozer	90	1	N/A	N/A	N/A	N/A	N/A	N/A
Construction management	Perimeter	Utility vehicles	90	3	N/A	N/A	N/A	N/A	N/A	N/A
Western breakwater (24/7 activity) (if required)										
Handling and placing rockfill	Breakwater	Excavator	50	1	N/A	N/A	N/A	N/A	N/A	N/A
Delivery of rockfill and rock armour	Stockpile awaiting barging to breakwater [2]	Trucks	50	12 (70 trips/day)	N/A	N/A	N/A	N/A	N/A	N/A
Reclamation area (dredge discharge activity 24/7; capping layer activity 12/5)										
Reclamation operations involving moving of pipelines, shifting surcharge material, placement of capping layer, construction of rail loop [3]	Reclamation area	Bulldozers/front-end loaders/ traxcavator	55	5[3]	55	3	55	3	40	3
		Off-road dump trucks	55	4	55	3	55	2	40	1
Delivery of material for capping layer and pavements	Reclamation area	On-road dump trucks	10	4 (9 trips/day)	10	4 (9 trips/day)	10	4 (9 trips/day)	10	4 (9 trips/day)
Construction management	Reclamation area	Utility vehicles	55	6	55	6	55	6	40	6

Works and Activities	Location	Equipment	Stage A		Stage B		Stage C		Stage D	
			Duration (weeks)	Number	Duration (weeks)	Number	Duration (weeks)	Number	Duration (weeks)	Number
Road, rail, civil works and services (12/5 activity)										
Earthworks, pavement formation layers, delivery of materials, civil works for trunk services and utilities	Reclamation area	Delivery trucks	30	4 (20 trips/day)	30	4 (20 trips/day)	20	4 (20 trips/day)	30	4 (20 trips/day)
		Bobcats	30	2	20	2	20	2	30	2
		Excavators	30	2	20	2	20	2	30	2
		Grader	30	1	20	1	20	1	30	1
		Utility vehicles	30	3	20	3	20	3	30	3
Wharf construction (24/7 activity)										
Concrete delivery	Wharf	Concrete trucks	35	2 (8 trips/day)	25	2 (8 trips/day)	25	2 (8 trips/day)	35	2 (8 trips/day)
Construction management	Wharf	Utility vehicles	40	3	25	3	25	3	40	3

1 Bulldozers expected to operate on rock only or wet environments. No dust expected.

2 The barge emissions are not expected to be a significant source of emissions. Rock armour is not expected to be a significant source of dust emissions (almost entirely large rock pieces with little dust) and as such excavators dumping material off barges not included in the modelling.

3 Of the five excavators expected in the reclamation area, only two are expected to operate on dry material generating dust. The remaining will be on wet material with negligible dust generation.

B.9.3.5.4 Emissions Estimation

A number of assumptions were made regarding the likely construction activities to be undertaken during PEP development. The main assumptions made regarding the site works are shown in Table B.9.8; these data were used to develop emissions estimates for assessed construction works.

Table B.9.8 Overall Project Area Development Parameters

Factor	Value	Unit
Mass of fill per truck	30	t
Truck trips per day	407	round trips
Average haul distance - trucks (round trip)	3	km
Number of site trucks	50	number
Small vehicle trips per day	30	round trips
Small vehicle haul distance (round trip)	3	km
Number of small vehicles	3	number
Material moved/handled	12,210	tonnes per day
Number of construction areas	4	number

Some construction works will be undertaken 24 hours per day, 7 days per week as described in Table B.9.7. Air emissions from shipping that might occur during the construction works were not assessed as it was not expected to be a significant source of emissions (emissions from engines only). The exposed area was assumed to be sealed or managed to an extent that dust emissions would not occur from this part of the Project. Heavy duty watering or surface sealing was assumed to be undertaken during activities where dust generation could occur.

The reclaim ponds around the new rail loop will also be managed so that dust emissions do not occur. This is expected to be through one of two ways:

- allowing the tidal exchange of seawater in the sediment pond bunds so that a layer of water is maintained over the silt surface
- isolating the sediment ponds from tidal influences, where the clay fines in the ponds will form a slightly hardened surface that will not generate dust emissions unless disturbed by traffic.

In the latter scenario, the surface can also be stabilised by growing long grasses or through other sealed surface protection mechanism such as hydromulching, mulch cover or spray sealant.

Vehicle and plant exhaust emissions were assessed in terms of particulate emissions only. While other pollutants will be emitted during the construction works (primarily combustion emissions, such as nitrogen oxides, sulphur oxides and polyaromatic hydrocarbons), the level of emissions of these pollutants is not expected to be distinguishable against the existing background levels from the surrounding port and other local sources. All plant and vehicles will be maintained appropriately to reduce exhaust emissions.

Emission rates for the construction works were estimated using emission factors published by the Commonwealth government for the National Pollutant Inventory (DSEWPC, 2011b).

B.9.3.5.5 Emissions Inventory

The emission source data modelled for each source representing construction activities are detailed in Table B.9.9.

Table B.9.9 Emissions Data – Construction Sources

Source	Source Type	Number of Sources	Modelled Emission Rates				
			TSP		PM_{10}		Units
			Day	Night	Day	Night	
Construction area	Area	1	0.000073	0.0000056	0.000020	0.0000028	g/m²/s
Road haulage [1]	Volume	8	1.22	0.81	0.37	0.25	g/source
Perimeter revetments	Area	8	0.44	0.44	0.14	0.14	g/source

1 The only differences between scenarios (Section B.9.3.5.3) are the number of road haulage sources. There are 8, 4 and 0 sources respectively for Scenarios 1, 2 and 3.

The reason for different emission rates between night and day in Table B.9.9 is due to the difference in the scheduled construction and haulage activities over the life of the PEP (refer Table B.9.7). Some areas are expected to occur 24 hours a day, whereas others are only during the day, hence the higher emission rates during the day.

The contributors to the emissions from the above three sources are summarised in Table B.9.10.

Table B.9.10 Emissions Data – Source Inclusions

Source	Area	Source Inclusions	Hours per Day
Construction area	Reclamation area	Open area wind erosion	24
		Excavator	12
		Truck dumping	12
		Bulldozer	12
	Road, rail, civil works and services	Bobcat	12
Road haulage	Main breakwater and perimeter revetments	Trucks	24
		Small vehicles	24
	Reclamation area	Trucks	12
		Small vehicles	12
	Road, rail, civil works and services	Small vehicles	12
		Grader	12
		Trucks	12
	Wharf construction	Concrete trucks	24
		Small vehicles	24
Perimeter revetments	Main breakwater and perimeter revetments	Excavator	24
		Bulldozer	24
		Front-end loader	24

B.9.4 Assessment of Potential Impacts

The overall risk based assessment considers:

- magnitude of effect (consequence): comprised of assessment of the intensity, scale (geographic extent), duration of impacts and sensitivity of environmental receptors to the impact
- likelihood of effect: assessing the probability of the impact occurring.

The matrix for risk assessment, descriptions of the likelihood and magnitude categories given in Part A are followed for this assessment.

The likelihood of air quality effects occurring was classed as ‘almost certain’, as dust will be generated by the construction activities at certain times, and the dispersion modelling predicted occasional exceedences of the 24-hour PM_{10} criterion.

The magnitude of air quality impacts for the PEP was classed as ‘moderate’. The long-term average concentration of TSP, PM_{10} and dustfall at receptor locations were predicted to be below the relevant guideline levels, while a number of exceedences of the 24-hour PM_{10} criterion were predicted at some receptors close to the port boundary. If managed properly in accordance with a well-managed, reactive dust management plan, the predicted dust concentrations are not expected to have an adverse impact on the natural or built environment surrounding the port.

The construction works are anticipated to present a medium-level environmental risk to air quality. Details of mitigation measures to manage the potential impacts are suggested in Section B.9.5.

B.9.4.1.1 Predictions of Potential Effects

To provide an assessment of cumulative effect – in combination with other known existing sources – the existing regional background pollutant levels (Section B9.3.4) were added to the modelling predictions at each nominated sensitive receptor location. The following background pollutant data were used:

- Annual TSP 43.6 µg/m³
- 70th percentile 24 hour PM_{10} 24.7 µg/m³
- Annual average PM_{10} concentration 21.4 µg/m³
- Dustfall 1.4 g/m²/month.

The results of the dispersion modelling for the three construction scenarios are provided in Table B.9.11. These results show the predicted modelling outputs for the construction works component, when considered in isolation (i.e. without considering existing ambient particulate concentrations). The predicted TSP and PM_{10} concentrations and dust fall rates were well below respective criteria at each modelled receptor location. Also when considered in isolation from background levels, there are no predicted exceedences of criteria noted for any dust fraction or deposition rate.

By way of explanation of some of the air quality terms used above, the following has been prepared to ensure the results and their implications are clearly understood.

When undertaking an air quality impact assessment, there are two areas that need to be considered:

- background air quality: pollutants in the air already as a result of natural (bushfires, dust storms etc) and manmade sources (wood smoke, industrial pollution etc)
- predicted contribution of a pollutant from the development: dust in the case of the PEP; these results are the expected concentrations predicted from a dispersion model and is often referred to as 'the impacts from the development considered in isolation from the background'.

When assessing whether a site may have an adverse impact on the environment firstly, the predicted contribution from the development needs to be assessed against relevant criteria and secondly, the cumulative concentration needs to be analysed and compared with criteria. The results have been considered using both the development in isolation from the background and cumulatively.

The presentation of the results has been undertaken in a number of different ways. The first methodology assumes the sixth highest concentration is used. The assessment criteria allow for five exceedences per year; therefore, the five highest concentrations are not considered.

Table B.9.11 Predicted Ground Level Pollutant Concentrations at Modelled Receptors (PEP Emissions Only)

Modelled Receptor (Site ID)	Annual Average TSP (µg/m³)			Annual Average PM_{10} (µg/m³)			6th Highest 24-Hour Average PM_{10} (µg/m³)			Annual Dustfall (g/m²/month)		
	Scenario			Scenario			Scenario			Scenario		
	1	2	3	1	2	3	1	2	3	1	2	3
Site 1	23.3	14.0	8.0	7.0	5.9	5.1	40.1	36.3	33.7	0.5	0.2	0.1
Site 2	18.6	11.6	6.8	6.0	5.1	4.5	38.1	34.3	33.1	0.3	0.2	0.1
Site 3	18.8	11.3	6.6	5.7	4.8	4.2	34.9	31.8	30.5	0.3	0.1	0.1
Site 4	18.1	11.4	5.9	5.0	4.2	3.5	30.2	25.5	22.5	0.2	0.1	0.1
Site 5	10.6	6.8	4.0	3.4	2.9	2.5	15.5	14.2	13.4	0.1	0.1	0.03
Site 6	8.8	5.9	3.5	2.9	2.6	2.3	14.2	12.1	11.1	0.1	0.1	0.03
Site 7	7.7	5.3	3.3	2.7	2.4	2.1	13.8	12.8	11.9	0.1	0.04	0.02
Site 8	8.3	5.4	3.2	2.7	2.4	2.1	20.2	18.2	16.9	0.1	0.05	0.02
Site 9	15.1	9.5	5.6	4.9	4.2	3.7	33.3	31.2	29.9	0.2	0.1	0.1

Modelled Receptor (Site ID)	Annual Average TSP (µg/m³)			Annual Average PM_{10} (µg/m³)			6th Highest 24-Hour Average PM_{10} (µg/m³)			Annual Dustfall (g/m²/month)		
	Scenario			Scenario			Scenario			Scenario		
	1	2	3	1	2	3	1	2	3	1	2	3
Site 10	2.6	1.8	1.1	0.9	0.8	0.7	4.3	3.9	3.4	0.0	0.01	0.004
Site 11	7.8	5.2	3.0	2.6	2.2	2.0	12.3	11.5	10.0	0.1	0.04	0.02
Criteria	90			30			50			2		

Figure B.9.4 to Figure B.9.6 show the concentration contours for modelled 24-hour PM_{10} in isolation from the background i.e. dust from the PEP construction activities only. The contours shown on each figure denotes the 6th highest 50 µg/m³ contour (24-hour average).

PORT EXPANSION PROJECT EIS

6th Highest Predicted 24 Hour PM_{10} Concentrations (CALPUFF) Scenario 1

Figure B.9.4

Legend

- Modelled Receptor Locations
- Railway Line
- Concentration Contours
- Project Area
- Townsville State Development Area
- Existing Port Land

N

Scale: 1:50,000 (when printed at A4)

0 0.5 1 2

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_110

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010
Base Image - ESRI 2012

PORT EXPANSION PROJECT
EIS

6th Highest Predicted 24 Hour PM_{10} Concentrations (CALPUFF) Scenario 2

Figure B.9.5

Legend

- Modelled Receptor Locations
- Railway Line
- Concentration Contours
- Project Area
- Townsville State Development Area
- Existing Port Land

N

Scale: 1:50,000 (when printed at A4)

0 0.5 1 2

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_111

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010
Base Image - ESRI 2012

PORT EXPANSION PROJECT
EIS

6th Highest Predicted 24 Hour PM_{10} Concentrations (CALPUFF)
Scenario 3

Figure B.9.6

Legend

- Modelled Receptor Locations
- Railway Line
- Concentration Contours
- Project Area
- Townsville State Development Area
- Existing Port Land

N

Scale: 1:50,000 (when printed at A4)

0 0.5 1 2

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_112

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011/2010
Base Image - ESRI 2012

B.9.4.2 Cumulative Airshed Conditions

Assessment of PEP needs to consider the predicted cumulative impacts from the PEP development activities (as outlined above) in concert with the existing operating facilities and industries and natural background.

There are a number of different methodologies that can be adopted for cumulative assessment. For short-term averaging periods, i.e. for 24-hour average PM_{10}, the two most common approaches are:

- adding the peak concentration at a receptor to the peak measured background pollutant concentration; this methodology is known as a ‘max plus max’ approach
- adding the average concentration for a specified time period to the corresponding time period measured pollutant concentration for the entire modelling period; this methodology is known as a contemporaneous assessment approach.

For the assessment of the short-term effects from the PEP, both cumulative methodologies were considered and are discussed below.

Annual average cumulative concentrations were assessed through the addition of background concentrations with the predicted concentrations at the set of modelled receptors. Results for the annual average TSP, PM_{10} and dustfall for the PEP are shown in Table B.9.12. In the following tables, the predicted concentration as a result of PEP is presented first, followed by the cumulative value in parentheses; e.g. ‘40.1 (64.7)’ represents a predicted value of 40.1 µg/m³ from the PEP source and a cumulative air quality value of 64.7 µg/m³.

Table B.9.12 Annual Average Cumulative Assessment Results

Modelled Receptor (Site ID)	TSP (µg/m³)			PM_{10} (µg/m³)			Dustfall (g/m²/month)		
	Scenario			Scenario			Scenario		
	1	2	3	1	2	3	1	2	3
Site 1	23.3 (66.9)	14 (57.6)	8 (51.6)	7 (28.4)	5.9 (27.3)	5.1 (26.5)	0.5 (1.9)	0.2 (1.6)	0.1 (1.5)
Site 2	18.6 (62.2)	11.6 (55.2)	6.8 (50.4)	6 (27.4)	5.1 (26.5)	4.5 (25.9)	0.3 (1.7)	0.2 (1.6)	0.1 (1.5)
Site 3	18.8 (62.4)	11.3 (54.9)	6.6 (50.2)	5.7 (27.1)	4.8 (26.2)	4.2 (25.6)	0.3 (1.7)	0.1 (1.5)	0.1 (1.5)
Site 4	18.1 (61.7)	11.4 (55)	5.9 (49.5)	5 (26.4)	4.2 (25.6)	3.5 (24.9)	0.2 (1.6)	0.1 (1.5)	0.1 (1.5)
Site 5	10.6 (54.2)	6.8 (50.4)	4 (47.6)	3.4 (24.8)	2.9 (24.3)	2.5 (23.9)	0.1 (1.5)	0.1 (1.5)	0.03 (1.4)
Site 6	8.8 (52.4)	5.9 (49.5)	3.5 (47.1)	2.9 (24.3)	2.6 (24)	2.3 (23.7)	0.1 (1.5)	0.1 (1.5)	0.03 (1.4)
Site 7	7.7 (51.3)	5.3 (48.9)	3.3 (46.9)	2.7 (24.1)	2.4 (23.8)	2.1 (23.5)	0.1 (1.5)	0.04 (1.4)	0.02 (1.4)
Site 8	8.3 (51.9)	5.4 (49)	3.2 (46.8)	2.7 (24.1)	2.4 (23.8)	2.1 (23.5)	0.1 (1.5)	0.05 (1.4)	0.02 (1.4)
Site 9	15.1 (58.7)	9.5 (53.1)	5.6 (49.2)	4.9 (26.3)	4.2 (25.6)	3.7 (25.1)	0.2 (1.6)	0.1 (1.5)	0.1 (1.5)
Site 10	2.6 (46.2)	1.8 (45.4)	1.1 (44.7)	0.9 (22.3)	0.8 (22.2)	0.7 (22.1)	0 (1.4)	0.01 (1.4)	0.004 (1.4)
Site 11	7.8 (51.4)	5.2 (48.8)	3 (46.6)	2.6 (24)	2.2 (23.6)	2 (23.4)	0.1 (1.5)	0.04 (1.4)	0.02 (1.4)
Criteria		90			30			2 (4)	

As shown in Table B.9.12, cumulative concentrations of TSP, PM_{10} and dustfall at each modelled receptor assessed comply with their respective long-term criteria. This indicates that, over the long term of a year, effects on air quality from the PEP development will not result in adverse air quality conditions.

B.9.4.2.1 'Max plus Max' Cumulative Assessment

The 'max plus max' approach is used where a representative background concentration is simply added to a predicted contribution from the PEP. Data used for this assessment were the 6th highest predicted concentration at the modelled receptor added to 24-hour PM_{10} concentration based on the highest 70th percentile PM_{10} concentration over the last 5 years (24.7 µg/m³).

The predicted and cumulative concentrations for PM_{10} at each sensitive receptor for each modelled scenario are shown in Table B.9.13. The number of exceedences refers to the number of days in the year where the predicted 24-hour concentration plus the background exceeds the 50 µg/m³ criterion. Exceedences are shown in **bold, red** font.

Table B.9.13 24-Hour Average PM_{10} 'Max plus Max' Cumulative Assessment (2008)

Modelled Receptor (Site ID)	Scenario 1		Scenario 2		Scenario 3	
	6th Highest (µg/m³)	Exceedences (days)	6th Highest (µg/m³)	Exceedences (days)	6th Highest (µg/m³)	Exceedences (days)
Site 1	40.1 **(64.8)**	12	36.3 **(61.0)**	9	33.7 **(58.4)**	8
Site 2	38.1 **(62.8)**	13	34.3 **(59.0)**	9	33.1 **(57.8)**	8
Site 3	34.9 **(59.6)**	11	31.8 **(56.4)**	7	30.5 **(55.2)**	7
Site 4	30.2 **(54.9)**	12	25.5 **(50.1)**	6	22.5 (47.2)	3
Site 5	15.5 (40.2)	2	14.2 (38.8)	1	13.4 (38.1)	1
Site 6	14.2 (38.9)	2	12.1 (36.8)	0	11.1 (35.8)	0
Site 7	13.8 (38.5)	0	12.8 (37.4)	0	11.9 (36.6)	0
Site 8	20.2 (44.9)	2	18.2 (42.8)	2	16.9 (41.6)	2
Site 9	33.3 **(58.0)**	8	31.2 **(55.9)**	8	29.9 **(54.6)**	7
Site 10	4.3 (29.0)	0	3.9 (28.5)	0	3.4 (28.1)	0
Site 11	12.3 (37.0)	1	11.5 (36.2)	0	10.0 (34.7)	0
Criterion	50					

The results shown in Table B.9.13 suggest that there is the potential for a limited number of PM_{10} exceedences to occur as a result of the PEP on individual days during the worst-case background year (over the last five calendar years) at receptors close to the port. As the worst-case 70th percentile background data was for the 2008 calendar year, the most recent year has also been analysed to provide a comparison of the more recent port operations. Background concentration of 19.7 µg/m³ applies to 2011. Results for the 2011 data are summarised in Table B.9.14.

Table B.9.14 24 Hour Average PM_{10} 'Max plus Max' Cumulative Assessment (2011)

Modelled Receptor (Site ID)	Scenario 1		Scenario 2		Scenario 3	
	6th Highest (µg/m³)	Exceedences (days)	6th Highest (µg/m³)	Exceedences (days)	6th Highest (µg/m³)	Exceedences (days)
Site 1	40.1 **(59.8)**	9	36.3 **(56.0)**	8	33.7 **(53.4)**	7
Site 2	38.1 **(57.8)**	9	34.3 **(54.0)**	8	33.1 **(52.8)**	7
Site 3	34.9 **(54.6)**	7	31.8 **(51.5)**	7	30.5 **(50.2)**	7

Modelled Receptor (Site ID)	Scenario 1		Scenario 2		Scenario 3	
	6th Highest (µg/m³)	Exceedences (days)	6th Highest (µg/m³)	Exceedences (days)	6th Highest (µg/m³)	Exceedences (days)
Site 4	30.2 (49.9)	5	25.5 (45.2)	3	22.5 (42.2)	2
Site 5	15.5 (35.2)	1	14.2 (33.9)	1	13.4 (33.1)	0
Site 6	14.2 (33.9)	0	12.1 (31.8)	0	11.1 (30.8)	0
Site 7	13.8 (33.5)	0	12.8 (32.5)	0	11.9 (31.6)	0
Site 8	20.2 (39.9)	2	18.2 (37.9)	1	16.9 (36.6)	0
Site 9	33.3 (53.0)	6	31.2 (50.9)	6	29.9 (49.6)	5
Site 10	4.3 (24.0)	0	3.9 (23.6)	0	3.4 (23.1)	0
Site 11	12.3 (32.0)	0	11.5 (31.2)	0	10 (29.7)	0
Criterion	50					

The predictions for the 2011 background data suggests that the modelling would be marginally better with generally lower cumulative predictions and a slightly lower number of exceedences predicted throughout the year. Overall the results for the cumulative assessment using the 2011 background concentrations are similar to those predicted for the worst-case 2008 year.

B.9.4.2.2 Contemporaneous Cumulative Assessment

When undertaking a contemporaneous assessment, the predicted 24-hour PM_{10} concentration for any 2008 day (as the baseline year) was added to the corresponding measured PM_{10} concentration for that day. This methodology requires predictions to be paired in time with the measurements and, as such, presents another picture of the expected cumulative concentrations during a particular time period.

The aim of contemporaneous assessment is to demonstrate how many additional exceedences may occur on individual days as if the PEP construction was occurring when monitoring data were collected in 2009. Table B.9.15 presents the number of additional exceedences expected as a result of the PEP activities. The number of monitoring exceedences in the 2009 data is six days. The range in exceedence numbers represents the number of exceedences expected between Scenarios 1 to 3.

Table B.9.15 Estimated Additional Days Above Ambient Criterion for 24-Hour Average PM10 as a Result of PEP Development (2009)

Modelled Receptor (Site ID)	Additional Exceedences Of Criterion (days)
Site 1	9 to 13
Site 2	7 to 11
Site 3	8 to 10
Site 4	2 to 8
Site 5	0
Site 6	0 to 1
Site 7	1
Site 8	0 to 1
Site 9	5 to 7
Site 10	0
Site 11	0

Based on the above, PEP construction activities would be expected to result in a number of additional exceedences at receptor locations nearest to the port and closest to its boundary.

The two different cumulative methodologies for calculating 24-hour PM_{10} levels for the PEP construction activities yielded very similar results. Both cumulative assessment methodologies suggest the potential for a limited number of exceedences of the 50 µg/m³ 24-hour criterion at receptors closest to the western boundary of the port. When the number of exceedences are taken into account, both assessment methodologies predict very similar exceedence patterns.

B.9.5 Mitigation Measures and Residual Impacts

B.9.5.1 Proposed Mitigation

Dust generation during construction works is primarily a management issue; emissions can be reduced with good management practices. Table B.9.16 summarises general mitigation measures considered applicable during the construction period.

Table B.9.16 Summary of Proposed Mitigation Measures

Trigger	Potential Impact	Mitigation Measures	Monitoring
Fugitive dust from exposed surfaces	▪ Increased risk to human health ▪ Nuisance ▪ Discoloration of buildings or structures	▪ Erect localised windbreak barriers on activities (to 2.4 m height), particularly to the west of works, if required. ▪ Water exposed surfaces at >2 L/min. ▪ Regular clean-up of spills to reduce tracking of dust-generating material onto roads. ▪ Operate a complaints management system to enable feedback from surrounding areas on air quality performance. ▪ Sweep and water using a water cart for handling of fill materials, transport and haul routes. ▪ Use a wheel wash whenever vehicles move from unsealed roads to sealed roadways e.g. road between reclamation area and off site. ▪ Adjust work practices (as required) based on wind observations (e.g. ceasing dust-generating works under extreme windy conditions or when dust is observed to leave the PEP/port boundary). ▪ Adjust work practices (as required) based on real time dust monitoring. ▪ Implement site speed limits. ▪ Reduce haul road lengths.	▪ Visual monitoring and observation of weather conditions. ▪ Continuous PM_{10} monitoring at border of PEP and existing port land. ▪ Record complaints.

Trigger	Potential Impact	Mitigation Measures	Monitoring
Fuel combustion emissions from vehicles and equipment	▪ Increased risk to human health	▪ Turn engines off while parked on site. ▪ Confine vehicular access to designated access roads to ensure control of speed and hence emissions. ▪ Regularly tune, modify or maintain Equipment, plant and machinery to reduce visible smoke and emissions.	▪ Record complaints.

B.9.5.2 Reactive Monitoring Program

Where possible, dust-generating works will be undertaken during the morning when the prevailing winds will typically blow any particulate matter away from receptors. In the afternoon, when the prevailing winds will blow dust from the Project Area towards receptors, additional care will be taken to manage and mitigate emissions.

Where a monitoring system is continuous in nature, trigger levels can be used as an early warning system for the monitoring of ambient air quality impacts on the local environment. The trigger levels are generally set below a relevant assessment criteria to alert staff prior to the pollutant concentration reaching the environmental monitoring criterion value (in this case for dust).

The reactive management procedure to be followed should a trigger level be exceeded is outlined below. The procedure is designed as a three stage approach:

- **Investigate:** identify the issue, the likely reasons and formulate a response should the Action Stage be reached
- **Action:** implement those measures formulated in the Investigate Stage and review their effectiveness
- **Stop Work:** should this stage be reached, there is a high likelihood that the dust criterion may be exceeded. Relevant dust-generating activities should stop until the measured dust levels fall below the Action Stage level.

Should the trigger level for PM_{10} be reached (and responsible staff notified through real time telemetry), an investigation should be conducted to determine the source/s of the dust and to evaluate the appropriate measures to be implemented. Measures, in addition to those already included, may include:

- increased use of a water cart or water sprays to suppress dust in open areas or roadways
- installation of temporary sheeting to cover localised exposed areas or stockpiles
- ensuring excavated material is moist at the time of exposure and handling
- covering soil stockpiles that will remain on the site for more than 24 hours (where practicable)
- consolidation of any stockpiled fill material
- use of chemical dust-suppressants, suitable for use immediately adjacent to water and workers, provided the chemicals do not pose a contamination or occupational health and safety hazard
- use of additional dust suppression features on items of dust-generating plant and equipment
- securely covering all loads entering or exiting the site (although it is expected that this would be a standard for the site)
- covering surfaces where appropriate
- ceasing works when works are generating unacceptable or predicted to exceed dust levels (as defined by the air quality management component of the Environmental Management Plan).

Table B.9.17 provides details of a conceptual reactive management procedure.

Table B.9.17 Reactive Management Procedure for PM_{10}

Trigger Stage	Averaging Period	Trigger Value (µg/m³)	Primary Responsibility	Action Required
Investigate	1-hour 3-hour	Triggers will be considered on a stage by stage basis depending on the nature of the expected activities.	Identified prior to the commencement of each stage of work.	Undertake review of possible dust sources operating during the average period. Identify possible control measures for these activities, action taken if deemed necessary.
Action	1-hour 3-hour	Triggers will be considered on a stage by stage basis depending on the nature of the expected activities.	Identified prior to the commencement of each stage of work.	Ensure implementation of the control actions identified in Investigate Stage. Effectiveness of control actions to be reviewed and escalate where appropriate. Identify long-term solutions to dust issues.
Stop Work	1-hour 3-hour	Triggers will be considered on a stage by stage basis depending on the nature of the expected activities.	Identified prior to the commencement of each stage of work.	Targeted shut down of relevant activities until the measured pollutant levels are below the stated Action Stage trigger value.

B.9.6 Cumulative Impacts

Two different averaging periods have been considered when assessing the PEP cumulative air quality effects. The two averaging periods were described in section 9.3.2 as follows:

- annual average conditions (for TSP, PM_{10} and dust fallout)
- 24-hour average PM_{10} concentrations.

outlines the findings of the cumulative assessment for the construction activities associated with Stage A of the PEP.

Table B.9.18 Cumulative Assessment Summary

Averaging Period	Factor	Predicted Effects	Summary
Annual average	PM_{10}	Acceptable	Cumulative PM_{10} concentrations show no exceedences of long-term criterion (30 µg/m³) at each modelled receptor location.
	TSP and dustfall	Acceptable	Cumulative TSP and dustfall concentrations show no exceedence of long-term criteria at each modelled receptor location.
24 hour average	PM_{10}	Number of predicted exceedences	Cumulative PM_{10} concentrations using 2008 and 2011 background data indicate between 0 and 13 daily exceedences predicted for receptors for the three modelled scenarios .
		Additional days in exceedence at nearby receptors	Three scenarios were considered using contemporaneous modelling and monitoring data for 2009. Between 0 and 13 exceedences of the 50 µg/m³ criterion were predicted over the full modelled time period.

The results of modelling suggest that the PEP construction activities may potentially result in elevated 24-hour average PM_{10} concentrations with potential exceedences of the 24-hour criterion but not the annual criterion. This is due to episodic influence of meteorological conditions (winds) on particular days and during certain seasons, which may result in elevated short-term dust concentrations. On this basis, precautions need to be taken to manage the risk of potential exceedences while PEP is under construction.

The most effective means to achieve this management is to implement:

- a construction program that allows for modified operations depending on ambient conditions that may cause wind re-suspension and mobilisation of particulates (e.g. periods when wind velocities exceed approximately 20 km/h from the east or north-east);
- a monitoring program aligning with the PEP construction activities.

These programs would need to be reactive in nature and include a series of measures that can be undertaken should elevated dust concentrations be detected (and attributable to the activities at the PEP). An example reactive dust management plan is included as Section B.9.5.2.

B.9.7 Assessment Summary

The potential air quality impacts associated with the construction of the PEP were assessed with predicted concentrations of particulates at indicative sensitive receptor locations estimated using the CALPUFF model.

Concentrations of TSP were predicted to be below the EPP (Air) criteria established for health and wellbeing and the NSW criterion for dust fall, also designed for health purposes.

The EPP (Air) criterion for PM_{10} was predicted to be exceeded at receptors close to the western boundary of the PEP over the course of the modelling period. The number of overall predicted short-term exceedences ranged between 0 to 13 days per year with adverse impacts over longer time periods not expected.

To reduce adverse impacts, a range of mitigation measures will be implemented during the construction period. The air quality monitoring component of the environmental management plan, which outlines mitigation measures and practices to reduce the generation of dust from the Project Area, particularly during periods where the meteorological conditions are likely to transport the dust off site, will be prepared and implemented for the construction activities for the PEP. Construction activities on the Project Area will be undertaken with the objective of preventing visible emissions of dust beyond the PEP/port boundary. In the event of visible dust emissions occurring at any time, practicable dust mitigation measures, including cessation of dust-generating works, will be considered and implemented where necessary.

Operational activities on the future operational port are subject to specific assessments for air quality by individual port tenants. Environmental monitoring conditions for these locations will be defined at a later date on a case-by-case basis.

Port Expansion Project EIS

Part B

Section B10 – Noise and Vibration

AECOM BMT WBM

Part B

B.10 Noise and vibration

B.10.1 Relevance of the Project to the Acoustic Environment

The purpose of this chapter is to assess the implications of noise and vibration from the project at potentially sensitive receptors. This chapter addresses Section 5.9 (Noise and vibration) of the *Terms of reference for an environmental impact statement,* which outlines the matters relating to noise and vibration:

- Identifies sensitive receptors adjacent to the project site and presents the measured existing background noise levels based on surveys at representative sites.
- Presents the results of predicted typical worst-case scenarios for potential construction noise and vibration effects of the port expansion on sensitive receptors.
- Presents the results of predicted typical worst-case scenarios for potential operational noise and vibration effects from the Port Expansion Project on sensitive receptors once completed. Provides an assessment of these potential effects against acoustic performance criteria and noise goals outlined in relevant standards, policies, guidelines and Acts.
- Provides in-principle noise and vibration control measures where these criteria or goals are shown to be exceeded.

The objective of setting environmental noise and vibration targets for the Port expansion project is to minimise the likelihood of adverse effects on the surrounding area whilst applying controls which would not adversely limit the construction and operation of the future Port.

Potential effects from future port construction include:

- Noise from on-site construction equipment.
- Noise from heavy construction vehicles accessing the site via Boundary Street, South Townsville and within the site.
- Noise and vibration from construction processes, particularly piling.

Potential effects from future port operations include:

- Vessels' exhaust noise.
- Loading and unloading activities.
- Heavy vehicle movement on public and internal roads.

B.10.2 Assessment Framework and Statutory Policies

The following legislation and policies are relevant to the assessment and management of environmental noise and vibration associated with the project:

Queensland Environmental Protection Act 1994

The Object of the Act is to "protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends". It describes environmental contamination, harm and nuisance, and provides default noise standards by which this is expected to be achieved. This requirement is further developed by the *Environmental Protection (Noise) Policy 2008.*

Environmental Protection (Noise) Policy 2008 under the Queensland Environmental Protection Act 1994

The purpose of the Policy is to achieve the object of the Act in relation to the acoustic environment, by identifying environmental values to be enhanced or protected, stating acoustic quality objectives to do so, and providing a framework for making consistent, equitable and informed decisions about acoustic environments in Queensland.

Acoustic quality values are to protect the health and diversity of ecosystems and human health / wellbeing, including ensuring suitable environments for individuals' sleep, study, recreation and relaxation, and protecting the amenity of the community.

The Department of Environment and Heritage Protection (formerly Department of Environment and Resource Management) Guideline *Planning for noise control* (Planning for Noise Control, dated August 2004)

The methods and procedures described in the Planning For Noise Control Guidelines are applicable for setting conditions relating to noise emitted from industrial premises (amongst others) in a planning framework. The document addresses three key factors: [1] the control and prevention of background noise creep from steady-state noise sources, [2] the containment of variable and short-term noise levels, and [3] the setting of external noise level targets that should not be exceeded to avoid sleep disturbance (EPA, 2004b).

The World Health Organisation *Guidelines for Community Noise* dated April 1999

The aim of the World Health Organisation's guidelines is to consolidate actual scientific knowledge of the health impacts of environmental noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments (WHO, 1999).

ECOACCESS Guideline for the Assessment of Low Frequency Noise, draft dated November 2004

The Department of Environment and Heritage Protection has previously released a draft guideline on the Assessment of Low Frequency Noise in 2004. This guideline has yet to be formally released. The draft Guideline is intended for planning purposes in which low-frequency noise emitted from industrial and commercial source is expected or for assessment of existing situations in which low-frequency noise is a feature. Parts of the draft guideline set noise goals against which the expected low-frequency noise (10 Hz to 200 Hz) can be assessed for the purposes of planning (EPA, 2004a).

The intent of the guideline is to assess the potential for annoyance and discomfort from low-frequency noise to persons at noise inside sensitive premises (EPA, 2004a).

Queensland Department of Transport and Main Roads' Road Traffic Noise Management *Code of Practice 2008*

The Code of Practice 2008 sets the policy and framework for the assessment, design and management of the impact of road traffic noise, including construction noise and vibration, on the built environment adjacent to State-controlled roads in Queensland. It is the Department's primary technical reference for people engaged in the planning and design of roads (DTMR, 2008a).

The purpose of the Code of Practice 2008 Guidelines is to provide guidance and instruction for the assessment and management of road traffic noise and the means for all road projects to be planned, designed and built within an agreed set of corporate standards that include consideration of local circumstances (DTMR, 2008a).

AS 2670.2–1990, Evaluation of human exposure to whole-body vibration, Part 2: Continuous and shock induced vibration in buildings

This Standard represents the relevant standard for nuisance vibration levels. It provides acceptable vibration levels, at each frequency, for different circumstances, and provides guidance on the magnitude of vibration at which adverse comment may begin to arise (Standards Australia, 1990a).

German Standard DIN 4150-1975, Part 2 Structural vibration – Human exposure to vibration in buildings

This Standard outlines methods and criteria for assessment of human exposure to structural vibration in the range of 1 to 80 Hz. It provides requirements which, when complied with, will generally negate human discomfort in dwelling and other sensitive buildings (DIN, 1999a).

German Standard DIN 4150 - Part 3 - Structural Vibration in Buildings - Effects on Structures

This Standard outlines methods and criteria for measurement and assessment of the effects of short-term or long-term vibration on structures designed primarily for static loading. It provides requirements which, when complied with, will generally ensure that no damage which will have an adverse effect on the structure's serviceability will occur (DIN, 1999b).

Queensland Work Health and Safety Regulation 2011

This document sets the exposure standards for noise in relation to a person in a workplace, in terms of a maximum average noise exposure level across a standard 8-hour work day, and an instantaneous maximum peak noise level. The document addresses the management of hearing loss in the workplace, audiometric testing, and the obligations of designers, manufacturers, importers and suppliers of plant in managing workplace noise exposure.

B.10.3 Existing Values, Uses and Characteristics

B.10.3.1 Site Description

The surrounding area is mainly residential, with some commercial buildings and a school. The area immediately adjacent to the landside boundary of the proposed Port Expansion Project is existing Port operations.

The location of the educational and residential receptors in relation to the Port is indicated in Figure B10.1. The residential locations specifically identified are those at which background noise monitoring was undertaken (refer to Section B.10.3.2 for details).

Figure B.10.1 Sensitive receptors

B.10.3.2 Sensitive Receptors

Sensitive receptors are defined in the EPP (Noise) to include dwellings, libraries and educational institutions, childcare centres and kindergartens, outdoor school playground areas, medical institutions, commercial and retail activities, protected areas, marine parks and passive parks and gardens. For this project, these comprise:

- Dwellings in Townsville, South Townsville, and Railway Estate comprising traditional single-storey, traditional double storey, apartments and Jupiters Hotel;
- Dwellings on Magnetic Island;
- Townsville South Primary School in South Townsville;
- Buildings with commercial and retail activity in Townsville and South Townsville;
- Commercial and retail buildings within the otherwise predominantly industrial Townsville Marine Precinct (Stage 1 complete); and
- Passive recreational parks/gardens in Townsville and South Townsville.

It is noted that the *Environmental Protection (Noise) Policy 2008* defines a sensitive dwelling receiver as a "building"; therefore, boats or other watercraft in the Breakwater Marina are considered in the context of assessment of noise effects because potential noise effects at the Breakwater Quays are a proxy for the "live-aboard" residents of the Breakwater Marina. The Townsville Marine Precinct is a commercial facility and there are no "live-aboard" vessels within it, so this need not be treated as residential.

The nearest potentially-affected noise-sensitive receivers, and those at which noise levels from the Port were assessed, are summarised in Table B.10.1. The receiver locations are shown in Figure B.10.1. Potential noise and vibration effects from the Port expansion project at noise-sensitive locations further from the Port than these receivers will be lower. For instance, Townsville South Primary School is further away than the site of 55 Macrossan Street.

Table B.10.1 Summary of Nearest Potentially-Affected Noise Sensitive Receivers

Location	Receiver Type	Direction from port expansion to receptor	Approximate distance from the port expansion
29 Hubert Street, South Townsville	Residential	SSW	1.9 km
55 Macrossan Street, South Townsville	Residential	SSW	1.8 km
5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville	Residential	SW	1.4 km
Jupiters Casino, Townsville	Residential	SW	1.2 km
1 Esplanade, Picnic Bay, Magnetic Island	Residential	N	8.8 km
Townsville Marine Precinct	Commercial	S	1.0 km

B.10.3.3 Existing noise environment

Baseline noise monitoring was conducted at the Townsville residential locations listed in Table B.10.1 from Thursday 2 June 2011 to Tuesday 14 June 2011, primarily in order to determine the contribution of noise from the Port itself, but also to investigate the existing ambient noise environment in the vicinity of the Port. Baseline noise monitoring was undertaken at Jupiters Casino from Tuesday 31 July 2012 to Tuesday 7 August 2012, in order to confirm the existing ambient noise environment in the vicinity of the Casino. Background noise measurements were taken in accordance with the Department of Environment and Heritage Protection *Noise Measurement Manual 2000*.

Baseline noise measurements were not taken at Magnetic Island as residential receivers on the island are at significant distance from the Port and therefore potential noise levels from the proposed port expansion will be lower than for the receivers at which noise measurements were undertaken. Also, as the noise environment at the nearest residential area on the island is known to be very quiet, the most stringent environmental noise goal has been adopted for this location (as detailed in Table B.10.3).

The existing noise environment at the monitoring locations is indicated in Table B.10.2 and Table B.10.3. Refer to Appendix N7 for detailed results and noise traces measured at each location.

Table B.10.2 Rating Background Level (RBL) at Each Measurement Location

Measurement location	Calculated Rating Background Level $minL_{A90, 1hr}$ dB(A)		
	Day 7am – 6pm	Evening 6pm – 10pm	Night 10pm – 7am
29 Hubert Street, South Townsville	38	39	38
55 Macrossan Street, South Townsville	41	35	32
5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville	42	43	41
Jupiters Casino, Sir Leslie Thiess Drive, Townsville	45	45	44

Table B.10.3 Maximum Hourly Sound Pressure Level at Each Measurement Location

Measurement location	Calculated $maxL_{Aeq, 1hr}$ dB(A)		
	Day 7am – 6pm	Evening 6pm – 10pm	Night 10pm – 7am
29 Hubert Street, South Townsville	51	49	46
55 Macrossan Street, South Townsville	57	51	49
5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville	51	53	48
Jupiters Casino, Sir Leslie Thiess Drive, Townsville	57	49	49

Observations made when setting up the noise logging equipment indicate that the daytime ambient noise environment at each location was controlled by:

- 29 Hubert Street, South Townsville
  - Construction noise from operators on the Port's industrial subdivision Nexus Park to the east of this site.
  - Construction noise from the Incitec Pivot shed immediately north of this site.
  - Distant traffic noise from Boundary Street and Benwell Road.
- 55 Macrossan Street, South Townsville
  - Traffic noise from Archer Street.
  - Occasional operational noise from the port was observed at this location.
- 5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville
  - Noise from private vessels (maintenance and movement) within marina.
  - Background noise controlled by exhaust noise from Jupiters Hotel.
- Jupiters Casino, Sir Leslie Thiess Drive, Townsville
  - Sources associated with the casino itself, predominantly building services plant noise.
  - Construction noise associated with Casino upgrades.
  - Construction noise associated with the Berth 8/10 (TPIX) project at the Port (particularly piling noise).
  - The operational noise from the existing Port was discernible only in lulls in both construction noise sources.

The Port of Townsville Limited confirmed that the construction activities in the vicinity of 29 Hubert Street, South Townsville were temporary, and only occurred between 6.30am and 3pm Mondays to Fridays. Therefore, the daytime noise levels at 29 Hubert Street were by atypical construction noises, and the resulting daytime noise target developed for this site was not considered to be appropriate in the longer term.

Attended noise measurements were undertaken only during daytime periods. As such, no observations were made of the controlling ambient noise sources during the evening and night time periods. However the recorded ambient noise levels were consistent with levels typical for these types of residential locations as measured by AECOM elsewhere in Townsville.

The noise environment at the Townsville Marine Precinct is controlled by “self-noise” sources associated with the predominantly industrial operation of the precinct itself e.g. cranes, vehicles and gantries moving across the yards; boat-maintenance activities such as slippage, grinding and drilling.

B.10.3.4 Existing vibration environment

Key vibration sources associated with the port include heavy vehicles moving to, from and about the site, the overhead cranes moving, and the impact of items being unloaded from ships onto the wharves. No ground-borne vibration from either the port or from passing traffic was discernible (by acoustic engineers in attendance during periods of noise measurements). Therefore, as a conservative background the existing vibration environment is characterised by Peak Particle Velocity vibration levels lower than 0.10 mm/s.

B.10.3.5 Meteorological conditions

A preliminary analysis of site-specific meteorological conditions was undertaken as per the requirements of the Planning for Noise Control Guidelines. This analysis was based on weather data from 2002 to 2008 from the Bureau of Meteorology weather station at the Townsville Airport, approximately 7 km from the study area.

Temperature inversions in the lower atmosphere are not typically a feature of tropical, coastal areas so it is considered that these aren’t a significant feature of the local environment. Analysis of the historical weather data indicated that wind was a feature of the local environment, particularly southerly and south-easterly winds at night during autumn and winter. Whilst calm conditions were not observed to be a significant feature of the area, these conditions have nevertheless been assessed as a typical worst-case scenario.

Accordingly, the following weather conditions were assessed:

- Pasquil Stability Class D with calm (no wind) conditions.
- Pasquil Stability Class D with south easterly winds with 3m/s (approximately 11 km/h) wind speed.
- Pasquil Stability Class D with southerly winds with 3m/s (approximately 11 km/h) wind speed.

Wind roses are provided in Appendix N5. These wind roses were generated based on the above historical data. While other meteorological data was used elsewhere in the EIS assessment, the data used here was based on the largest contiguous available data set, from 2002 to 2008 (other data was for smaller time frames), and was separable into seasons and times of day (day, evening, night) to better align with the acoustic assessment requirements which called for closer scrutiny of meteorological effects.

B.10.4 Assessment of Potential Impacts

B.10.4.1 Assessment methodology

B.10.4.1.1 Pre-construction and Construction noise assessment

In the assessment of construction noise from the port expansion, reference was made to the general environmental and legal obligations as contained in:

- The Queensland Environmental Protection Act 1994; and
- The Queensland Work Health and Safety Regulation 2011.

The assessment of construction noise effects from the port expansion was based on typical construction noise levels experienced at a distance of 10 metres from a variety of different noise sources. The assessment assumes that equipment associated with construction is operating continuously (no idling or shutdown periods) on flat ground and there is no shielding along the propagation path by intervening structures. This means that the noise predictions are conservative and actual noise levels will likely be lower.

A desktop analysis was conducted of construction noise effects based on these stipulated noise sources, and basic geometric propagation formulae.

Piling operations and the limited rock breaking operations generally produce the highest levels of construction noise. However, a range of other typical equipment from earthmoving equipment, trucks and generators is also included in the assessment to indicate likely construction noise effects to be expected for the port expansion.

B.10.4.1.2 Construction and operational vibration

The assessment of the impact of vibration on people and structures does not differentiate between operational and construction effects, and therefore the methodology is the same for each.

The effects of ground vibration may be segregated into the following two categories:

- Human exposure – disturbance to building occupants, arising from vibration which inconveniences or possibly disturbs the occupants or users of the building.
- Effects on building structures – vibration which may compromise the integrity of the building structure itself.

In general, vibration goals for human disturbance are more stringent than vibration criteria for effects on building contents and building structural damage. Hence, compliance with the more stringent limits dictated by human exposure generally means that compliance is also achieved for the “effects on building structures” category.

For the assessment of operational vibration from the Port expansion, reference was made to vibration levels generated by heavy vehicles travelling over roads with significant irregularities, as measured previously by AECOM for various North Queensland road construction projects. These are considered to represent worst-case vibration generation from the Port expansion, indicative of heavily laden road-trains moving around on site.

For the assessment of construction vibration, reference was made to the base vibration levels generated for a selection of typical construction equipment; namely hydraulic hammers, vibrating rollers and piling. It is generally the piling activities on a construction site which will generate the highest level of vibration, such that compliance with the defined goals and criteria for piling generally means that compliance is also achieved for less significant construction vibration sources.

B.10.4.1.3 Operational noise

This noise assessment has addressed the ‘typical worst case’ noise impact of the port expansion, as required by the Planning for Noise Control guidelines (EPA, 2004b). Typical noise levels from the most significant noise-emitting operational plant located around the berths for the Year 2040 (when the Port Expansion Project is complete) and adopted typical adverse weather conditions, as discussed in Section B.10.3.5.

As the operation of the port expansion is ongoing and long-term, with continuous operation (24 hours/day, 365 days/year), the environmental noise impact assessment for the operational phase of the project has considered the worst-case noise emissions against the most stringent noise goals.

A description of the methodology adopted for the detailed operational noise assessment is provided in Appendix N3.

B.10.4.2 Pre-construction noise and vibration effects

Major infrastructure projects such as new road or rail corridors often have pre-construction activities such as relocation of services before construction works can begin. There will be pre-construction activities on the Eastern Reclaim Area immediately adjacent to the project site. These activities are likely to consist of stockpiling of rock and possible laydown of some other construction materials.

The assessment of noise and vibration generated for these activities is likely to be consistent with that presented for the actual construction activities planned for the port expansion. Refer to Sections B.10.4.3 and B.10.4.4 for details of assessment.

B.10.4.3 Construction phase noise effects

In the assessment of construction noise from the port expansion, reference is made to the general environmental duty and regulatory requirements as follows:

B.10.4.3.1 Construction noise goals

General environmental duty

The general environmental duty (section 319, Queensland *Environmental Protection Act 1994*) is:

> *A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm.*

Protection of the environment

The Queensland *Environmental Protection Act 1994* (Section 440 R) states that:

> *Building Work*
>
> *(1) A person must not carry out building work in a way that makes an audible noise*
>
> - *(a) on a business day or Saturday, before 6.30 a.m. or after 6.30 p.m.; or*
> - *(b) on any other day, at any time.*

Construction activity between the hours of 6.30am to 6.30pm Monday to Saturday, excluding public holidays, is therefore not normally subject to a numerical noise limit. The requirement to minimise “noise nuisance” still applies.

B.10.4.3.2 Construction noise assessment

The proposed types and use of construction equipment utilised are provided in Chapter B14 (Transport & Infrastructure).

Daytime construction noise sources

Table B.10.4 below presents the typical construction noise levels experienced at a distance of 10 metres from a variety of different noise sources. These levels are sourced from Australian Standard AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* and British Standard BS 5228-1:2009 *Code of practice for noise and vibration on construction and open sites Part 1: Noise.* The data for typical sound pressure levels includes the noise from “reversing” beepers where relevant to the specific item of equipment (BSI, 2009).

The predicted noise levels at the noise-sensitive receivers are external noise levels i.e. at the exterior of the structure on the property.

Table B.10.4 Typical Source Sound Pressure Levels and Predicted Noise Levels from Construction Plant and Equipment – Day Time Construction Works

Plant	Typical Sound Pressure Level at 10 m dB(A) #	Predicted daytime noise level at nearest noise-sensitive receptors dB(A)					
		29 Hubert Street	55 Macrossan Street	5 Breakwater Quays	Jupiters Casino	1 Esplanade	Townsville Marine Precinct
Asphalt Paver	80	34	35	37	38	21	40
Barge	76	30	31	33	34	17	36
Boat	78	32	33	35	36	19	38
Bulldozer	81	35	36	38	39	22	41
Compactor	85	39	40	42	43	26	45
Concrete truck	80	34	35	37	38	21	40
Crane	82	36	37	39	40	23	42
Dredge	82	36	37	39	40	23	42
Excavator	79	33	34	36	37	20	39
Generator (diesel)	71	25	26	28	29	12	31
Grader	82	36	37	39	40	23	42
Piling - hammer driven (tubular piling)	104	58	59	61	62	45	64
Piling - sheet (L_{max})	109	63	64	66	67	50	69
Piling (vibratory)	97	51	52	54	55	38	57
Rock tipping	80	34	35	37	38	21	40
Rock Breaker	90	44	45	47	48	31	50
Roller (vibratory)	80	34	35	37	38	21	40
Truck (> 20 tonne)	79	33	34	36	37	20	39
Tug for barge	82	36	37	39	40	23	42

sourced from AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* and BS 5228-1:2009 *Code of practice for noise and vibration on construction and open sites Part 1: Noise.* Where they apply to constructional plant, reversing beepers are included in SPLs.

The noise levels presented above represent the noise from each individual item of equipment (by either its engine or its activity) at its closest point to each relevant receiver. At working locations further from the existing perimeter of the current Port layout, and as the Stages of construction progress away from the existing Port, noise levels at the relevant receivers will correspondingly reduce.

It should be noted that these predicted noise levels assume that the plant is operating continuously (no idling or shutdown periods) on flat ground, there is no shielding along the propagation path by intervening structures and that noise mitigation measures have not been implemented. This means that the noise predictions are conservative and actual noise levels will likely be lower.

It is noted that the highest noise levels are expected from the piling to be undertaken during land reclamation and berth construction. Sheet piling is required for the bulkhead wharf type while hydraulic hammer tubular piling is required for the suspended wharf type. Piling is planned to occur for 40 weeks during Stages A and D, and 25 weeks during Stages B and C. This is scheduled to require approximately 15 strikes per minute, 2 hours per pile and 2.5 piles per day. The remainder of each day would be spent in the trimming of piles and other preparatory and maintenance activity.

Stages A and D consist of two wharf structures of 266 piles each, which equates to 213 days (35 weeks) of piling for each stage. Stages B and C consist of one wharf structure each, equating to 107 days (17 weeks) of piling for each of these stages.

In summary, based on the known existing daytime noise levels at residential receivers, the typical construction noise levels identified in Table B.10.4 for individual items of equipment are:

- Below the existing daytime average ambient noise levels of 51 to 57 dB(A) at the residential measurement locations including Jupiters Casino for all activities except piling.
- Up to 14 dB(A) higher than the existing daytime average ambient noise levels at the residential measurement locations for piling activities.
- Below the existing average background noise levels of 38 to 45 dB(A) at the residential measurement locations for all activities except piling and limited rock breaking .
- Up to 25 dB(A) higher than the existing daytime background “typical quietest” noise levels at the residential measurement locations for piling and limited rock breaking activities.

A buffer distance of approximately 4000 to 7900m would be required before noise levels from piling met the existing daytime average ambient noise levels of 51 to 57 dB(A).

In situations where multiple items of equipment are operating simultaneously in close proximity to the project area’s boundary in particular, temporary increases in the predicted noise levels associated with construction may also occur, depending on the quantity and location of the equipment. However, as it is unlikely that any item of equipment will be operating continuously (i.e. for 100% of the daytime work period), the predicted noise levels are an overestimate of the likely average noise levels across the day for any given item of equipment.

It is likely that there will be multiple items of equipment operating simultaneously during the night time period, and hence the total noise levels from construction received at the noise-sensitive receivers will be higher than those provided above for individual items of equipment. However the exact location of any item of equipment on the site, and the highly variable combinations of equipment operating at any one time, make it impractical to determine the total noise emissions from the entire construction area at any given point in time.

The Townsville Marine Precinct’s location immediately adjacent to the Port’s southern and eastern boundaries (and therefore proximity to existing noise sources at the Port) and the predominantly industrial activities within the Precinct itself indicate that ambient noise levels there will be higher there than for any of the modelled residential locations shown in Table B.10.4. Therefore, the typical construction noise levels at the Precinct will also be below average existing ambient and background noise levels. Only noise levels from piling and limited rock breaking activities will be higher than average existing ambient and background noise levels in the Precinct. However, as the commercial/retail activities take place within the buildings within this Precinct, mitigation is afforded by the building façade to control noise ingress from the Precinct itself, which also serves to control day time noise effects from the Port expansion project.

Noise from day time construction of the Port Expansion Project at Magnetic Island is predicted to be below 26 dB(A) for most construction activities, and is therefore unlikely to be audible at this location. Rock breaking and piling activities may be audible, but are unlikely to be significant except during lulls in local ambient noise levels.

Night time construction noise sources

Most of the construction activities associated with the Port Expansion Project will be undertaken during normal daytime hours (6:30a.m. to 6:30p.m.) only, 6 days per week; however, several of the processes are proposed to be carried out over 24 hours, 7 days a week. A summary of these activities, and the reason that the night time works are required, is as shown in Table B.10.5:

Table B.10.5 Night time Construction Works Plan

Construction Activity	Stage	Duration (weeks)	Reason for Night time Works
Dredging	Stage A	45	Due to volume of materials removed, 24/7 dredging during construction is time-critical to the completion of the project; reduced dredging hours would unreasonably prolong the construction period and increase potential environmental impacts.
	Stage B	5	
	Stage C	15	
	Stage D	-	
Rock Supply / Placement	Stage A	140	Due to the volume of materials to supply, 24/7 delivery of materials to the site during construction is time-critical to the completion of the project; reduced supply hours would unreasonably prolong wharf construction and therefore the construction period and increase potential environmental impacts.
	Stage B	-	
	Stage C	-	
	Stage D	40	
Pouring of wharf decks	Stage A	35	The volume of concrete to be poured for each Stage requires 24/7 pouring in order to ensure that the concrete sets correctly.
	Stage B	25	
	Stage C	25	
	Stage D	35	
Reclamation fill	Stage A	55	Required for reasonable speed of land preparation and bringing in fill materials.
	Stage B	55	
	Stage C	55	
	Stage D	40	

Table B.10.6 Typical Source Sound Pressure Levels and Predicted Noise Levels from Construction Plant and Equipment – Night Time Construction Works

Plant	Typical Sound Pressure Level at 10 m dB(A)	Predicted Night Time noise level at nearest noise-sensitive receptors dB(A)					
		29 Hubert Street	55 Macrossan Street	5 Breakwater Quays	Jupiters Casino	1 Esplanade	Townsville Marine Precinct
Barge	76	30	31	33	34	17	36
Boat	78	32	33	35	36	19	38
Bulldozer	81	35	36	38	39	22	41
Concrete truck	80	34	35	37	38	21	40
Crane	82	36	37	39	40	23	42
CSD Dredge	82	36	37	39	40	23	42
Excavator	79	33	34	36	37	20	39
Generator (diesel)	71	25	26	28	29	12	31
Truck (> 20 tonne)	79	33	34	36	37	20	39
Tug for barge	82	36	37	39	40	23	42

While daytime equipment is conservatively assumed to operate 100% of the time, the highest percentage of time operating at night for each item of equipment has been provided.

The average noise levels across the night time period utilise the percentage of operating time in the calculation. Table B.10.7 provides predicted unmitigated noise levels at the closest sensitive receivers.

As the Townsville Marine Precinct is a commercial precinct with daytime occupancy only, night time noise levels are not relevant to this receiver, and so have not been calculated. The predicted noise levels at the noise-sensitive receivers are external noise levels as described in Section B.10.4.3.2.

Table B.10.7 Typical Predicted Noise Levels from Construction Plant and Equipment – Night time Construction Works

Plant	% of Night time Operations	Predicted noise level at nearest noise-sensitive receptors dB(A)			
		29 Hubert Street	55 Macrossan Street	5 Breakwater Quays	Jupiters Casino
Barge	20%	23	24	26	27
Boat	20%	25	26	28	29
Bulldozer	70%	34	34	37	38
Concrete truck	70%	33	33	36	37
Crane	80%	35	36	38	39
CSD Dredge	100%	36	37	39	40
Excavator	70%	32	32	35	36
Generator (diesel)	100%	25	26	28	29
Truck (> 20 tonne)	75%	32	33	35	36
Tug for barge	10%	26	27	29	30

Based on the known night time pre-construction noise levels at residential areas tabulated in Appendix N7, the typical night time construction noise levels identified in Table B.10.7 for individual items of equipment are:

- Below the existing average night time ambient noise levels of 46 to 49 dB(A) for all activities; and
- At or below the existing average night time background noise levels of 38 to 45 dB(A) for all activities.

In situations where multiple items of equipment are operating simultaneously in close proximity, temporary exceedances of the predicted noise levels from the construction site may occur, depending on the quantity and specific locations of the equipment. As noted above, it is unlikely that any item of equipment other than generators will be operating continuously and therefore the predicted noise levels are an overestimate of the likely average noise levels across the night time period.

It is also noted that, as several items of equipment will be operating for a significant portion (period >70%) of the construction period, it is likely that there will be multiple items of equipment operating simultaneously during the night time period, and hence the total noise levels from construction received at the noise-sensitive receivers will be higher than those provided above for individual items of equipment. However the exact location of any item of equipment on the site, and the highly variable combinations of equipment operating at any one time, make it impractical to determine the total noise emissions from the entire construction area at any given point in time.

Similarly, the noise levels represent the noise from each individual item of equipment at its closest point in the Port Expansion Project footprint to each relevant receiver. At working locations further from the perimeter of the Port Expansion Project, and as the Stages of construction progress away from the existing Port, noise levels from the Port Expansion Project at the relevant receivers will correspondingly reduce.

It should be noted that these predicted noise levels are based on the plant operating continuously (no idling or shutdown periods) on flat ground, there is no shielding along the propagation path by intervening structures and that noise mitigation measures have not been implemented. It is understood that South Townsville has some above-ground infrastructure which will provide some shielding effect to noise levels to the south. This means that the noise predictions are conservative and actual noise levels will likely be lower.

B.10.4.4 Construction phase vibration effects

B.10.4.4.1 Construction vibration goals and criteria

The effects of ground vibration on buildings within the vicinity of the Port Expansion Project may be segregated into the following two categories:

- Human exposure – disturbance to building occupants, arising from vibration which inconveniences or possibly disturbs the occupants or users of the building.
- Effects on building structures – vibration which may compromise the integrity of the building structure itself.

In general, vibration goals for human disturbance are more stringent than vibration criteria for effects on building contents and building structural damage. Hence, compliance with the more stringent limits dictated by human exposure generally means that compliance is also achieved for the other category.

No distinction is made between vibration generated by construction and vibration generated by operations. Therefore, the criteria outlined below apply equally to the assessment of operational vibration as described in Section B.10.4.4.

Human exposure standards in Table B.10.8 indicate typical human perception of vibration in terms of Peak Particle Velocity, based on the provisions of German Standard DIN 4150-1975, *Part 2 – Structural vibration – Human exposure to vibration in buildings*.

Table B.10.8 Vibration and human perception of motion, 8 to 80 Hz

Approximate Peak Particle Velocity vibration level (mm/s)	Subjective perception
0.10	Not felt
0.15	Threshold of perception
0.35	Barely noticeable
1.0	Noticeable
2.2	Easily noticeable
6.0	Strongly noticeable

Australian Standard AS 2670.2–1990, *Evaluation of human exposure to whole-body vibration*, *Part 2: Continuous and shock induced vibration in buildings* represents the relevant standard for nuisance vibration levels. It provides a collection of curves that specify acceptable vibration levels, at each frequency, for different circumstances (Standards Australia, 1990a).

Table B.10.9 provides guidance on the magnitude of vibration at which adverse comment may begin to arise. The levels have been expressed as peak particle velocity for consistency with the structural damage criteria. Operational vibration may fall into either the continuous or the transient category, therefore for the purposes of this assessment, the more stringent lower goal is proposed for the assessment. In most cases, the vibration generated by construction activities is continuous or intermittent in character and therefore subject to the lower value.

Table B.10.9 Building vibration combined direction (x,y,z) vibration goals in mm/s (PPV)

Type of building occupancy	Continuous or intermittent vibration (mm/s)	Transient vibration excitation with several occurrences per day (mm/s)
Residential – Night	0.2	0.2 – 2.8
Residential – Day	0.3 – 0.6	4.2 – 12.7
Office	0.6	8.5 – 18.1
Workshop	1.1	12.7 – 18.1

Note: Combined vibration is the peak vector sum of the three vibration axes.

For the purposes of the current assessment, the values in Table B.10.8 and Table B.10.9 will be used to gauge any comments in relation to potential adverse affects that may be received from occupants of sensitive buildings close to the Port Expansion Project.

B.10.4.5 Structural damage standards

Currently no Australian Standard exists for assessment of building damage caused by vibration. German Standard DIN 4150 - Part 3 - *Structural Vibration in Buildings* - *Effects on Structures* is widely used in Australia to provide recommended maximum levels of vibration that are designed to reduce the likelihood of building damage. The DIN 4150 criteria are maximum levels measured in any direction at the foundation, or, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor, and are summarised in Table B.10.10. The maximum levels are also referred to as Peak Particle Velocities.

For this project, dwellings in the study area fall under Group 2, whilst commercial/retail buildings fall under Group 1.

Table B.10.10 Structural damage 'safe limits' for building vibration

Group	Type of structure	Peak Particle Velocity vibration level (mm/s) At foundation at a frequency of		
		1–10 Hz	10–50 Hz	50–100 Hz
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or use (i.e. residential)	5	5 to 15	15 to 20
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (e.g. heritage-listed)	3	3 to 8	8 to 10

For frequencies above 100 Hz, the higher values in the 50–100 Hz column should be used.

Conservatively, a screening criterion of 2.5 mm/s is used to assess the risk of structural damage. This corresponds with the long-term limit of structures which have particular sensitivity to vibration such as heritage listed buildings. In practice even cosmetic damage such as the forming of cracks does not occur from typical construction activities below 15 mm/s.

The DIN 4150 criteria levels are 'safe limits' up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. DIN 4150 states that when vibrations higher than the 'safe limits' are present, it does not necessarily follow that damage will occur.

B.10.4.5.1 Construction vibration assessment

Reference was made to the Australian Transport Infrastructure Development Corporation's publication entitled *Construction Noise Strategy (Rail Projects).* Distances at which vibration from key vibration-generating construction activities are expected to achieve the relevant human comfort vibration goals and structural criteria are provided in Table B.10.11. The locations and durations of use of this equipment is given in Chapter B14 (Transport & Infrastructure).

The sensitive receptors identified in relation to the port expansion are located at distances significantly greater than those indicated as minimum separation distances below. On this basis, the effect of construction vibration from the port expansion at the nearest (and consequently all) receptors will be negligible.

Table B.10.11 Separation distances for structural damage and human comfort

Plant	Estimated "Buffer" (m)	
	Structural Damage	Human Comfort / Tactile Vibration
Small hydraulic hammer	4	10
Medium hydraulic hammer	12	30
Large hydraulic hammer	40	90
Sheet piling	6	30
10T vibrating roller (high setting)	15	50

B.10.4.6 Operational noise effects

Noise effects outlined in this section have been predicted based on the assumptions discussed in Appendix N9 and the methodology discussed in Section B.10.4.1.3.

Conservative assumptions relating to the retention of existing fixed and mobile plant and equipment (excluding rail movements) have been made where specific data were not available. As such, clarification of some assumptions may serve to reduce the predicted noise levels.

It is important to note that the noise goals presented in this Environmental Impact Statement assessment are guideline targets for the operation of the Port, and do not represent environmental noise criteria which are enforceable. As stated in the Environment Protection Act 1994 a person does not contravene a noise standard by causing an environmental nuisance from noise from operating a ship or associated activities. However, management practices have been recommended to the Port of Townsville in relation to noise and vibration mitigation measures to consider.

B.10.4.6.1 Operational noise goals

Documents which provide guidance and noise goals for the assessment of environmental noise generated by general industry are summarised in Section B.10.2 and discussed in Appendix N8.

Based on the results of the noise monitoring, noise goals for the Port Expansion Project have been determined and are summarised in Table B.10.12. Apart from the low frequency noise target, these are applicable to external noise levels at any noise-sensitive receiver. As baseline noise measurements were not conducted at Magnetic Island, the Planning for Noise Control noise goals have been derived for this location based on assumed background noise levels as described in Appendix N8.

Table B.10.12 Summary of noise goals applicable at nearest noise sensitive receivers

Period	Time	Environmental Protection Policy (Noise) 2008 $L_{Aeq, adj, 1hr}$ dB(A)	Planning for Noise Control $L_{Aeq,1hr}$ dB(A)	World Health Organisation guidelines L_{Aeq} dB(A)	ECOACCESS Low Frequency dB(Lin)
Day	7am – 6pm	50	28 – 48*	40 – 45	50 dB(Lin) Screening test (indoors)
Evening	6pm – 10pm	50	28 – 46*	40 – 45	
Night	10pm – 7am	45	28 – 44*	35 – 40	

*Note: These are specific for each noise sensitive receiver. Table 13 displays the Planning for Noise Control noise goals for each noise sensitive receiver.

Table B.10.13 Summary of Planning for Noise Control goals

Location	Planning for Noise Control goals, $L_{Aeq, 1hr}$ dB(A)		
	Day	Evening	Night
29 Hubert Street, South Townsville	41	42	41
55 Macrossan Street, South Townsville	44	38	35
5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville	45	46	44
Jupiters Casino, Townsville	48	48	42
1 Esplanade, Picnic Bay, Magnetic Island	28	28	28

Field measurements would be required to validate the predicted Planning for Noise Control noise goal for Magnetic Island, and may provide a less stringent daytime goal than that adopted.

Port operations, by necessity, run continuously throughout the day, evening and night periods. As such, the most stringent noise goal out of the day, evening or night time targets has been applied to this assessment.

It is reiterated that the noise goals presented above are guideline targets for the operation of the Port, in order to plan for optimal operations and activities.

As a commercial receiver, neither the Environmental Protection Policy nor the Planning for Noise Control specifies external noise goals which are applicable to the Townsville Marine Precinct. Rather, the

Environment Protection (Noise) Policy 2008 sets an acoustic quality objective of 45 dB $L_{Aeq,adj,1hr}$ for inside a commercial premises for “when the activity is open for business”.

The noise goals in this report require that the noise emission from the port shall not exhibit “annoying” characteristics as defined by the Department of Environment and Heritage Protection, i.e. no noticeable tonality or impulsiveness; refer also to AS 1055.2-1997 *Acoustics - Description and measurement of environmental noise - Application to specific situations*. Where tonality or impulsiveness is audible, further adjustments would apply. Currently there are Operational Licence conditions for operators within the Port facility, and most of these incorporate noise and/or vibration conditions to which the individual operators and tenants of the Port must comply. Although not directly applicable to the Port Expansion Project, these are briefly discussed in Appendix N9 for completeness. It is likely that the operators at the PEP will have similar noise conditions to address.

The assessment presented in this report is based on the equipment operating at the heights above ground level nominated in Appendix N9 for the year 2040 when the Port Expansion is forecast to be complete. This is considered to represent the scenario that would generate typical maximum operational noise into surrounding areas.

Consideration was given to the number of ships at berth and mobile and fixed plant servicing the ships at any particular time for the expanded portion of the Port to represent ‘typical worst case’ operation at the Port.

Table B.10.14 below presents the results of noise modelling (under the meteorological conditions described in Section B.10.3.5) at 2 metres above local ground level for the residential locations and at the uppermost floor for Jupiters Casino. As the Port will operate 24/7, they can represent either daytime or night time predicted noise levels. Predicted exceedances of the Planning for Noise Control noise goals are shown in **bold**.

A series of noise contour plots for the predicted external noise levels at 2 metres above local ground level are given in Appendix N10. The operational noise levels (L_{Aeq}) for neutral wind conditions are shown in Appendix N11. Noise goals and predicted noise levels for noise-sensitive receivers are for noise external to the dwelling / building.

Table B.10.14 Predicted typical operational external noise levels at nearest noise-sensitive receivers, calendar year 2040

Location	Noise Goal Range, dB(A)		Forecast La_{eq} Noise Level, dB(A)		
	Planning for Noise Control	World Health Organisation	Neutral, D Class Calm	D Class 3m/s SE wind	D Class 3m/s S wind
29 Hubert Street	41	35 – 40	40	38	37
55 Macrossan Street	35	35 – 40	**41**	**41**	38
5 Breakwater Quays	44	35 – 40	43	**48**	41
Jupiters Casino	42	35 – 40	**45**	**50**	**43**
1 Esplanade, Picnic Bay, Magnetic Island	28	35 – 40	23	28	28
Townsville Marine Precinct	N/A	70	48	45	44

*Most stringent Planning for Noise Control noise target for each location provided

Comparison against Planning for Noise Control noise goals

The operation of the expanded portion of the Port in Calendar Year 2040 is expected to produce noise levels of up to 41 dB(A) at Macrossan Street, 48 dB(A) at Breakwater Quays and 50 dB(A) at the Jupiters Casino (i.e. with Pasquil Stability Class D conditions and adverse wind conditions). The predicted noise levels at the Hubert Street and Magnetic Island receptors are forecast to be equal to or less than the relevant Planning for Noise Control noise goals under all modelled meteorological conditions.

Comparison against World Health Organisation guidelines

As the World Health Organisation guidelines presented here are in relation to the potential for sleep disturbance, the night time assessment period is the most important.

External noise levels at Macrossan Street, Breakwater Quays and Jupiters Casino from the operating Port Expansion Project under the identified prevailing wind conditions are predicted to be higher than the upper World Health Organisation guidelines by up to 10 dB(A).

The predicted external noise levels at the Hubert Street location fall within the range stated by the World Health Organisation guideline, and at the Magnetic Island location are forecast to be below the lower under all modelled meteorological conditions.

At Macrossan Street, the exceedance of the World Health Organisation external noise guidelines is marginal, 1dB. A difference of 1dB is not generally perceptible and therefore the difference between a compliant and a non-compliant noise level at this receptor should not be noticeable.

At Breakwater Quays, the exceedance of the World Health Organisation guidelines is up to 8 dB. Typical reduction across a standard residential facade with windows open is in the order of 10 to 15 dB; therefore the internal noise levels are likely to achieve the World Health Organisation's indoor sleep and night time guidelines

The predicted external noise level of 50 dB(A) at the Jupiters Casino is unlikely to be significant in terms of disturbance to hotel patrons who are inside the building. It is also noted that for this receiver, as the hotel rooms are also air conditioned, this allows patrons to keep external doors and windows closed, for which an outdoor-to-indoor noise reduction of 20 dB(A) is expected. Therefore, internal noise levels as a result of port operations in hotel rooms are predicted to achieve the WHO's indoor sleep and night time guidelines.

Table B.10.14 shows external noise levels of up to 48 dB(A) predicted at the Townsville Marine Precinct from the Port Expansion Project. Typical reduction across a standard commercial façade (closed windows and doors, air conditioned etc) is 20 dB; therefore, the internal guideline level of 45 dB(A) for the commercial properties at the Townsville Marine Precinct is likely to be readily achieved.

B.10.4.6.2 Comparison against existing noise levels

Based on the measured daytime noise levels (refer to Appendix N7 and the predicted noise levels presented in Table B.10.3), these worst-case operational Port noise levels are:

- Below the existing daytime average ambient average noise levels of 51 to 57 dB(A) at all receptor locations.
- Up to 8 dB(A) higher than the existing daytime background "typical quietest" noise levels of 38 to 42 dB(A).

However, when compared to the measured night time noise levels, these worst-case operational Port noise levels are:

- Below the existing night average ambient average noise levels of 46 to 49 dB(A) at all modelled receptor locations (except Jupiters Casino, where the predicted worst-case operational Port noise levels is forecast to be 1 dB higher than the existing ambient noise levels at this location).
- Up to 9 dB(A) higher than the existing night time background "typical quietest" noise levels of 32 to 41 dB(A).

Therefore, the operational noise emitted from the expanded portion of the Port under certain prevailing wind conditions is likely to be audible at the nearest mainland receptors. A discussion of mitigation measures to address the predicted noise emissions in relation to the Planning for Noise Control noise goals is provided in Section B.10.5.2.

B.10.4.6.3 Low frequency noise effects

The draft ECOACCESS *Guideline for the Assessment of Low Frequency Noise* provides an initial screening assessment for the audibility of low frequency noise.

The following two requirements are specified as part of this screening test:

- The overall sound pressure level within dwellings does not exceed 50 dB(Lin); and
- The overall dB(Lin) level within dwellings does not exceed the dB(A) level by more than 15 dB.

Where these conditions are not met, there is an increased likelihood that low frequency noise may be audible and additional assessment by way of measurement is recommended. It is noted that this initial screening test only identifies the risk of increased audibility as detailed below.

The predicted external noise levels at the identified receptors under the worst-case weather conditions for each receptor are summarised in Table B.10.15 below. The predicted noise levels at the noise-sensitive receivers are external noise levels.

Table B.10.15 Predicted worst-case external noise levels at sensitive receivers

Location	Overall dB(Lin)	Overall dB(A)	Difference dB
29 Hubert Street, South Townsville	52	40	12
55 Macrossan Street, South Townsville	52	41	11
5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville	59	48	11
Jupiters Casino	61	50	11
1 Esplanade, Picnic Bay, Magnetic Island	44	28	16
Townsville Marine Precinct	63	48	15

Predicted noise levels at modelled mainland locations meet the requirement that the overall dB(Lin) should not exceed the dB(A) level by more than 15 dB. The predicted external noise level at Magnetic Island is less than 50 dB(Lin), which meets the requirement for the first screening condition. Accordingly, low frequency noise is forecast to have a low probability of significant audibility within nearby sensitive buildings.

B.10.4.7 Maintenance dredging noise

Future dredging activities are not forecast to be more frequent or of longer duration than the current situation with the expanded port. Therefore, in terms of the noise and vibration impact from future dredging associated with the port expansion, only a minor and temporary effect is expected to occur. No significant change from the impact of current dredging activities is expected, as the Port Expansion Project harbour basin is more distant than the inner harbour for mainland receivers.

B.10.4.8 Traffic noise

Most heavy vehicle traffic accessing the Port of Townsville will travel via the Townsville Port Access Road, from the commencement of construction through to its final complete operational scenario, while cars associated with the Port will travel along either Boundary Street (90% of vehicles) or the Townsville Port Access Road (10% of vehicles).

Minimal traffic associated with either the construction or operation of the Port is forecast for the Port Expansion Project to travel along Archer Street, as outlined in Chapter B14 (Transport & Infrastructure). Therefore, only traffic noise levels on Boundary Street are assessed here.

An assessment of operational road traffic noise levels associated with the port expansion has been undertaken. Predictions were based on desktop calculations using the *Calculation of Road Traffic Noise 1988* equations, applying differences in traffic volumes and percentage of heavy vehicles (UKDoT, 1988). The posted speed (60km/h) and road surface (5-14 bituminous seal) were assumed to be unchanged.

The assessment of noise and/or vibration from the railway servicing the current and future Port operations is excluded from this reporting, as the railway falls under Queensland Rail and/or Queensland Rail National jurisdiction and is not within the Port of Townsville's development control or authority. Effects from haulage through access corridors, unloading and shunting would need to be undertaken separately, with the POTL serving in its capacity under IDAS for proposals on strategic Port land. Depending on the location of the proposal, the Port of Townsville Limited may be the assessment manager.

B.10.4.8.1 Traffic noise criteria

Benwell Road, which leads directly from the Port, is a private road belonging to the Port from the Archer Street intersection. Changes in traffic along this road might normally be considered as part of the operational noise model. However this road does not have any noise-sensitive receptors located on it, and residential receivers at greater than 100m from a road are typically not considered to be adversely affected by road traffic noise, and therefore this road is not addressed as part of the traffic noise assessment.

Boundary Street, onto which Port traffic on Benwell Road travels, is a State-controlled road, and thus falls under the jurisdiction of the Department of Transport and Main Roads (TMR) and its *Road Traffic Noise Management: Code of Practice 2008*. The Code of Practice provides guidance and noise criteria for the modelling of State-controlled roads throughout Queensland (DTMR, 2008a).

The road is not proposed to be upgraded as part of the project. However, the noise criteria which may be considered to be most appropriate to noise from Boundary Street for the purposes of this assessment are based on the Code of Practice's *Upgrading Existing Roads*. These criteria are summarised in Table B.10.16 below.

Table B.10.16 Summary of external noise criteria at noise sensitive receptors for upgrades to an existing State-controlled road

Building Type	Measurement Location	Descriptor	Criterion dB(A)
Dwelling	Outside habitable rooms, 1 metre in front of the most exposed façade	Façade Corrected $L_{A10(18h)}$	68
Outdoor Educational and Passive Recreational Areas	1.5 m above ground level in the free field	Free-field $L_{A10(12h)}$	63

Victoria Park is classified as an outdoor passive recreational area; the Bowls Club on within the park grounds is an active area. Similarly, the Code of Practice does not address traffic noise at commercial receivers, and so the Townsville Marine Precinct has been excluded from the traffic noise assessment.

B.10.4.8.2 Traffic noise assessment

Traffic noise measurements were taken in 2008 as part of the Eastern Access Corridor noise assessment (Bassett Acoustics, 2009) that was based on the measured traffic noise levels at 282 Boundary Street, South Townsville, at a distance of 20 metres from the kerb into Victoria Park. For consistency, it was adopted for comparison in this assessment.

Pre-construction traffic

Early rock deliveries for the Port Expansion Project will be delivered to site and stockpiled on the Eastern Reclamation Area from approximately 2015. Approximately 250,000 tonnes of material will be delivered – in the order of 150,000 tonnes from the Port of Townsville Limited's quarry, the remainder from other quarries. Heavy vehicle movements associated with this will travel via the Townsville Port Access Road, and as such is managed by any noise control conditions placed on the Townsville Port Access Road.

Construction traffic

The traffic assessment of the staged construction of the Port expansion (Tables B.14.2 and B.14.3 of Chapter B14) concluded that Stage D (Year 2035) will generate the highest traffic volumes and so was considered the critical construction stage in terms of potential impacts on the surrounding road network and traffic noise emissions.

At that time, a peak volume of 24 cars and 4 trucks are estimated to access the site each hour, equating to over 430 cars and 70 trucks associated with construction over the 18-hour traffic noise assessment period. That rate represents approximately 2% of the forecast total traffic volumes on Boundary Street for that year. The contribution to overall $L_{A10(18h)}$ traffic noise levels on Boundary Street from construction traffic is less than 0.5 dB, and is therefore not considered to represent a significant contribution to the traffic noise environment at that time.

Operational traffic

Stage 1 of the Townsville Marine Precinct is complete and operational; minor works are in progress, and it is anticipated that the Precinct will be fully operational by 2035; therefore, the data without the Marine Precinct traffic are provided for completeness. The influence of the Townsville Port Access Road is also taken into account in the future traffic volumes.

Table B.10.17 Predicted Future Traffic Noise Levels at 282 Boundary Street, South Townsville

Scenario	Measured dB(A)	Predicted dB		
	2008	Current (2011) without Port Expansion Project nor Townsville Marine Precinct	2035 with Townsville Marine Precinct only	2035 with Port Expansion Project and Townsville Marine Precinct
Measured/predicted 18 hour traffic flow	2377 37% commercial vehicles	2232 14% commercial vehicles	10823 9% commercial vehicles	11750 9% commercial vehicles
Measured/Predicted $L_{A10(18h)}$ noise level at upper storey façade of dwelling dB(A)	65	62	**70**	**71**
Predicted $L_{A10(12\ h)}$ noise level at Victoria Park dB(A)	**67**	**64**	**72**	**73**

The decrease in traffic volumes on Boundary Road from 2008 to 2011 is described in Chapter B14 (Transport & Infrastructure*)* of this Environmental Impact Statement as being due to the opening of the Townsville Port Access Road removing a significant number of heavy vehicles from the previous road network.

Potentially, the proposed residential and passive recreational traffic noise criteria are forecast under future Year 2035 scenarios to be exceeded, but with no significant difference (<1dB) in predicted noise level as a result of the Port Expansion Project.

It is noted that residences on Boundary Street would not qualify for noise treatments, even if the road was being upgraded. The main reasons for this are given in Section 3.2 of the Code of Practice, being that:

- The residences have direct access onto Boundary Street, and the limitation regarding access-controlled State roads is invoked.
- The speed limit on Boundary Street is 60km/hr, below the threshold 80km/hr at which the Code of Practice becomes applicable.

In addition, the calculations show that the predicted traffic noise levels in 2035 are not materially affected by the development of the Port Expansion Project in comparison to the Townsville Marine Precinct only. No further mitigation is therefore warranted on the basis of traffic arising due to the Port Expansion Project.

The predicted traffic noise level in areas of Victoria Park close to the road exceed the 63 dB $L_{A10(12hr)}$ criterion. However, noise levels beyond a distance of 270m from the Boundary Street kerb are forecast to be below 63 dB(A). Under the Code of Practice requirements, the minimum area over which the criterion is to be achieved for outdoor passive recreational areas is 2000m^2 (DTMR, 2008a). As Victoria Park is a large park with an area much greater than 2000m^2, the criterion is forecast to be achieved and no further mitigation to address noise from PEP traffic is required.

B.10.4.9 Operational vibration effects

As described in Section B.10.4.5.1, no distinction has been made between vibration generated by construction and operations. Therefore, the Human Response vibration goals and Structural Damage limits given in Table B.10.8, Table B.10.9 and Table B.10.10 are also applicable to vibration from Port operations.

B.10.4.9.1 Operational vibration assessment

Vibration levels were measured for heavy vehicles travelling along the Bruce Highway adjacent to road surface irregularities (AECOM 2011).

This worst-case measured vibration levels were used to estimate vibration emission during typical plant operation. Due to attenuation of ground vibration with distance, the operational vibration levels at the nearest receiver (1.4km away) is forecast to be well below both the night time residential vibration goal of 0.2mm/s for human comfort and the 0.1mm/s guideline value at which vibration is typically perceptible. The 5mm/s threshold limit for potential building damage at the lower frequencies (5 Hz) will also be readily achieved. Therefore, the impact of operational vibration from the port expansion at the nearest (and consequently all) receptors is forecast to be negligible.

B.10.4.10 Decommissioning noise and vibration

There is currently no intention to decommission the expanded Port and it is anticipated to continue to operate as a port for the foreseeable future. The site is well established for the specific use for port operations and the likelihood of the site being rehabilitated or converted to another purpose is not part of the Port of Townsville's strategic plan. Therefore, noise and vibration issues associated with decommissioning are not addressed.

Should Port tenants seek to decommission their developments (at the cessation of their operation within the Port Expansion Project), they would detail such plans in future planning and development applications and impact assessments.

B.10.5 Mitigation Measures and Residual Impacts

B.10.5.1 Construction Noise

The assessment conducted of construction noise levels for the port expansion show that most proposed activities are unlikely to cause significant disturbance or have a quantifiable effect on potentially sensitive receivers. Activities forecast to generate significant noise are rock breaking (although of limited duration) and piling. In practice, it is very difficult to mitigate noise levels from such construction activities.

Mitigation to be adopted is generally limited to:

- Restriction of hours of piling to well within the daytime period (i.e. commencing after 7am and finishing before 6pm) to minimise the potential for sleep disturbance in the earlier part of the day, and to minimise the effect on relaxation time at the end of a working day;
- Monitoring site conditions and adjusting (where necessary) elements of piling such as reducing the height and weight of the impact hammer, however although this will reduce the noise levels, it will most likely increase the duration of the piling required;
- Consideration of alternative piling types e.g. screw-type piling in place of impact piling.

General control strategies which minimise noise during construction may also include enclosures, silencers or the substitution of alternative construction processes. Identification of all reasonable and feasible noise mitigation methods should be conducted by the construction contractor and/or other nominated representative on a daily basis during potentially noisy works. The construction contractor will have the authority to modify work practices in response to complaints, where this is considered appropriate.

Noise level emissions and potential annoyance depend significantly on the type and condition of the equipment, its operation, duration and time of day work is conducted. All major items of plant should be checked for noisy operation at the commencement of works on site and following a major service.

During construction, it is important that the community be kept informed as to works programming and the progress of construction works, and to have a means for community complaints and response to construction activities. The Port of Townsville Limited already has a documented "Complaints Handling Process" policy and response form in place; these should be updated to include elements associated with the construction of the port expansion. This can be referenced at http://www.townsville-port.com.au/content/view/171/158/

Noise management measures should be considered as part of normal construction processes, and may include the general site initiatives given below in Sections B.10.5.1.1 to B.10.5.1.3. Additional mitigation measures outlined in the following Sections B.10.5.2.1 to B.10.5.2.3 are equally applicable to the construction period. The Construction Environmental Management Plan will be implemented for construction of the various stages of the site.

B.10.5.1.1 Acoustic enclosures and screening

Where noise-emitting plant is to be fixed in a stationary location such that it may affect sensitive receivers for a significant length of time (i.e. generator located near the Port of Townsville property boundary for greater than a week), an acoustic enclosure should be installed where practical. Further site-specific analysis should be conducted based on measured noise levels of plant, intervening topography between source and receiver, and the baseline receptor noise environment to determine appropriate acoustic mitigation.

Acoustic enclosures should be made of minimum 6 mm thick plywood or acoustic equivalent, and lined with 50mm thick sound absorption material. Australian Standard AS 2436-2010 *Guide to noise and vibration control on demolition, demolition and maintenance sites* provides practical examples on how to build and use an effective acoustic enclosure.

Due to the location of the works, fences and acoustic shielding of noisy activities are unlikely to represent reasonable and practicable mitigation measures in most cases. However, the project manager should consider the site topography, buildings and other shielding features to an advantage in terms of increased shielding where possible.

B.10.5.1.2 Site management

Site management should include the following:

- Use major and established thoroughfares / routes when accessing the site.
- Locate site compounds and noise emitting plant as far away from noise sensitive receptors as possible whilst still allowing efficient and safe completion of the work.
- Ensure materials are not dropped from a height, including into a truck.
- The reversing of vehicles should be minimised to reduce the noise from safety signals.
- Truck operators should ensure that tailgates are cleared and locked at the point of unloading within the Port Expansion Project to minimise tailgate rattle.
- Vehicle warning devices such as horns should not be used as signalling devices.
- Two-way radios should be used at the minimum effective volume, particularly when in close proximity to the Port of Townsville boundary.
- When work is complete, minimise the noise of packing up plant and equipment and departing from the site.

B.10.5.1.3 Equipment management

Equipment management should include the following:

- Select low-noise plant and equipment.
- Equipment should have high-quality mufflers installed.
- Equipment should be well maintained and fitted with adequately maintained silencers which meet the design specifications.
- Plant known to emit noise strongly in one direction (such as manifolds on compressors) should be orientated so that the noise is directed away from noise sensitive areas.
- Machines that are used intermittently should be shut down in the intervening periods between works or throttled down to a minimum.
- Silencers and enclosures should be kept intact, rotating plant should be balanced, loose bolts tightened, frictional noise reduced through lubrication and cutting noise reduced by keeping blades sharp.
- Equipment not in use should be shut down or removed from the site.
- Only necessary power should be used to complete the task.

B.10.5.1.4 Community Engagement and Complaints Management

A Community Relations Plan would be implemented to assist in managing communications with the public. The plan is to include measures to inform the public, neighbours and tenants in advance of potentially annoying noise, such as a period of pile driving. A complaints management procedure should also be implemented by the construction manager to deal with, and respond to, complaints should they arise. A complaints management procedure could include:

- Steps that will be taken to advise the community of upcoming noise issues.
- A documented process by which communications are handled, including the personnel responsible.
- A register to record all relevant information associated with the complaint.
- The investigation process for dealing with complaints.
- Measures to be taken to ensure the feedback on the outcomes.

Port of Townsville Limited already has a documented Complaints Handling procedure in place. This should be updated to include elements associated with the Port Expansion Project. Further details of construction environmental management actions and proposed mitigation measures are provided in Part C2.2.

B.10.5.1.5 Environmental Management Plan

The following table presents the adaptive management approach to identifying objectives, implementing strategies, monitoring performance and taking additional corrective action to manage noise and vibration effects from construction activities.

Table B.10.18 Environmental Management Plan – Construction Activities

Element/Issue	Construction Noise and Vibration
Objective	▪ Avoid construction noise impacts to sensitive receptors in the vicinity of the Port and of construction transport corridors ▪ Avoid human discomfort and structural damage due to construction vibration
Performance Criteria	▪ Construction noise – Queensland *Environmental Protection Act 1994*, which controls hours of construction works. ▪ Construction vibration – Human exposure standards given in DIN 4150-1975 Part 2 and AS 2670.2-1990 Part 2;structural damage standards given in DIN 4150-1975 Part 3.
Implementation strategies	▪ Establishing and adopting the Construction Environmental Management Plan. ▪ Implementation of the mitigation measures identified above in Sections B.10.5.1.1 to B.10.5.1.3. ▪ Proactive community consultation before and routinely during prolonged construction works, particularly in relation to periods between construction stages. ▪ Maintaining hours of construction to normal daytime working hours, other than for activities scheduled for 24/7 activity.
Monitoring	▪ Active noise and vibration monitoring – to be undertaken at potentially most affected receivers during those works identified as being most likely to cause community disturbance (piling, limited rock breaking). ▪ Reactive monitoring – to be undertaken in response to community complaint.
Auditing	▪ Review of the Environmental Management Plan and construction noise and vibration monitoring results against the Port of Townsville's Complaints Register for the duration of the construction works.
Reporting	▪ Reporting of construction noise and vibration monitoring to be in accordance with the Standards outlined in the Performance Criteria. ▪ Reporting of monitoring in response to a community complaint to be in accordance with Port of Townsville's Complaints and Improvements procedures, or specifically developed procedures for the Port Expansion Project, and incorporated into the Complaints Register database.
Corrective Action	▪ In the event of exceedances of the construction noise and vibration performance criteria, the construction activities in question will be reviewed and alternative methods/equipment/timing or additional controls investigated and implemented where practical. ▪ Supplementary monitoring to be undertaken following corrective action. ▪ Further corrective action may also be required where further complaints are received.

B.10.5.2 Operational Port Noise

Activity at the Port will be dominated by the operations of Port tenants, on sites leased under commercial agreement through the Port of Townsville Limited. These tenants will be bound to operate under licences issued by the Department of Environment and Heritage Protection in relation to various environmentally – relevant activities such as loading / unloading of bulk goods prescribed by Environmental Protection Regulation. The noise assessment undertaken for this Environmental Impact Statement has sought to characterise the type and situation of major operating plant typical of that currently associated with the existing Port.

During future operation, however, prospective tenants will need to consider noise impacts and make applications to show that their proposals, in conjunction with other existing operations, meet the relevant Standards and legislation.

In this assessment of predicted operational noise associated with the loading and unloading of ships at berth, the acoustic assessment is a “worst-case” assessment, and so is conservative in its predictions. Ongoing clarification of model inputs may have the effect of reducing the predicted noise levels from the Port.

All ships are being serviced (loaded/unloaded) for the entire time they are at berth – currently, all ancillary plant such as loading equipment and overhead gantries are in operation full time. As the environmental noise goals provided by the Planning For Noise Control document are guidelines (rather than legislation), it may be unacceptable for the noise levels to exceed the nominated noise targets if they can be shown to be reasonable. However, the future port expansion will be in operation 24 hours a day i.e. at any time of the day or night. Therefore it is unlikely that a noise target for the operations less stringent than the night time noise goals would be considered to be reasonable.

Practical noise mitigation measures to be considered for the operation of the Port include are largely limited to selection of low-noise-emitting equipment to be installed on port expansion areas. It may be feasible that new equipment can be specified to have lower source noise levels than those which have been measured for equipment at the existing port.

With additional mitigation in the form of selection of low noise emitting operating equipment, it is feasible that the cumulative noise levels would be reduced to meet the current noise targets, and provide a reduction which is significant in terms of human perception of noise. This would need to be assessed in detail when specific items of equipment are introduced to the Port.

Note that treatment of noise from ship exhausts at the source, other than the alignment of the ships in berth, is outside the scope of the Port of Townsville Limited to influence, as the ships are not owned by the Port, and therefore the Port has no direct jurisdiction over ship-based noise.

The installation of localised barriers around the new berths and loading equipment is not considered to be a practical or effective solution. The height of the most significant noise sources would require a noise barrier of impractical height, particularly to attenuate noise at the upper levels of Jupiters Casino hotel. Similarly, the distances between any such barriers and the noise-sensitive receivers would mean that the shielding effect of a barrier is very low.

The enclosure of certain fixed items of equipment could be considered. However, the location (at height for the gantry equipment) and the necessity for movement around the site (for forklifts, trucks and the like) of the most significant sources make this an impractical option for mobile equipment.

B.10.5.2.1 Project-wide operational noise mitigation measures

Noise attenuation measures shall be considered when planning and scheduling future day-to-day Port operations. While each of the following measures is not, in isolation, likely to notably affect the noise emissions from the Port, they may in combination have a significant effect

- Limiting the speed of vehicles on internal roads;
- Scheduling equipment movements wherever possible to avoid activities during sensitive periods such as night time;
- Maintaining internal roads in good working order;
- Requesting that Port operators replace standard, tonal reversing beepers on mobile equipment with a lower-impact beeper. The use of a broadband beeper e.g. “Backalarm” should be considered.

- Ensuring that vehicles, plant and machinery are maintained in proper working order to avoid unnecessary engine, motor or muffler noise; and
- Making sure vehicle and plant operators are aware of the location of sensitive receptors and the measures required for reducing noise emissions.

B.10.5.2.2 Community and Complaints Management

The process of consultation and complaints management as identified for the construction phase of the Port Expansion Project will be continued through from the current port operation, or aligned with the existing management process.

B.10.5.2.3 Noise Monitoring

In its operational phase, the Port of Townsville Limited itself has relatively limited contribution to the overall noise emission from the Port area, with most noise generation related to Port tenants and their loading / unloading of bulk goods. While noise monitoring should be conducted to determine the overall noise emissions from the Port area, separate Environmental Protection Act Environmentally Relevant Activity operating conditions for scheduled activities are likely to make requirements on individual Port tenants' operations with respect to noise. That site-based noise monitoring may provide further resolution of noise emission sources and adaptive management of individual tenant operations.

B.10.5.2.4 Environmental Management Plan

The development and implementation of a Construction Environmental Management Plan and an Operational Environmental Management Plan for the site will enable the control of environmental noise from Port activities and common use areas when these are not under control of another party such as licensed Operators within the Port site. This will need to conform to the requirements of the Port of Townsville's existing Planning Codes and Guidelines and incorporate each element of Table 1-19 (POTL, 2010c).

Table B.10.19 Environmental Management Plan – Operation Activities

Element/Issue	Operational Noise and Vibration
Objective	▪ Avoid operational noise impacts to sensitive receptors. ▪ Avoid human discomfort and structural damage due to operational vibration.

Performance Criteria	▪ Operational noise :
	  ▪ Queensland Environmental Protection Act (1994), Queensland Environmental Protection (Noise) Policy 2008, Planning for Noise Control and World Health Organisation Guidelines for Community Noise targets for residential, educational and health receivers;
	  ▪ World Health Organisation Guidelines for Community Noise targets for commercial properties;
	  ▪ ECOACCESS Draft Guideline for the Assessment of Low Frequency Noise (2004) targets for low frequency noise.
	▪ Operational vibration :
	  ▪ Human exposure standards - DIN 4150-1975 Part 2 and AS 2670.2-1990 Part 2;
	  ▪ Structural damage standards - DIN 4150-1975 Part 3.

Implementation Strategies	▪ Establishing and adopting the Operational Environmental Management Plan ▪ Port of Townsville's *Planning Codes and Guidelines* ▪ Implementation of the mitigation measures identified above in Sections B.10.5.2 to B.10.5.2.3.
Monitoring	▪ Reactive monitoring – to be undertaken in response to community complaints regarding POTL activities

Element/Issue	Operational Noise and Vibration
	▪ Routine and reactive noise monitoring by Port tenants – review available records from operators' EP Act licence Annual Returns
Auditing	▪ Review of the Environmental Management Plan and operational noise and vibration monitoring results against the Port of Townsville's *Environmental Management System*, *Environmental Policy* and *Planning Codes and Guidelines* and the Port's Complaints Register.
Reporting	▪ Reporting of operational noise and vibration monitoring to be in accordance with the Performance Criteria. ▪ Reporting of monitoring in response to a community complaint to be in accordance with Port of Townsville's Complaints and Improvements procedures and incorporated into the Complaints Register database.
Corrective Action	▪ Noise emissions from activities conducted by the POTL which are suspected of exceeding the Performance Criteria will be reviewed and alternative methods/equipment/timing investigated and implemented where practical. ▪ Port tenants holding Environmental Protection Agency licences will be required to take corrective action, including by direction from the Department of Environment and Heritage Protection and/or Townsville City Council.

B.10.6 Cumulative Impacts

The following projects have been identified as being under consideration and/or under construction in the vicinity of the Port:

- Townsville Marine Precinct – a commercial small-boats facility on the eastern reclamation area of the port expansion (Stage 1 complete).
- Berth 12 – a new bulk handling berth outside the existing harbour adjacent to Berth 11 (approved; not yet commenced).
- Cruise ship terminal, Berth 8 and Berth 10 upgrade (under construction).

Minor channel improvement works - increasing Sea and Platypus junction bend radii, channel widening between beacons P14 and P16 (underway incrementally with each maintenance dredge campaign).There is potential for redevelopment of the Townsville Entertainment and Convention Centre, adjacent to Jupiters Casino. Similarly, the expansion of Jupiters Casino was announced in 2010, with an "increase in meeting and ballroom space" in order to "increase the space available for major events in the region"[1]. The site immediately to the west of the Jupiters Casino is currently earmarked for development as waterfront apartments, as an extension of the Breakwater residential precinct. These will likely generate increased noise levels from sources such as additional building services plant and equipment, and additional car parking and vehicle movements. The apartments will also represent other sensitive receivers in the vicinity of the Port. However, as no details of either of these developments are available, they cannot realistically be included in this assessment of cumulative noise.

Stage 1 of the Townsville Marine Precinct is complete; Stages 2 and 3 constructions are expected to commence in approximately 2015 and 2019 respectively. Therefore the Precinct is expected to be largely operational before the commencement of any of the Port expansion works and would therefore be an "existing" use at the time of the Port expansion becoming operational, and is therefore considered in the assessment of cumulative impacts. Noise data for the Townsville Marine Precinct are based on the predicted operational noise levels as given in Table B.10.11, Appendix K (Noise and Vibration Assessment), of the Townsville Marine Precinct Project EIS (GHD, 2009a).

[1] Tabcorp Holdings Limited Public Affairs announcement 11 December 2010, www.tabcorp.com.au

Environmental noise modelling shows that the worst-case operational port expansion noise levels are below the existing daytime ambient “average” noise levels at nearby receptor locations, but up to 10 dB(A) higher than the existing daytime background “typical quietest” noise levels, particularly at 5 Breakwater Quays and Jupiters Casino. This means that the noise emitted from the combined existing and future Port operations is expected to be audible at the residential receiver locations during “typical quiet” moments, but not at other times and that noise from future Port operational sources may not be distinguishable from each other.

The existing noise levels measured at the receptor locations include the contribution from the existing Port operations, so the predicted noise levels from the future Port expansion are greater than the noise levels currently emitted from the Port. The cumulative noise effect is therefore controlled by the Port expansion alone. To note the predicted noise levels presented in Section B.10.4 of this assessment report represent only the noise from the construction and operation of the port expansion, and do not include the contribution of the existing Port operations or other construction projects in the vicinity of the Port.

Similarly, the development of the other projects identified above will not materially change the current noise emissions from port operations. Therefore the cumulative impact of the existing Port plus these other projects with the Port expansion is not changed because of these projects. This situation may change as the port-related projects are developed.

Table B.10.20 Cumulative noise levels – day time port operations

Location	Estimated cumulative noise levels L_{Aeq} dB					
	Existing 2011 day-time noise levels	Predicted Townsville Marine Precinct noise levels	Total noise levels (without the Port Expansion Project)	Worst-case predicted Port Expansion Project noise levels	Total noise levels (with the Port Expansion Project)	Estimated increase with the Port Expansion Project
29 Hubert Street, South Townsville	51	36	51	40	51	0
55 Macrossan Street, South Townsville	57	34	57	41	57	0
5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville	52	28	52	48	53	1
Jupiters Casino	59	30	59	50	60	1
1 Esplanade, Picnic Bay, Magnetic Island	40*	14	40	28	40	0
Townsville Marine Precinct	59**	59	62	48	62	0

Table B.10.21 Cumulative noise levels – night time port operations

Location	Estimated cumulative noise levels L_{Aeq} dB					
	Existing 2011 night time noise levels	Predicted Townsville Marine Precinct noise levels	Total noise levels (without the Port Expansion Project)	Worst-case predicted Port Expansion Project noise levels	Total noise levels (with the Port Expansion Project)	Estimated increase with the Port Expansion Project
29 Hubert Street, South Townsville	46	-	46	40	47	1
55 Macrossan Street, South Townsville	49	-	49	41	50	1
5 Breakwater Quays, Sir Leslie Thiess Drive, Townsville	48	-	48	48	51	3

Location	Estimated cumulative noise levels L_{Aeq} dB					
	Existing 2011 night time noise levels	Predicted Townsville Marine Precinct noise levels	Total noise levels (without the Port Expansion Project)	Worst-case predicted Port Expansion Project noise levels	Total noise levels (with the Port Expansion Project)	Estimated increase with the Port Expansion Project
Jupiters Casino	52	-	52	50	54	2
1 Esplanade, Picnic Bay, Magnetic Island	30*	-	30	28	32	2
Townsville Marine Precinct	52**	-	52	48	53	1

* Estimated from AS 1055.2 (Standards Australia, 1997b)
** Estimated based on measured noise levels at Jupiters Casino

Based on the above estimation of future noise levels, the cumulative daytime operational noise impact of the proposed Port expansion and the known Townsville Marine Precinct is negligible (i.e. up to 1dB).

The night time cumulative noise levels of the existing and future Port operations and the Townsville Marine Precinct (inactive at night) indicates negligible change in amenity for the residences at 29 Hubert Street and 55 Macrossan Street, and small but unnoticeable (i.e. less than 3dB) at 1 Esplanade, Picnic Bay, Magnetic Island and Jupiters Casino. At 5 Breakwater Quays, the estimated cumulative impact of all known Port-related developments is just noticeable at a 3 dB increase in combined effect when compared to the developments in the absence of the proposed Port expansion.

In reality, however, the noise levels at these receivers from sources other than the proposed Port expansion are also expected to increase, such that the noise contribution from the Port expansion alone becomes less significant. Other future sources, which at this stage cannot be quantified, include:

- Noise from an expanded casino operation (e.g. building services noise, car park and vehicle noise from Sir Leslie Thiess Drive).
- Noise from the Breakwater Quays development (as yet incompletely developed) (e.g. building services noise, car park and vehicle noise from Sir Leslie Thiess Drive).
- Noise from general growth and development of the city centre and Flinders Street East.
- Noise from vehicles on the Townsville Port Access Road.
- Noise from upgraded rail operations within both the Port area and the Eastern Access Corridor.

The cumulative effect of all these developments is expected to increase the actual noise environment in the vicinity of the Port, and hence at the time of its operation, the additional impact of the Port expansion on the noise environment at that time will correspondingly be less. These factors and contributions can be more meaningfully assessed in the future at stages when applications by port tenants are undertaken.

B.10.7 Assessment Summary

A summary of the risk assessment carried out in relation to potential noise and vibration impacts from the port expansion project is provided in Appendix N2. Potential noise and vibration impacts of the proposed expansion of the Port of Townsville were assessed for both its construction and assumed final operational configuration phases.

B.10.7.1 Existing acoustic environment

Measurement and observation of the existing acoustic environment at sensitive receptors show that the surrounding area is mainly traditional residential, with some commercial buildings and a school. The existing ambient environment is characterised by traffic noise and existing Port activities. The nearest sensitive receptors are 1.2km from the boundary of the proposed port expansion; the southernmost residential area of Magnetic Island was also included in the assessment.

B.10.7.2 Construction noise

The impact of construction noise from the port expansion is negligible for most construction activities. Predicted noise levels are below the existing daytime background “typical quietest” and ambient “average” noise levels for all activities except piling and limited rock breaking. Predicted noise levels from sheet piling activities (for constructing bulkhead wharves) are up to 14 dB(A) higher than the “average” ambient noise levels and up to 25 dB(A) higher than the existing daytime background “typical quietest” noise levels for the nearest sensitive receptors.

B.10.7.3 Construction vibration

The likely highest construction vibration levels at the nearest sensitive receptor will be well below the most stringent goals for human comfort and the threshold limit for potential building damage. Therefore, the impact of operational vibration from the port expansion at the nearest (and consequently all) receptors is expected to be negligible.

B.10.7.4 Operational noise

Operation of the expanded section of the Port (including traffic noise and low frequency noise) will result in negligible increases at most sensitive receptors, as worst-case predicted noise levels achieve the identified noise limits, and are predicted to fall within existing daytime ambient levels. However, operational noise at the closest residential locations assessed (Jupiters Casino and Breakwater Quays) may exceed the identified noise goals, with predicted noise levels greater than existing night time ambient levels and therefore potentially audible. Hence, the impact may be described locally as moderate.

B.10.7.5 Operational vibration

The predicted maximum operational vibration levels at the nearest sensitive receptor are well below the most stringent goals for human comfort and the threshold limit for potential building damage. Therefore, the impact of operational vibration from the port expansion at the nearest (and consequently all) receptors is expected to be negligible.

Port Expansion Project EIS

Part B

Section B11 – Greenhouse Gas Emissions

AECOM BMT WBM

B.11 Greenhouse Gas Emissions

B.11.1 Relevance of the Project to Greenhouse Gases

A strengthening scientific position, heightened public interest and expectations, and an increasing focus on national and international policy mean that managing greenhouse gas emissions at the corporate and national level is becoming standard practice. The business environment now includes a price cost on greenhouse gas emissions as a direct result of government action, and companies see adapting to climate change as a risk-adverse and cost-effective position long term.

This chapter provides an assessment of the greenhouse gas emissions associated with the construction and operational phases of the PEP.

B.11.2 Assessment Framework and Statutory Policies

B.11.2.1 Defining Scopes – Sources and Responsibilities for Greenhouse Gases

In corporate carbon management and accounting, greenhouse gas emissions are separated into scopes, which are determined by the organisation's activities. There are three types of emission scopes – Scope 1, 2 and 3.

Scope 1 emissions refer to direct emissions where the point of emission release is owned by the organisation in question, such as company owned equipment. Scope 2 emissions refer to indirect emissions that are from the purchase of electricity, heat or steam consumed by the organisation. Scope 3 emissions refer to all other indirect greenhouse gas emissions that are not Scope 2 emissions. These occur outside the boundary of the organisation's operations, but are a result of activities of the organisation, such as embodied energy emissions from construction materials, air travel and waste production.

The purpose of differentiating between scopes of emissions is to avoid the potential for double counting. Double counting occurs when two or more organisations assume responsibility for the same emissions in the same scope.

Reporting under the *National Greenhouse and Energy Reporting Act 2007*(NGER Act) requires that organisations report Scope 1 and Scope 2 emissions but not Scope 3 emissions. Scope 3 emissions can be reported voluntarily. The NGER Act states that the following gases must be reported: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6).

The calculations in this assessment use equivalent carbon dioxide (CO_2-e) as it is the universally accepted measure for calculating the global warming potential of different greenhouse gases to derive a single greenhouse gas emissions unit. Carbon dioxide is used as the reference gas with a global warming potential of one. The global warming potential of a greenhouse gas is the radiative forcing impact contributing to global warming relative to one unit of CO_2. The standard unit of measurement of CO_2-e typically used is tonnes (t).

B.11.2.2 Calculation Approach

This section provides information on the methods used to make the projected annual greenhouse gas emissions estimates.

The greenhouse gas assessment aligns with accounting standards set out by the NGER Act, which are:

- *National Greenhouse and Energy Reporting (Measurement) Determination 2008*
- *National Greenhouse and Energy Reporting (Measurement) Technical Guidelines July 2011.*

The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* outlines the calculation process to determine the quantity of greenhouse gas emissions emitted.

Emissions have been calculated by multiplying activity data with the appropriate emission factor in order to provide the results in tonnes of CO_2-e. The detailed calculation approach and emission factors used are outlined in **Error! Reference source not found.**.

B.11.2.3 Carbon Pricing Mechanism

From 1 July 2012, Australia will join Europe, New Zealand, and other parts of the world in putting a price on greenhouse gas emissions. Under the carbon pricing mechanism businesses that generate at least 25,000 t of CO_2-e a year will be required to buy and surrender to the government a permit for every tonne of pollution they produce. Most of these businesses directly emit greenhouse gases, and include power stations, mines, water utilities and heavy industry. Some will be public authorities responsible for emissions from landfills. The carbon price will not apply to emissions from agriculture or to emissions from fuel used for farm equipment, light commercial or private vehicles.

The carbon price is initially fixed at $23/t for 2012/13, rising annually by 2.5% in real terms. From 1 July 2015, an emissions trading scheme will commence whereby the government sets the emissions level cap for Australia and the market determines the price of permits. From 2015 to 2018, there will be a price collar, with minimum and maximum prices. The scheme aims to change company behaviour by encouraging private investment in more efficient practices and technologies, as well as renewable energy. Companies can buy carbon credits generated by eligible projects under the Carbon Farming Initiative to offset their emissions. From 2015 they will be able to obtain up to 50% of their credits from the international market, and from 2021, 100% of credits. Although unlikely to be affected directly by the carbon pricing mechanism, Port of Townsville Limited (POTL) will be exposed to a range of indirect costs associated with the carbon price, including increased costs of energy and other carbon intensive products and services in the supply chain as suppliers pass on their own carbon price liability.

B.11.2.4 National Greenhouse and Energy Reporting Act 2007

The NGER Act established a national system for reporting greenhouse gas emissions, energy consumption and energy production by corporations from 1 July, 2008. The NGER Act requires eligible corporations to publically report their greenhouse emissions, energy consumption and energy production each financial year.

The 2011/12 reporting year has a corporation threshold for reporting of 50,000 t of CO_2-e emitted and 200 terajoules of energy consumed or produced (Figure B.11.1). The 2011/12 reporting year has a facility threshold of 25,000 t of CO_2-e emitted and 100 terajoules of energy consumed or produced. These will be the thresholds for subsequent years.

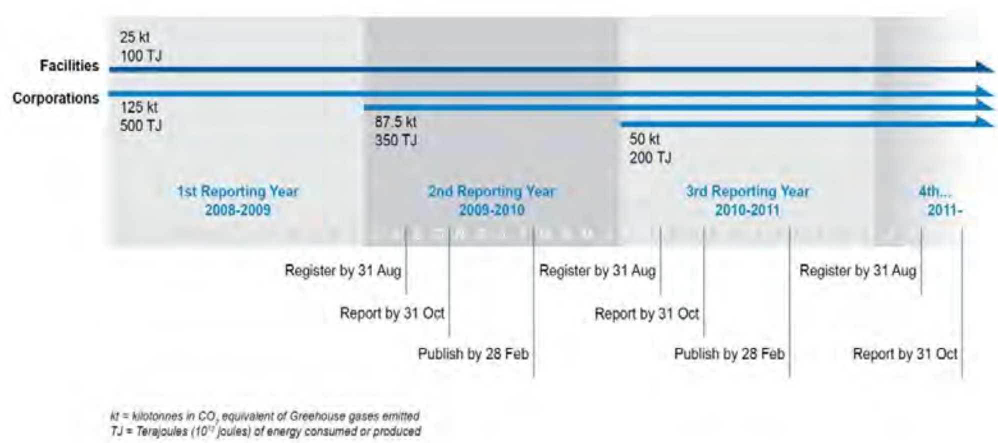


Figure B.11.1 NGER Act Reporting Timeline

Port of Townsville does not trigger the NGER Act and is not required to publically report its annual greenhouse gas emission and energy use. This situation is unlikely to change for subsequent reporting years.

B.11.3 Existing Values, Uses and Characteristics

The existing sources of greenhouse gas emissions for the Port of Townsville are from office facilities (such as refrigerants from air conditioning units, stationary energy fuel use from emergency generators and electricity use), fleet and machinery. The quantity of these emissions does not trigger the NGER Act, and are considered minimal in the context of corporations in Australia.

B.11.4 Assessment of Potential Impacts

B.11.4.1 Background

The main sources of greenhouse gas emissions for the construction phase of the Project include:

- fuel use from the transport of construction materials from the quarry to site
- fuel use from onsite machinery
- fuel use from the capital dredging operations
- stationary energy use from onsite electricity generators (for safety lighting)
- embodied emissions of the construction materials

The main sources of greenhouse gas emissions for the operational phase of the Project include:

- fuel use from fleet, trucks and plant
- fuel use from maintenance dredging
- fuel use from wharf infrastructure, such as cranes
- SF6 use from high voltage switch gear
- refrigerants from office air conditioning units
- stationary energy from office emergency generators
- electricity use from offices and berth lighting
- fuel use from staff use of taxis/buses, air travel and car hire.

Greenhouse gas emissions from tenant and shipping operations have not been included in this assessment as POTL has no control over these emissions.

B.11.4.2 Projected Greenhouse Gas Emissions from Construction

B.11.4.2.1 Transportation of Construction Materials to Site

The construction materials transported by trucks from the quarry to the Project Area include the breakwater and revetment core material and armour, rock fill, and rock armour. Table B.11.1 summarises the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the transport of construction materials to site. Further detail on the calculation process and detailed assumptions is available in **Error! Reference source not found.**. Transportation of construction materials is considered a Scope 1 emission source.

Table B.11.1 Assumptions for Calculating Emissions from the Transport of Construction Materials

Construction Stage	Total Hours	Fuel consumption per truck (L/hr)	Total fuel consumption (kL)
Stage A	647,400	25	16,185
Stage B	1,620		40.5
Stage C	1,620		40.5
Stage D	4,860		121.5

The greenhouse gas emissions produced from the transport of construction materials to site are shown in Table B.11.2.

Table B.11.2 Greenhouse Gas Emissions from Transport of Construction Materials

Stage	t/CO_2-e
A	39,296.2
B	98.3
C	98.3
D	295
Total	39,787.9

B.11.4.2.2 Onsite Machinery

The onsite machinery expected to be used during construction includes excavators, bulldozers, cranes, utility vehicles, transport barges, work boats, survey boats, tugs for barges, off-road dump trucks, on-road dump trucks, stone column or wick drain rig, delivery trucks, bobcats, graders, paving machines, track machines, barge-mounted pile drivers and concrete trucks. Onsite machinery is considered a Scope 1 emission source.

Table B.11.3 summarises the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the onsite machinery for each construction stage of the PEP. Further detail on the calculation process and detailed assumptions are available in **Error! Reference source not found.**. The machinery associated with the transport of construction materials to site and capital dredging were excluded from this greenhouse gas calculation, and will be calculated elsewhere.

Table B.11.3 Assumptions for Calculating Emissions from Onsite Machinery for Stage A

Onsite Machinery	Stage A			Stage B			Stage C			Stage D		
	Total Hours	Fuel Consumption		Total Hours	Fuel Consumption		Total Hours	Fuel Consumption		Total Hours	Fuel Consumption	
		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)
Barge mounted pile driver	2,160	15	32.4	1,350	15	20.3	1,350	15	20.3	2160	15	32.4
Bobcat	2,580	8	20.6	1,720	8	13.8	1,720	8	13.8	2580	8	20.6
Bulldozer	37,900	80	3,032.0	7,806	80	624.5	14,610	80	1,168.8	750	80	60.0
Concrete truck	8,260	25	206.5	5,900	25	147.5	5,900	25	147.5	8260	25	206.5
Crane 1	20,385	30	611.6	1,675	30	50.3	1,515	15	22.7	870	15	13.1
Crane 2	1,703	15	25.5	1,056	15	15.8	1,675	30	50.3	2345	30	70.4
Delivery truck	840	0.4	12.6	840	0.4	12.6	560	15	8.4	840	15	12.6
Excavator	36,520	36	1,314.7	2,190	36	78.8	2,190	36	78.8	2910	36	104.8
Grader	1,080	15	16.2	720	15	25.9	720	36	25.9	1080	36	38.9
Off-road dump truck	16,464	40	658.6	7,056	40	282.2	9,240	40	369.6	8100	20	162.0
On-road dump truck	35,280	20	705.6	8,100	20	162.0	17,820	20	356.4			
Paving machine	216	20	4.3	162	20	3.2	162	20	3.2	162	20	3.2
Stone column or wick drain rig	1,350	20	27.0	1,350	20	27.0	1,350	20	27.0	1350	20	27.0
Survey boat	1,250	40	50.0	-	-	-						
Track machine	216	20	4.3	162	20	3.2	162	20	3.2			
Transport barge	2,500	120	300.0	275	50	13.8						
Tug for barge	440	50	22.0				1,350	15	20.3	440	50	22.0
Utility vehicle	50,880	10	508.8	21,960	10	219.6	30,000	10	300.0	25185	10	251.9
Work boat	2,260	50	45.2	350	50	7.0	350	50	17.5	560	50	28

The greenhouse gas emissions produced from the onsite machinery are shown in Table B.11.4.

Table B.11.4 Greenhouse Gas Emissions from Onsite Machinery

Stage	t/CO_2-e
Stage A	18,447.4
Stage B	4,145.7
Stage C	6,394.4
Stage D	2,557.3
Total	31,544.8

B.11.4.2.3 Capital Dredging

The dredging machinery expected to be used during construction include mechanical dredges, small tug, work boats, survey boats, hopper barges, small trailing suction hopper dredgers (TSHD), medium cutter suction dredgers (CSD) and medium TSHD. Dredging is considered a Scope 1 emission source.

Table B.11.5 summarises the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the dredging machinery. Further detail on the calculation process and detailed assumptions is available in **Error! Reference source not found.**. Dredging is not required for Stage D.

Table B.11.5 Assumptions for Calculating Emissions from Capital Dredging

Dredging Machinery	Stage A			Stage B			Stage C		
	Total Hours	Fuel Consumption		Total Hours	Fuel Consumption		Total Hours	Fuel Consumption	
		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)
Mechanical dredge	3,978.5	215	855.4	163.5	215.0	35.2	163.5	215.0	35.2
Small tug	1,715.5	50	85.8	70.5	50.0	3.5	70.5	50.0	3.5
Work boat	5,466.5	50	273.3	1,806.5	50.0	90.3	4,162.5	50.0	208.1
Survey boat 1	4,092.0	50	175.9	985.0	50.0	49.3	766.0	50.0	38.3
Survey boat 2	2,450.0	30	73.5	1,400.0	30.0	42.0	2,750.0	30.0	82.5
Hopper barges	8,541.0	250	2,135.3	234.0	250.0	58.5	234.0	250.0	58.5
Small TSHD	4,212.0	225	947.7	292.5	225.0	65.8	351.0	225.0	79.0
Medium CSD	5,341.0	1150	6,142.2	3,052.0	1,150.0	3,509.8	5,995.0	1,150.0	6,894.3
Medium TSHD	1,529.5	3750	5,735.6				1,463.0	3,750.0	5486.3
Medium CSD	3,052.0	1,150.0	3,509.8						

The greenhouse gas emissions produced from capital dredging are shown in Table B.11.6.

Table B.11.6 Greenhouse Gas Emissions from Capital Dredging

Stage	t/CO_2-e
Stage A	39,947.6
Stage B	9,358.2
Stage C	31,285.4
Total	80,591.2

B.11.4.2.4 Stationary Energy

The quantity of greenhouse gas emissions from stationary energy (for example, diesel generators) used for lighting for night works, pumps and booster pumps cannot be estimated due to lack of data. These emissions will be very minor compared to the other sources of greenhouse gas emissions during the construction phase. Stationary energy is considered a Scope 1 emission source.

B.11.4.2.5 Embodied Energy from Construction Materials

The main construction materials used in the construction phase of the Project include primary armour material, core material, filter material, geotextile, concrete and steel (reinforcement and piles). Of these, geotextile, concrete and steel have the highest embodied energy emissions.

Table B.11.7 outlines the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the embodied energy of geotextile, concrete and steel. The emissions from embodied energy of construction materials will be Scope 3 emissions.

Table B.11.7 Assumptions for Calculating Emissions from Embodied Energy from Construction Materials

Material	Stage A	Stage B	Stage C	Stage D	Density (kg/m^3)
Geotextile	116,000 m^2 (length) 0.001 m^2 (width)	0	0	0	1,250
Concrete (m^3)	20,400	7,000	7,700	16,500	2,400
Steel (reinforcement and piles) (t)	10,600	3,600	4,000	8,600	-

The greenhouse gas emissions produced from the embodied energy from construction materials are shown in Table B.11.8.

Table B.11.8 Greenhouse Gas Emissions from Embodied Energy from Construction Materials

Stage	t/CO_2-e
Stage A	34,164.2
Stage B	11,539.2
Stage C	12,782.3
Stage D	27,454.4
Total	85,940.1

B.11.4.2.6 Summary of Construction Emissions

Table B.11.9 summarises the greenhouse gas emissions produced for each source of emissions in the construction phase of the Project.

Table B.11.9 Summary of Greenhouse Gas Emissions for Construction

Scope	Source of Emissions	t/CO_2-e				
		Stage A	Stage B	Stage C	Stage D	Total
1	Transportation of materials	39,296.2	98.3	98.3	295	39,787.9
1	Onsite machinery	18,447.4	4,145.70	6,394.40	2,557.30	31,554.8
1	Capital dredging	39,947.6	9,358.20	31,285.40	0.00	80,591.2
3	Embodied energy emissions	34,164.2	11,539.20	12,782.30	27,454.40	85,940.1
	Total	**131,855.4**	**25,141.4**	**50,560.4**	**30,306.7**	**237,874.0**

Figure B.11.2 shows a breakdown by source of greenhouse gas emissions from the construction phase for all stages of the construction phase.

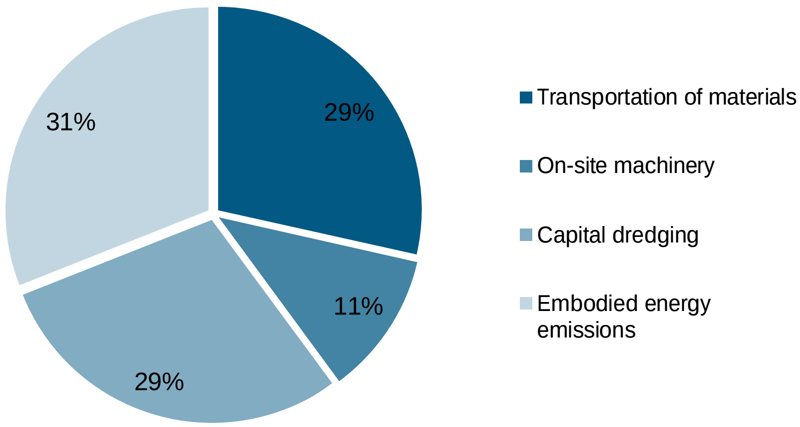


Figure B.11.2 Greenhouse Gas Emissions from the Construction Phase by Source

Table B.11.10 outlines the projected annual greenhouse gas emissions for the construction phase of the Project. Improvements in the performance on greenhouse gas abatement will reduce the amount of greenhouse gas emissions, which will reduce the projected amount of emissions.

Table B.11.10 Projected Annual Greenhouse Gas Emissions for Construction Phase

Construction Stage	Duration of Construction (months)	Total Greenhouse Gas Emissions (t/CO_2-e)	Annual Greenhouse Gas Emissions (t/CO_2-e)
Stage A	36	131,855.4	43,951.8
Stage B	18	25,141.4	16,760.9
Stage C	18	50,560.4	33,706.9
Stage D	15	30,306.7	24,245.4
Total	87	277,170.2	38,230.4

B.11.4.3 Projected Greenhouse Gas Emissions from Operations

Where possible, the projected greenhouse gas emissions for the operational phase of the Project have been estimated using a pro rata basis from POTL greenhouse gas inventory data for 2011. Information from 2011 was used as this was deemed to be the most reflective of current and future operations. There is only three years of data available, which is an inadequate length of time to determine trends over time. Greenhouse gas emissions have been estimated based on tonnes of CO_2-e/Mt of trade and tonnes of CO_2-e/ha.

POTL had 11 Mt of trade in 2010/11. The forecast growth in trade is

- 2015 - 21.9 Mt
- 2020 - 29.7 Mt
- 2025 - 33.4 Mt
- 2030 - 41.7 Mt
- 2035 - 45.8 Mt
- 2040 - 48.3 Mt.

The PEP will increase the area of the port by 100 ha, from 404.5 ha to 504.5 ha.

Projected greenhouse gas emissions based on changes in trade tonnage are shown in Table B.11.11 and changes based on size of port area are shown in Table B.11.12 for:

- fuel use from fleet, trucks and plant (Scope 1)
- sf_6 use from high voltage switch gear (Scope 1)
- electricity use from offices and berth lighting (Scope 2)
- fuel use from staff use of taxis/buses, air travel and car hire (Scope 3)

Greenhouse gas emissions from the fuel use associated with maintenance dredging are not included in POTL greenhouse gas inventory because the dredging is done by an external operator. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project.

Greenhouse gas emissions from the fuel use from wharf infrastructure are not included in POTL greenhouse gas inventory. This is due to the minor contribution wharf infrastructure would make to the overall greenhouse gas inventory. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project.

Greenhouse gas emissions from the refrigerants associated with air conditioning units are not included in POTL greenhouse gas inventory. This is due to the minor contribution refrigerants would make to the overall greenhouse gas inventory. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project. Refrigerants would be a Scope 1 emission source.

Greenhouse gas emissions from emergency generators are not included in POTL greenhouse gas inventory. This is likely due to the minor contribution emergency generators would make to the overall greenhouse gas inventory given that they are a back-up source of power. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project. Stationary energy would be a scope 1 emission source.

B.11.4.4 Summary of Operational Emissions

Table B.11.11 summarises the greenhouse gas emissions produced for each source of emissions with available data in the operational phase of the Project using a pro rata basis and based on changes to trade tonnage.

Table B.11.11 Operational Greenhouse Gas Emissions based on Changes to Trade Tonnage

Year	t/CO_2-e								
	Fleet	Trucks	Plant	High Voltage Switch Gear	Electricity Consumption	Taxis/ Buses	Air Travel	Car Hire	Total
2011	167	15.1	292	1.3	947.0	1.7	156	0.3	1,580.4
2015	330.7	30.7	580.4	2.6	1,883.4	3.3	308.8	0.7	3,140.6
2020	448.5	41.6	787.1	3.6	2,554.2	4.5	418.8	0.9	4,259.2
2025	504.3	46.8	885.1	4.0	2,872.4	5.0	470.9	1.0	4,789.5
2030	629.7	58.4	1,105.1	5.0	3,586.2	6.3	588.0	1.3	5,980.0
2035	691.6	64.1	1,213.7	5.5	3,938.8	6.9	645.8	1.4	6,567.8
2040	729.3	67.6	1,280.0	5.8	4,153.8	7.2	681.0	1.4	6,926.1

Table B.11.12 summarises the greenhouse gas emissions produced for each source of emissions with available data in the operational phase of the Project using a pro rata basis and based on changes to size of port area.

Table B.11.12 Operational greenhouse gas emissions based on changes to size of port area

Scenario	t/CO_2-e								
	Fleet	Trucks	Plant	High voltage switch gear	Electricity consumption	Taxis/ buses	Air travel	Car hire	Total
Current port	167.0	15.1	292	1.3	947.0	1.7	156	0.3	1,580.4
Current port and PEP	196.8	20.2	348.1	1.5	1,125.0	2.0	185.7	0.5	1,879.8

B.11.5 Mitigation Measures and Residual Impacts

To continually improve performance on greenhouse gas abatement for the construction phase of the Project, it is recommended that POTL follow the carbon management cycle. The carbon management cycle provides a clear framework for organisations to develop a carbon management strategy for the business. At each step of the cycle, specific activities can be undertaken according to priority to realise emission reductions.

The steps in the carbon management cycle are:

- Step 1 Measure: Calculate the quantity and source of onsite and indirect greenhouse gas emissions through a carbon footprint.
- Step 2 Set Objectives: Identify and set greenhouse gas reduction target (e.g. achieve annual carbon neutrality, achieve a 20% reduction on 2004 greenhouse gas emissions by 2015).
- Step 3 Avoid: Reduce greenhouse gas emissions through avoiding unnecessary generation of greenhouse gas emissions (e.g. use of teleconferencing instead of unnecessary flights).
- Step 4 Reduce: Implement energy saving initiatives to reduce energy consumption (e.g. motion sensor lighting, reduced use of fleet, lighting efficiency).
- Step 5 Switch: Switch to cleaner and less energy intensive energy sources (e.g. install solar panels, purchase renewable energy through the Green Power scheme).
- Step 6 Sequester: Identify opportunities to sequester emissions onsite (e.g. plant vegetation on port land to absorb carbon dioxide from the atmosphere and lock it up in a created carbon forest).
- Step 7 Assess: Assess residual greenhouse gas emissions by calculating the quantity of greenhouse gas emission that cannot be avoided or reduced through previous steps.
- Step 8 Offset: Identify opportunities to offset residual emissions by purchasing carbon offsets from accredited carbon abatement providers.

The cycle steers organisations to avoid, reduce and switch to alternatives in the approach to carbon management. The purchase of offsets is only considered when all other possibilities for reducing greenhouse gas emissions have been explored. This helps to ensure that carbon management contributes to improving business and energy efficiency as well as contributing to greenhouse gas emission reductions.

Table B.11.13 suggests abatement measures that would improve greenhouse gas performance during the construction phase. For the operational phase POTL will only be managing common areas, it is recommended that POTL also consider abatement measures for these areas; however, focus has been given to construction emissions as this will be the majority of emissions produced for the Project.

Table B.11.13 Abatement Measures

Measures	Abatement Measure
Awareness	Include greenhouse gas awareness training as part of site inductions
	Undertake periodic energy audits to monitor energy use and changes to efficiency on site
	Keep informed of best practice industry standards, research into new technology and energy efficiency and trial new approaches where appropriate
Targets and goals	Develop a greenhouse gas inventory to effectively monitor, audit and report on the Project's greenhouse gas emissions
Energy efficiency – construction	Install light sensitive switches on lights so that they do not unnecessarily operate during the day (Site Offices, Construction Lighting)
	Ensure equipment is well maintained
	Install energy saving timers and energy efficient lighting in and around the buildings
	Select appliances based on energy efficiency
Energy efficiency – operations	Require preventative maintenance on equipment and engines to ensure equipment is well maintained
	Ensure lighting and other electrical equipment that is not in use is switched off
	Use variable speed drives with high efficiency linings
	Consider the use of high efficiency electrical motors
	Develop an energy efficiency management plan
	Consider purchasing electricity from renewable sources through Green Power
Renewable energy	Investigate renewable energy options for administration facilities
	Investigate the feasibility of generating electricity from a renewable source onsite
	Consider power generation from wind turbines or solar photovoltaics
	Consider the use of solar panels for road lighting and powering isolated items such as pumps
Fuel use during construction	Source the majority of fill material for the reclamation from capital and maintenance dredging operations in close proximity to the reclamation area
	Reduce haul distances between construction sites and spoil sites by selecting the most direct haulage route possible, provided other aspects of haulage routes are equal (such as safety and available road infrastructure)
	Reduce mobilisation of plant
	Reduce distance to DMPA where possible plus reduce dredge mobilisation distances where possible
	Plan construction works to avoid double handling of materials where possible
	Ensure efficient design of the dredging sequence operations
	Select newer equipment with more efficient engines if possible
	Use fuel efficient vehicles
	Investigate replacing diesel with a less emission intensive fuel, such as biodiesel or use of hybrid vehicles where possible
	Provide information to drivers about smoother driving practices for the trucks transporting the quarried materials to site
	Provide single direction loop roads in and out of the sites that allow trucks to enter and leave without unnecessary manoeuvring, where possible
	Implement procedures to encourage drivers to turn off engines when any significant delays are experienced along the route
	Coordinate staff travel arrangements to reduce trips and maximise passenger loads on each trip
	Choose the most suitable site equipment that can carry out the required tasks with the most efficient fuel consumption rates
	Include energy efficiency clauses in equipment tender specifications
	Incorporate scheduled equipment maintenance procedures
	Implement a regular maintenance program for equipment and construction fleet

Measures	Abatement Measure
	Reduce any unnecessary travel
Procurement	Develop a sustainable purchasing policy for the Construction Contract
	Consider energy efficiency in procurement of equipment
Material use and selection	Use materials with high recycled content or lower embodied construction materials
	Consider the feasibility of sourcing polyester geotextile manufactured from recycled polyethylene terephthalate (PET) for the reclamation area if performs to same level
	Reduce the quantity of imported material required
	Re-use dredge spoil wherever feasible as part of footprint design
Offsets for carbon neutrality	Purchase offsets through a certified offset provider in Australia

B.11.6 Assessment Summary

The total greenhouse gas emissions to be produced during the entire construction phase of the Project are estimated at 237,874.0 t of CO_2-e, which is comprised as shown in Table B.11.14.

Table B.11.14 Construction Greenhouse Gas Emissions

Source	t/CO_2-e	Percentage of Emissions
Transportation of construction materials to site	39,787.9	28.5
Onsite machinery	31,554.8	11.4
Capital dredging	80,591.2	29.1
Embodied energy from construction materials	85,940.1	31.0

The projected annual greenhouse gas emissions from the construction phase are show in Table B.11.15.

Table B.11.15 Projected Annual Greenhouse Gas Emissions (Construction)

Stage	t/CO_2-e	Period
Stage A	43,951.8	36 months
Stage B	16,760.9	18 months
Stage C	33,706.9	18 months
Stage D	24,245.4	15 months
All stages	38,230.4	per annum (assuming a linear construction period)

The operational greenhouse gas emissions were estimated using a pro rata basis from POTL greenhouse gas inventory data for 2011, specifically the tonnes of CO_2-e/Mt of trade and tonnes of CO_2-e/ha. The annual greenhouse gas emissions projected to be produced during the operational phase of the Project are shown in Table B.11.16.

Table B.11.16 Projected Greenhouse Gas Emissions (Operations)

Year	t/CO_2-e	Based on Changes To
2015	3,140.6	trade tonnage
2020	4,259.2	trade tonnage
2025	4,789.5	trade tonnage
2030	5,980.0	trade tonnage
2035	6,567.8	trade tonnage
2040	6,926.1	trade tonnage
annually	1,879.8	size of port area

Port Expansion Project EIS

Part B

Section B12 – Waste

AECOM BMT WBM

B.12 Waste

B.12.1 Relevance of the Project to Waste Management

Ports and harbours generally act as the interface between marine vessels and the land-based waste disposal systems for wastes generated while at sea. In addition to vessel waste, port activities inherently produce their own waste through the loading and unloading of cargoes, effluents, and runoff from the in situ handling of raw cargo. Waste is also generated from port activities as a result of maintenance and upkeep of port infrastructure, as well as domestic waste generated by port employees and users.

Waste management is an integral part of planning for any new project. An appropriate level of planning needs to take into consideration each project phase (preconstruction and construction, operation and decommissioning) to ensure that appropriate waste management strategies and provisions are implemented to reduce potential impacts to the receiving environment.

The Port of Townsville Limited (POTL) currently operates its port activities under the Port of Townsville Environmental Management System (EMS). This system is certified to ISO 14001:2004 and includes waste management practices and performance reporting requirements to create a feedback loop to initiate ongoing improvement. The EMS only covers common areas of the port and POTL activites. Individual tenants are responsible for the environmental management, including waste management, in their own lease areas.

As part of future port operations a range of port tenants may use the Port Expansion Project (PEP). These port tenants would generate wastes, which would need to be assessed during the planning and approval phases for facilities proposed by these users.

The current EMS waste management practices and requirements will be extended to common areas in the PEP in the operational phase.

This chapter addresses Section 5.10 of the *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement* and the *Guidelines for an environmental impact statement for the Port of Townsville Port Expansion Project, Queensland (EPBC 2011/5979/GBRMPA G34429.1)* as they apply to waste. It specifically describes:

- the statutory framework, legislation and policies applying to PEP waste management
- the waste streams, including sources of waste that are likely to be related to port operations at the port and in particular for the PEP
- the potential impacts of individual waste types and associated practical mitigation measures for wastes generated during the construction and operational phases of the PEP.

This section addresses landside waste management. A separate Marine Operations Management Plan has been prepared to address the production and management of waste from ships while at sea. Details of the Marine Operations Management Plan are in Chapter C2.3, including the legislative and policy framework, waste reduction and management of wastes produced.

B.12.2 Assessment Framework and Statutory Policies

B.12.2.1 State Statutory Framework

Queensland legislation that is directly relevant to the control of wastes for the construction and operation of the PEP is:

- *Waste Reduction and Recycling Act 2011* and *Waste Reduction and Recycling Regulation 2011*
- *Environmental Protection Act 1994* and associated subordinate legislation:
  - *Environmental Protection Regulation 2008*
  - *Environmental Protection (Waste Management) Regulation 2000*
  - *Transport Operations (Marine Pollution) Act 1995.*

The *Waste Reduction and Recycling Act 2011* aims to reduce total waste generation by reducing resource consumption, increasing efficiency and recycling or re-use of wastes to avoid the need for disposal.

Waste is defined in s. 13 of the *Environmental Protection Act 1994* as being:

- leftover or an unwanted by-product from an industrial, commercial, domestic or other activity
- surplus to the industrial, commercial, domestic or other activity generating waste.

Queensland's legislative waste management framework provides a strategic framework for managing waste in Queensland. It establishes the principles for achieving good waste management and a preferred waste management hierarchy, which moves from the most preferred to least preferred method as waste avoidance, waste re-use, waste recycling, energy recovery from waste or waste avoidance, and waste disposal.

Under this policy POTL, and future tenants that may operate out of the PEP, are required to manage waste in accordance with the waste hierarchy. This policy also establishes the principle of polluter pays, which seeks to encourage the reduction in waste production through charging for its disposal.

As a result of implementation of this policy POTL and future tenants will need to prepare and maintain waste management plans. POTL and tenants, depending on their specific activities, will be required to maintain these plans to show how waste is reduced, handled, transported and disposed of. This includes recording waste generation for various waste streams to determine if waste reduction strategies are working and identify where improvements can be made.

The *Environmental Protection (Waste Management) Regulation 2000* gives state legislative support to various national guidelines, plans and standards, and also provides for a system that tracks specified wastes and obtains data on their generation, transportation and treatment/disposal in Queensland and interstate.

In Queensland state waters, the Department of Transport and Main Roads (Maritime Safety Queensland) administers the *Transport Operations (Marine Pollution) Act 1995* to protect Queensland's marine and coastal environment by reducing deliberate and negligent discharges of ship-sourced pollutants into state coastal waters up to three nautical miles offshore. This Act prohibits the disposal of oil, garbage, harmful substances, noxious liquid substances and sewage into coastal waters and gives government power to check that records are kept to validate the acceptable disposal of residuals from ships.

B.12.2.2 International and Commonwealth Statutory Framework

Australia is party to the *1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972*, now known as the London Protocol. The London Protocol limits the types of materials that may be considered for ocean disposal. The aims of the London Protocol are to protect and preserve the marine environment from sources of pollution and to prevent, reduce and eliminate pollution by controlling the dumping of wastes and other materials at sea.

Waters surrounding Australia's coastlines are protected from wastes and pollution by the *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act), which is administered by the Department of Sustainability, Environment, Water, Population and Communities. The Sea Dumping Act regulates the loading and dumping of waste at sea. This Act fulfils Australia's international obligations under the London Protocol.

The operational discharges from ships, such as sewage and galley scraps, are regulated through the implementation of the *International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978* (MARPOL 73/78).

MARPOL 73/78, to which Australia is a signatory, is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The current convention is a combination of the 1973 convention and the 1978 protocol, and entered into force on 2 October 1983.

The convention deals with all forms of waste disposal from ships and includes regulations aimed at preventing and reducing such pollution from ships through the five technical annexes covering oil, bulk noxious liquid substances, packages, sewage and garbage.

The Australian Maritime Safety Authority is responsible for the application and enforcement of MARPOL 73/78 and its annexes in areas of Commonwealth jurisdiction, which extends to the exclusive economic zone (up to 200 nautical miles offshore), through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*.

The *Quarantine Act 1908* seeks to protect Australians unique environment from harmful or invasive plant and animal species. Materials and substances, including waste products are subject to quarantine requirements, and where necessary specific handling and disposal as advised by the Australian Quarantine and Inspection Service (AQIS).

The *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* protects Australia's marine and coastal environment from the effects of harmful anti-fouling systems. This is achieved by defining offending uses of harmful anti-fouling systems by both Australian and non-Australian ships in Commonwealth waters.

The management of sea-borne and ship-generated waste will be through the implementation of a Shipping Management Plan, which has been prepared. Reference is made to Chapter 24 (Cumulative Impacts) for further discussion on the management of ship generated waste. This chapter will focus on landside waste management.

B.12.3 Existing Values, Uses and Characteristics

B.12.3.1 Existing Values

The Project Area and surrounding environments are typical of an urban/port/sea interface with waste matters primarily related to the port operations.

B.12.3.2 Existing Uses

POTL currently manages waste generated through POTL activities through its existing EMS and Port Environmental Management Plan (under development). The primary waste performance objective of this system is to ensure appropriate management for the handling and storage of waste materials in the common areas, using the following criteria to measure performance:

- waste materials are handled and stored in a safe and appropriate manner
- no environmental impact on, and disturbance to, the surrounding marine area from waste
- no pests are encouraged
- no mosquito breeding habitats are generated.

These criteria are achieved through the implementation of the port's existing waste management actions. These are:

- provide appropriate waste disposal facilities for domestic waste such as galley waste and guidelines for boat owners in mooring leases
- erect signage advising location of oily waste disposal sites and liquid waste reception facilities for sewage and other liquid wastes
- sewage pumped directly to the council sewerage system unless port tenant arranges transport to an appropriate disposal facility
- require permits for activities that may generate waste, e.g. vessel maintenance;
- Availability of services to visiting vessels.

These measures will be implemented and monitored in accordance with the Port Environmental Management System with ameliorative actions identified and reported as necessary to ensure waste is management to a high standard.

POTL tenants who undertake their own waste management are required through their lease agreement to maintain a high standard of waste management or be responsible for the costs associated with removing problematic waste.

B.12.3.3 Existing Waste Management Characteristics

A general outline of the waste types, sources and management practices is provided in Table B.12.1.

Table B.12.1 Summary of existing waste characteristics.

Area	Characteristic
Port operator/port tenants	▪ Responsibility as the operator/user for activities, offices, cargo handling and berth operation (when under their use). ▪ Includes stormwater management and disposal of road sweeper residue etc. ▪ Berth wastes not only includes the cargo (and any spills), but spare packaging, dunnage, road sweeper residue. ▪ Waste is managed under their approval or environmental management plan (it is a POTL requirement that tenants provide an environmental management plan and that this plan addresses waste). ▪ Zero discharge of contaminants (land or facility) under port notices. ▪ Recycling is the responsibility of each operator.
Shipping	▪ Responsibility of the shipping agent, in conjunction with AQIS and waste providers. Possible onboard wastes include: tank washings, chemical residues, sewage, exhaust scrubber wastes, oily bilge water, oily wastes and general waste. Onboard treatment required, e.g. shipboard treatment for sewage. ▪ AQIS is only interested in any quarantine risk and will not oversee disposal of other waste. ▪ AQIS involvement is in accordance with relevant legislation.

POTL activities	▪ Maintenance activities, offices, landscape maintenance, workshop, spill clean-up if managed by POTL.
	▪ Managed under the EMS and relevant controls.
	▪ Spills:
	  ▪ significant oil spills managed Queensland Coastal Contingency Action Plan
	  ▪ POTL construction or maintenance projects with substantial ranking (in POTL's Risk Assessment) will have required an emergency response plan
	  ▪ other spills are dealt with as per standard incident response.
	▪ Trade waste: POTL has a trade waste agreement with Townsville City Council; port tenants sign a trade waste agreement with POTL to discharge into POTL system.
	▪ Rubbish: general POTL rubbish bins (including common use areas) are routinely collected regardless whether full or empty. Currently this occurs three times a week with additional service that removes all the bins (to a secure location) prior to a cyclone.
	▪ Maintenance dredging:Environmental management issues related to maintainence dredging are covered in POTL's long term Dredge Management Plan.

Common user areas	▪ Under the control of POTL e.g. roads, general use carparks, ablution blocks, berths when not in use, Marine Precinct common area, unleased lands etc. managed by POTL. ▪ General rubbish, sewage,removed to licensed facility, suitably located and contained receptacles to prevent ingress and loss, e.g. vermin, insects, blown rubbish etc.

Possible receiving stations for waste generated by the PEP is listed in Table B.12.2.

Table B.12.2 Summary of Townsville Waste Disposal Facilities

Facility	Disposal and Resource Recovery
Landfill and Transfer Stations	
Hervey Range Landfill and Transfer Station, Hervey Range Road, Bohle Plains	Resource recovery facilities are available for mixed recyclables, cardboard, motor oil (less than 20 L), batteries, metal, tyres and greenwaste. Construction and demolition material is received and recovered on these sites, with the exception of the Picnic Bay Landfill.
Jensen Landfill and Transfer Station, Geaneys Lane, Deeragun	
Stuart Landfill, Vantassel Street, Stuart	
Waste Water	
Mt St John Waste Water Treatment Works	Disposal of wastewater from facilities and potentially from PEP construction activities.

In addition to solid waste services, Townsville City Council operates and maintains a reticulated sewage network, which may be used by port tenants for the disposal of wastewater. Tenants can also dispose liquid trade waste to the council operated network having applied for and obtained the relevant approval from council.

The existing waste infrastructure of the Townsville area has the facilities and capacity to accept waste products from the PEP.

B.12.4 Assessment of Potential Impacts

This section identifies the possible waste types and sources of waste generated by preconstruction, construction and operation of the PEP on sensitive factors such as land, water and air. While detailed quantification of the waste streams will be completed during preliminary design, this section outlines the likely waste streams and where possible, provides approximate volumes of the major wastes generated, to provide a sense of scale.

B.12.4.1 Key Waste Generation

B.12.4.1.1 Preconstruction Phase

Major infrastructure projects such as new road or rail corridors often have preconstruction activities to address such as relocation of services that must occur before construction works proper can begin. Pre-construction activities for the PEP are anticipated to include stockpiling of armour rock on the Eastern Reclaim Area and storage / laydown of some construction items.

The assessment of wastes generated is likely to be consistent with that presented for the actual construction activities planned for the PEP. Any preconstruction waste would be addressed in the same manner as the construction waste.

B.12.4.1.2 Construction Phase

Wastes that may be generated during construction include building waste from land-based construction activities, as well as dredging and tailwater waste generated by the deepening of the outer harbour to allow for future ship movement. Consideration of the dredging and tailwater management is dealt with in Chapter B3 (Coastal Processes), B4 (Marine Water), B5 (Marine Sediment Quality), B6 (Marine Ecology),

The main types and sources of construction wastes generated by the Project are listed in Table B.12.3.

Table B.12.3 Summary of Construction Waste Streams

Type	Generation
Concrete and bricks	Concrete mixture including sand, aggregate and cement, brick products and besser blocks and similar materials produced during construction of wharf facilities.
Timber	Timber materials typically used as formwork during construction, but can include packing crates from various construction materials.
Pavement and asphaltic products	Bituminous hydrocarbon products typically used for sealing hardstand areas. May include small amounts of other products such as concrete.
Metals	Primarily ferric metals may be generated, such as reinforcing offcuts. Standard construction wastes such as steel pile off-cuts, reinforcing steel off-cuts and used steel formwork may also be generated.
Hydrocarbons, chemicals and other liquids (excluding sewage)	Temporary workshops (if required) and facilities to provide dredging equipment maintenance, minor marine fabrication to support the dredging works, and for landside construction equipment maintenance are likely to be established on the site. This will generate minor workshop wastes typical for a marine mechanical plant maintenance workshop, such as spent lubricants, oils, anti-fouling paints. Because the major works for the Project will be staged over some 20 years, the amount of plant on site at any one time is expected to be minor and quantities of wastes will be relatively small.
Sewage	Sewage wastewater generated by construction staff in temporary ablutions facilities.
General office waste	Temporary offices, crib facilities and construction material storage areas are sources of general office waste. Construction will be in stages. Each stage will last approximately 2 years. Due to anticipated breaks between stages crib rooms would likely be dismantled between stages. Any waste associated with these facilities would be generated in bursts with no generation between stages.
Hazardous and potentially hazardous waste	Some hazardous and potentially hazardous waste may be produced. This may include certain chemicals or other non-hazardous materials contaminated by such chemicals. While no specific hazardous waste have been identified they will be considered and planned for during waste planning so they can be appropriately managed should they arise.

The BRE Group from the United Kingdom, have developed a web-based tool SMARTWaste Plan (BRE Group, 2012), to assist the construction industry prepare, implement and review site waste management practises. . As part of this, they have developed performance indicators for development projects, which can be used to estimate the amount of waste generation for a project.

For a civil engineering project, it is estimated that waste generation will be at 22.2 $m^3/100\ m^2$ of total project (floor) area. For the PEP, a 100 ha project, this equates to 0.2 Mm^3 of total waste generation spread over the 30 year construction period (includes all waste that can be recycled as well).

The total construction and demolition waste generated for Queensland was used to calculate the percentages for each of the categories. As detailed data for waste masonry materials does not exist for Queensland, the percentages of these categories were calculated from the Western Australian data, as the overall volume production was similar.

To estimate the amount of general waste that may be generated through the construction phase the per capita waste generation for commercial and industrial waste in Queensland was extracted from *Waste and Recycling in Australia* (Hyder, 2009).

Wastewater production was extracted from *Planning Guidelines for Water Supply and Sewerage Chapter 5 Demand/Flow and Projections*, *Table A. Indicative Average Demands/Flows from Commercial/Institutional Developments (litres/day)* (DERM, 2005).

The estimated construction waste generation rates for the PEP are presented in Table B.12.4.

Table B.12.4 Estimated Construction Waste Quantities

Waste Category	% of Total Waste Generated	Volume (m³)	Per Person
Asphalt	4.56%	10,000	NA
Bricks	16.60%	37,000	NA
Concrete	20.58%	46,000	NA
Other masonry	27.98%	62,000	NA
Metals	4.15%	9,000	NA
Organics	6.39%	14,000	NA
Paper and cardboard	0.46%	1,000	NA
Plastics	0.52%	1,200	NA
Other	0.45%	1,000	NA
Hazardous	18.33%	40,700	NA
Sewage	n/a	n/a	150 to 300 L/day
General office waste	n/a	n/a	13.3 kg/week

Construction waste generation estimates are based on other construction industry activities. Due to the nature and timeframe of the Project, ultimate totals and percentages of waste produced may vary considerably.

B.12.4.1.3 Operational Phase

Wastes generated by operational activities will come from three main sources:

- shipping waste from vessels arriving in port
- from the operational activities of the port including POTL offices, general maintenance activities in common areas, roads, workshops and common user berths when no ships present
- from operators/tenants who will have control of their specified site, certain berths and all shipping, loading and unloading when at berth.

Operational infrastructure, including shiploading equipment, storage sheds, and other supporting infrastructure and facilities will be the responsibility of the individual port tenants and the generation, handling and disposal of those operational wastes will be assessed under separate environmental assessments. Table B.12.5 provides further detail on each of these waste streams.

Table B.12.5 Summary of Operational Waste Streams

Type	Source	Generation
General garbage (mixed waste)	Shipping	▪ General mixed wastes which may include components of paper, plastics, metal and glass. ▪
	Port operations (common areas)	Comprised of wastes generated in the common areas, which is comprised of no more than 50% of any single material and may include paper, plastics, packaging, which may not be recyclable or suitable for separation into recyclable components.
Wastes from commercial cargo activities	Shipping and tenants.	Wastes from cargo e.g. spills, which may occur on ships or the port.
Hydrocarbons, chemicals and other liquid wastes (excluding	Shipping	▪ Waste oils and lubricants from ship maintenance. ▪ Oil water mixtures e.g. oily bilge water. ▪ Paints and chemicals generated during ship

Type	Source	Generation
sewage).		maintenance activities. ▪ Ballast water. ▪ Accidental spills.
	Port operations (common areas)	▪ Waste oils and lubricants from wharf machinery plant/vehicle maintenance and workshop. ▪ Paints and chemicals (including anti-fouling paints) used during ongoing port facility maintenance. ▪ Accidental spills.
Sewage	Shipping	Failure/leakage of onboard holding tanks or accident while discharging to sewer.
	Port operations (common areas)	Sewage from wharf common area facilities.
Maintenance dredged material	Port operations (ongoing maintenance)	Dredged material generated during the ongoing maintenance of the inner harbour channels to maintain required depths for shipping.
Hazardous waste	Shipping	▪ Batteries. ▪ Fluorescent and mercury vapour bulbs. ▪ Spills of chemicals or loss of drums that contain chemicals.
Quarantine Waste	Shipping	▪ Waste classified or deemed as quarantine waste by AQIS. ▪ Waste from quarantine bins. ▪ Organic waste (galley waste).

Based on the categories for operational waste, data from existing operations and the anticipated increase in shipping from the PEP, indicative waste generation rates have been calculated as shown in Table B.12.6.

Table B.12.6 Estimated Quantities of Operational Waste

Type	Current Generation Rate [1]	Generation Rate of Increased Vessels [2]	Total Anticipated Generation [3]
General garbage (mixed waste)	14 m³/month	9 m³/month	23 m³/month
Hydrocarbons, chemicals and other liquid wastes (excluding sewage).	16 m³ per vessel 11,680 m³/annum	16 m³ per vessel 12,032 m³/annum	32 m³ per vessel 23,680 m³/annum
Sewage	25 kL/day	16 kL/day	41 kL/day
Maintenance dredged material	400,00 to 500,000 m³/annum	400,00 to 500,000 m³/annum	400,000 m³ to 500,000 m³/annum or possibly less than existing total. No net increase
Hazardous waste	0.2 m³/month	0.13 kg/month	0.33 kg/month
Quarantine waste	156 kg/month	101 kg/month	257 kg/month

1 Based on 730 vessels per annum
2 Based on operations increasing by 470 ships per annum
3 Based on a minimum of 1200 vessels per annum

Due to the nature of the Project a number of methodologies were used for estimating generation rates including:

- general, hazardous and quarantine waste: calculated from site audit data provided by POTL and waste contractors (JJ Richards); average monthly generation rates were calculated and increased on a pro-rata basis to estimate future generation rates
- hydrocarbons, chemicals and other liquid wastes (excluding sewage): calculated from shipping waste data
- sewage: the current generation rate provided by POTL with increases based on industry standards
- maintenance dredged material: based on anticipated ongoing project maintenance as described in Chapter A3.

No estimated quantities of waste from commercial cargo activities have been made. No accurate estimate can be made of the likely amounts of waste from vessels to the variability of a number of factors such as cargo becoming waste due to spoilage or spills being highly unpredictable.

B.12.4.1.4 Decommissioning Phase

Waste will be generated during the physical demolition of the PEP infrastructure. The timing and relevance for such activities is in the future and as discussed in Part A, Section 3. It is unlikely that the base infrastructure of the PEP, comprising the reclamation, breakwaters and channels, would ever be removed. Consideration of decommissioning waste is not required; however, some general comments can be made regarding waste generation in the event of demolition.

Characteristics of the demolition wastes are related to the previous use of the site. Prior to any demolition works the site history would be well known with the land mass having been specifically created for the PEP (from reclamation). Any infrastructure/use would also be new and well documented. The PEP is to be constructed using conventional materials and standard construction methods. No unusual or high risk methods or materials will be required. Consequently, no special wastes are likely to be generated during demolition and waste types will be similar to those indicated for during construction.

The decommissioning of wharves is a routine process. Demolition typically involves the removal of the concrete deck and beams by sawing the deck into sections and removing by crane, or using excavator-mounted demolition hammers and recovering concrete spalls from the seabed using a dragline or long reach excavators. Removal of the piles is by vibratory equipment mounted on floating plant or more likely cutting off the piles at seabed level.

Operational infrastructure, including shiploading equipment, storage sheds, and other supporting infrastructure and facilities will be the responsibility of the individual port tenants. The generation, handling and disposal of those decommissioning wastes will be assessed under separate environmental impact assessments. In the same manner wastes from the decommissioning of these facilities would be addressed by separate site specific environmental assessments.

B.12.4.2 Key Waste Impacts

B.12.4.2.1 Preconstruction Phase

As no major preconstruction works are expected to be required for the PEP, little waste is expected to be generated during this phase. Preconstruction activities would be limited to office and organisational works, which may generate waste paper (This would be managed through existing POTL waste and recycling management practices and is unlikely to have any waste impacts) and stockpiling of rock and construction materials.

B.12.4.2.2 Construction Phase

Section B.12.3.3 established that construction waste can include a range of waste types from activities such as wharf construction and worker generated waste. Table B.12.7 identifies the potential construction waste impacts of the PEP and summarises the potential impacts of each waste type.

Table B.12.7 Summary of Potential Construction Waste Impacts

Aspect	Potential Impacts
Concrete and bricks	▪ Degradation of visual amenity. ▪ Degradation of water quality and increased turbidity.
Timber	▪ Degradation of visual amenity. ▪ Potential spread of contamination materials that have been in contact with wood. ▪ Fire hazard.
Pavement and asphaltic products	▪ Degradation of visual amenity. ▪ Potential toxicity to flora and fauna. ▪ Contamination of soils and sediment. ▪ Degradation of water quality and increased turbidity.
Metals	▪ Decomposition into soils, sediments and water.
Hydrocarbons, chemicals and other liquids (excluding sewage).	▪ Contamination of soils and sediments. ▪ Degradation of water quality. ▪ Toxicity to flora and fauna. ▪ Odours.
Sewage	▪ Degradation of visual amenity. ▪ Contamination of sediments through leaching. ▪ Odours. ▪ Public health risks.
General office waste (including plastics and paper)	▪ Degradation of visual amenity. ▪ Injury to terrestrial or marine fauna. ▪ Potential to encourage mosquito and pest breeding.
Hazardous and potentially hazardous waste	▪ Potential hazard to human health. ▪ Potential contamination of the environment. ▪ Toxicity to terrestrial and marine life.

B.12.4.2.3 Operational Phase

Section B.12.3.3 established that operational waste can include vessel waste generated from shipping, cargo transfer, shipping maintenance and general port maintenance. Table B.12.8 provides summary of these main potential waste streams by identifying possible sources, in addition to the potential impacts of each.

Table B.12.8 Summary of Potential Operational Waste Impacts

Waste	Impacts
Garbage (mixed waste) ▪ General office waste. ▪ Rubbish from maintenance and cleaning of common areas. ▪ General mixed waste from berth areas. Managed by operators and tenants when in use or POTL when vacant.	▪ Degradation of visual amenity. ▪ Entanglement or ingestion by marine birds and mammals.Potential to encourage pest and mosquito breeding. ▪
Wastes from commercial cargo activities (incidental waste, spills etc) in the port	▪ Degradation of visual amenity. ▪ Potential contamination of marine waters and benthic environment. ▪ Contamination of sediments.

Waste	Impacts
	▪ Potential toxicity to marine flora and fauna.
Hydrocarbons, chemicals and other liquid wastes (excluding sewage)	▪ Contamination of soils and sediments. ▪ Degradation of water quality. ▪ Potential toxicity to flora and fauna. ▪ Odours.
Sewage	▪ Degradation of visual amenity. ▪ Contamination of additional sediments through leaching. ▪ Odours. ▪ Public health risk.
	▪
Hazardous waste	▪ Potential hazard to human health. ▪ Potential contamination of the environment. ▪ Potential toxicity to terrestrial and marine life.
Quarantine waste	▪ Introduction of foreign pest species (terrestrial or marine) into Australia. ▪ Environmental, economic and community impacts.
Facilities maintenance waste ▪ Concrete, brick rubble material from any required maintenance activities.	Visual impacts from residual waste material stockpiles.

B.12.4.2.4 Decommissioning Phase

As discussed in Section B.12.4.1.4, as many elements of the PEP will be permanent, waste from decommissioning would be related to decommissioning specific berth related activities by tenants. These decommissioning activities would be the responsibility of the individual tenants to manage. Where wastes may be generated, for example during the decommissioning of old infrastructure, wastes will be similar to those generated during construction. Reference is made to Table B.12.4.

Exceptions to this include wharf and pile removal, which require specific consideration with regard to their condition. Less permanent features of the PEP will be addressed by environmental assessments for component developments on the PEP site. These will address in detail the specific decommissioning waste requirements for their facilities.

B.12.5 Mitigation Measures and Residual Impacts

Due to the environmental values of the port and surrounding waters, any works in or around the port require careful management of wastes to reduce their generation, and where they cannot be avoided, manage the risk of their environmental impacts through implementation of the waste management hierarchy as shown in Figure B.12.1.

Figure B.12.1 Waste Management Hierarchy

As part of implementing the waste hierarchy the following mitigation measures, will be put in place.

B.12.5.1 Pre-construction and Construction Phase

In order to mitigate potential adverse impacts of wastes that may be generated during the construction phase of the PEP mitigation measure listed in Table B.12.9 that may be implemented as appropriate.

Table B.12.9 Construction Phase- Key Waste Mitigation Measures

Waste	Mitigation Measures [1]
Concrete and bricks[2,3]	▪ Provide separate stockpile for waste concrete or brick products to avoid contamination with any other waste stream assisting its potential re-use. ▪ Re-use onsite as hard fill. ▪ Removal to recycling facility.
Timber[2,3]	▪ Provide separate stockpile or bin. ▪ Use excess or waste timber in other construction processes where possible.
Pavement and asphaltic products[2,3]	▪ Provide appropriate bunded and covered locations for the storage of asphaltic products. ▪ Re-use excess products either on or off site or dispose of appropriately.
Metals[2,3]	▪ Provide separated stockpile or bin for storage, one for each ferrous and nonferrous metal. ▪ Remove to recycling facility.
Hydrocarbons, chemicals and other liquids (excluding sewage)	▪ Provide specific waste bins/receptacles to isolate liquid wastes. ▪ Provide onsite storage and handling compatible with local recycling facilities to separate recyclable waste from non-recyclable waste. ▪ Avoid comingling with other waste streams. ▪ Store in appropriately bunded area.
Sewage	▪ Work with licensed contractor to accurately determine the number of temporary ablution facilities required during the construction phase. ▪ Sewage to be removed via a temporary connection to reticulated waste water system if possible.
General office waste	▪ Provide facilities for the appropriate separation of wastes for recycling. ▪ Engage licensed waste contractor to regularly remove and dispose of waste at licensed facilities and maintain waste disposal areas. ▪ Educate staff to reduce waste. ▪ Where possible source materials from suppliers who participate in the Australian Packaging Covenant. ▪ Implement *Recycling and Reusing in your Workplace* (SV, 2008a), *Reducing and Recycling Workplace Waste* (SV, 2008b), *Waste Reduction in Office Buildings, A Guide for Building Managers* (Resource NSW, 2002), or similar. ▪ Storage in sealed bins to reduce vermin attraction. ▪ Remove / reduce standing or water to minimise mosquito breeding potential.

Waste		Mitigation Measures [1]
	▪	Engage licensed pest contractor to manage pests.
Hazardous and potentially hazardous waste	▪	Maintain inventory and material safety data sheets for hazardous substances.
	▪	Store in appropriately bunded area.
	▪	Bring only the minimum required amount of any substance required by construction activities to site.
	▪	Store drums and storage containers when empty or containing residual amounts of substances in bunded area.
	▪	Collect empty drums for re-use or recycling.

1 Construction waste management would be undertaken in accordance with the *Code of Best Practice for Waste Processing in the Construction and Demolition Industries* (WMAA, Undated).

2 Consideration would be given to *Construction and Demolition Waste Guide – Recycling and Re-use Across the Supply Chain* (DSEWPC, 2012i).

3 Recycling and re-use of construction waste would be maximised through following the *Guidelines to the Recycling Policy for Buildings and Civil Infrastructure* (DPW, 2009).

B.12.5.1.1 Construction Waste Management

The following general waste management measures are proposed for the PEP during construction. Management measures would be incorporated into a Construction Environmental Management Plan as part of an overall waste minimisation strategy that utilises the waste management hierarchy (Figure B.12.1) as defined in Queensland waste management legislation. The Construction Environmental Management Plan will detail the waste management requirements and identify waste management responsibilities of personnel. Managing construction waste will include the implementation of the following:

- Construction wastes is not to be disposed to the marine environment or incinerated in vessels at sea.
- Construction waste (with the exception of clean fill) is not to be disposed into the terrestrial environment of the port or the reclamation area. Dredge spoil used as reclaim is a natural resources and not a waste.
- Specific waste management locations will be identified prior to the commencement of construction and designated collection bins or other appropriate containers will be supplied to facilitate waste segregation.
- Materials recycling or re-use on site will be encouraged (for example, rock armour from the existing breakwaters and revetments may be re-used in the construction of new structures).
- Loose waste and bins will be kept covered to secure waste to prevent wind, rain or animals spreading litter or contaminants through the Project Area.
- The Project Area will be maintained in a clean and tidy manner and waste will be progressively removed from site and not allowed to stockpile.
- The collection and transport of waste from the Project Area will be by licensed contractors and disposed of at waste disposal facilities licensed for the various waste streams.
- A complete inventory, including material safety data sheets, of chemicals to be used on site will be developed and maintained. Chemicals and fuels, including empty drums, are to be stored in appropriately bunded areas in accordance with relevant regulations. The volumes of these chemicals/fuels on site are to be kept below limits for notifiable activiters or if above these limits, appropriate permits and license are to be obtained.
- Any unknown or suspected contaminated material will be handled and disposed in accordance with legislative requirements.
- The movement and quantities of wastes and recovered materials on/off site will be recorded in accordance with legislative requirments.

- In the event of any of waste release into the environment (marine or terrestrial), the incident will be reported following the requirement of the Construction Environmental Management Plan and the relevant incident response plan. Appropriate spill clean-up procedures will be followed. An Environmental Incident Report and Corrective Action Report will also be completed as soon as possible, but within 24 hours of the incident occurring.

To address the waste management hierarchy as applicable to Queensland waste legislation, options for the construction contractor to consider are provided in relation to avoiding waste generation, re-use, recycling and appropriate disposal. Avoidance, re-use and recycling are presented in order of preference, where feasible.

Waste Avoidance/Reduction

- Accurately estimate quantities of materials required during the construction phase to reduce excess that could add to waste.
- Consider the whole-of-life environmental cost of products chosen for construction and ensure durability standard are high to prevent the need for ongoing replacement.
- Reduce transportation and handling of materials both within the Project Area and by suppliers.
- Formulate contractual clauses to encourage the good waste management practices.
- Design into construction stages measures to reduce waste generation and allow waste handling facilities to be incorporated. For example maintaining the separation of waste streams throughout construction to improve ruse and recycling where possible thereby avoiding waste going to landfill.

Waste Re-use

- Employ a waste contractor to collect recoverable materials from site.
- Crush concrete and brick materials generated in feasible quantities for re-use on and off site.
- Maintain a separation of waste streams to maximise the use of waste products, prevent the contamination of recoverable materials and prevent damage to unused materials so they may be used in other parts of the Project.
- Schedule works to maximise the use of excess or waste materials in the next component of work.
- Stockpile or store waste or excess materials appropriately so their re-use can be maximised
- Maximise the re-use of dredging spoil in reclamation areas.

Waste Recycling

- Where possible and permissible by engineering specification, preference the use of products that included recycled content.
- Advise contractors and suppliers to use recycled products or products with recycled constituent components where feasible.
- Investigate the use of alternative materials where possible to reduce the use of virgin materials; for example, the use of fly ash in concrete, where this will result in the same or better engineering strength.

Waste Disposal

- Maintain a record of waste generation including re-use and recycled material use and generation. Where possible required contractors to do the same or provide this information.
- Implement training to maximise awareness around waste reduction, re-use and recycling.
- Develop and implement procedures for the disposal of waste including standardised containers for different waste streams, signage, locations and stockpile management.
- Employ suitably qualified contractors for the management of wastewater from ablution facilities. Require proof of appropriate disposal (receipts from licensed facility) of wastewater.

- As soon as practically possible, remove for disposal waste with no potential for recycling or re-use; for example, non-recyclable wrapping/packaging, road sweeper waste, spill kit waste.

B.12.5.2 Operational Phase – Key Waste Mitigation Measures

A summary of key operational waste mitigation measures is listed in Table B.12.10.

Table B.12.10 Operational Phase - Key Waste Mitigation Measures

Waste	Mitigation Measures
Garbage	▪ Identify specific waste management locations in the Project Area during detailed design. Supply designated collection bins or other appropriate containers to facilitate segregation and encourage waste recycling or re-use. Use internationally recognised, and where possible ISO signage, to aid international visitors/crews to meet Australian Maritime Safety Authority and AQIS requirements for their waste and to prevent mixing. ▪ Keep loose waste and bins covered to secure waste to prevent wind, rain or animals spreading litter or contaminants through the port. ▪ Maintain the Project Area in a clean and tidy manner and progressively remove waste from site and do not allow to stockpile. ▪ Collect and dispose wastes from ships (liquid and other) by licensed contractors and at licensed waste disposal facilities. ▪ Remove any trade or regulated waste by a licensed trade waste contractor to a licensed reception facility. ▪ Store and remove garbage to mininise pest attraction and breeding potential.
Wastes from commercial cargo activities (incidental waste, spills etc.)	▪ Transport cargos in correct containers, which are maintained and handled in accordance with industry and manufacturer standards. ▪ Operators to implement appropriate training for staff involved in the handling of cargo.
Hydrocarbons, chemicals and miscellaneous liquid wastes	▪ Handle liquids in accordance with the appropriate material safety data sheets and manufacturer specifications. ▪ Transport and store chemicals in containers fit for purpose. ▪ Use spill kits to address spills as necessary. ▪ Call emergency services to assist with hazardous material spills.
Sewage	▪ Dispose greywater and sewage from the Project Area to the Townsville City Council local sewerage system. Prior to finalisation of the PEP design, provide Townsville City Council with likely flow volumes and trunk connection points for water and sewerage and undertake a network analysis to assess potential impacts on existing infrastructure. ▪ Individual port tenants to negotiate trade waste agreements with licensed contractors for removal of wastes not able to be disposed of to the domestic sewerage infrastructure.
Hazardous waste	▪ Port tenants to develop and maintain a complete inventory, including materials safety data sheets, of chemicals to be used on their respective sites. Store chemicals and fuels, including empty drums, in appropriately bunded areas in accordance with relevant regulations. Keep the volumes of chemicals/fuels on site to a minimum. Remove waste chemicals and fuels from the site by licensed waste contractors to approved waste facilities. ▪ Handle and dispose any contaminated material in accordance with legislative requirements.
Quarantine waste	▪ Record the movement and quantities of regulated and quarantine wastes. It is recommended that all waste be recorded where feasible to provide baseline data from which to assess future waste strategies; for example, to assess the effectiveness of reduction initiatives. ▪ Ships berthing at the Port of Townsville to adhere to relevant MARPOL annexes and other legislative requirements with regard to the disposal of quarantine wastes.

Operational Waste Management

POTL will be responsible for the management of operational wastes for common areas of the POTL and operations. Future tenants will be required to obtain separate statutory environmental approvals prior to commencing operations covering the handling and environmental management of their product. This will also include measures to manage waste.

The ongoing management of operational waste can generally be divided into two main areas:

- General port waste generated from port based activities including POTL operational waste and tenant operational waste
- Shipping waste including quarantine waste.

Port Waste

In order to manage the port's operational waste, common use areas and facilities will be managed via the existing waste management practices included in POTL's certified EMS. A description of the PEMP under development is provided in Section B.12.3.2.

For the new common areas, bins would be opportunistically checked by POTL and regularly emptied by the waste contractor, and the bin areas kept free of unsecured waste, as is currently the practice.

Lease agreements for POTL tenants will continue to include clauses that require the lessee to maintain high standard of waste management, or cover additional costs associated with the remediation, rectification or clean-up of waste and associated impacts.

In the event of any of waste release into the environment (marine or terrestrial), the appropriate manager will undertake an assessment of the situation, and appropriate spill clean-up procedures and notifications would follow. There are strict reporting requirements in the event of a marine incident occurring in Australian waters, which are also applicable to the PEP.

Specific details regarding the potential impacts of spills and actions to be taken in the event of spills, reference is made to Chapters B4 (Marine Water Quality) and B22 (Hazards and Risk).

Shipping Wastes

Ships at berth must arrange for the appropriate collection and disposal of wastes; quarantine or otherwise.

Quarantine waste must be kept in sealed plastic bags on board the vessel until arrival of the collection vehicle. These wastes are currently, and will continue to be, disposed of at a licensed quarantine waste facility.

Shipping wastes from ships berthing in the port are handled by the shipping companies themselves, and are not the responsibility of POTL. POTL port procedures require that shipping waste collection is organised by the shipping agent and handled in accordance with the Australian Maritime Safety Authority regulations. This occurs under the supervision of AQIS (for quarantine wastes), and includes the collection of liquid waste from the ship into road tankers by licensed contractors for disposal at a licensed facility.

The waste discharged from ships is small in volume and typically comprises:

- oil wastes (including oil, sludge and oily water) averaging 16 m^3/ship
- plastics, averaging 3 bins/ship
- cargo residues, averaging 2 bins/ship
- food waste, averaging 1 bin/ship
- incinerator ash, averaging 0.15 m^3/ship.

A sample of the waste contractors' records show that quarantine waste collected from ships averaged around 150 kg/ship, and was in the range 12 kg to 433 kg. Under the ultimate trade forecast scenario it is envisaged that up to 1200+ ship movements per annum may call at the port following the completion of the PEP.

Currently the only vessels discharging sewage into reticulated sewers or by pump-out to shore are cruise ships and military vessels. These vessels may only occasionally berth in the outer harbour.

Similar arrangements will apply to future common user berths in the port including the new outer harbour; that is that the tenant of each facility or berth will be responsible for the collection and disposal of the shipping waste generated by the ship at each berth, under the supervision of AQIS where quarantine waste has been identified.

B.12.5.3 Residual Impacts

The planning for and implementation of appropriate waste management practices and controls can help to ensure the efficient use of resources, limit the release of waste into the receiving environment, and provide for the safe handling, transport and disposal of waste materials.

POTL has a policy of zero discharge of contaminants both on port facilities and on land and water, and requires that the potential for spills and contamination is ‘designed out’ wherever possible to avoid or reduce spillage. Port Notices advise shipping companies and facility operators that it is the responsibility of port tenants and vessels to conduct any developments, activities or operations in accordance with the applicable legislation.

Penalties are imposed for any action contrary to POTL’s environmental management requirements and directions. Port Notices require that any incidents with potential to cause environmental harm as defined in the *Environmental Protection Act 1994* on POTL land , must be reported to POTL, Department of Environment and Heritage Protection and the relevant local authority if the incident requires notification under the Act.

As discussed above, waste generated by the construction and operation of the port, including shipping activities if not managed appropriately, can have negative impacts on the receiving marine and terrestrial ecosystems, water quality and amenity. Waste can be generated on vessels and in facilities at the port. It is important that this waste be managed with respect to reducing, re-using, recycling and finally disposing of wastes.

POTL manages wastes in the common areas of the port and waste generated by POTL under its EMS. This includes the implementation of waste management practices in accordance with legislation and regulations. This system seeks to reduce waste, prevent pollution, promote efficient use of resources, reduce environmental impacts, and continually improve environmental and management system performance.

The current waste management requirements under POTL’s EMS will be extended to common use areas in the PEP and future tenants will be required to implement required waste measures suitable for this site and in accordance with separate approvals sought prior to commencing operations.

With the range of ongoing and proposed mitigation measures in place for wastes resulting from the PEP any residual would be appropriately managed.

B.12.6 Cumulative Impacts

It is expected that increased activity (both in ship movements and cargo throughput) generated by increases in forecast trade through the port will result with more wastes being generated. These activities coupled with other projects in the region have the capacity to have cumulative impacts on both terrestrial and marine ecological values if not properly managed. Potential cumulative impacts for inappropriate waste practices and disposal are similar to those identified for the PEP and include:

- increased generation of solid and liquid wastes from vessels
- increased waste from port operations due to increased activity, maintenance and staff
- increased potential for accidental release of liquid and solid waste material into the receiving environment due to increased vessel activity and cargo handling

- increased potential for intentional (illegal) dumping of various types of waste at sea
- increased potential for land and water contamination
- increase potential for pests and vermin
- reduction in visual amenity.

Increases in the quantity of wastes also places increased pressure on existing waste facilities and the regional sewerage system. Consultation with the Townsville City Council will continue to ensure that appropriate planning of waste infrastructure is undertaken to ensure sufficient capacity is available.

As part of impact assessment and planning, future regional projects would assess and implement appropriate waste management practices and measures to reduce their impacts on the ecological values, and demonstrate compliance with legislative requirements which will reduce such cumulative impacts. Consultation with infrastructure providers will also ensure future planning of likely waste disposal in the region. The PEP is not expected to result in significant impact due to the type and likely quantities of wastes generated and implementation of waste management procedures and practices.

B.12.7 Assessment Summary

The construction of the PEP will generate a variety of waste that requires appropriate storage handling management and disposal to reduce impact on the environment, community and existing port users. Opportunities exist to reduce, re-use and recycle waste materials generated by the PEP and where feasible and practical these need to be fully implemented.

A Construction Environmental Management Plan has been prepared (Chapter C2.2) and will be implemented through the construction phase of the PEP to promote the efficient use of resources, limit the release of waste into the receiving environment, and provide for the safe handling, transport and disposal of waste materials. The placement and management of dredging spoil will be undertaken in accordance with the Dredge Management Plan.

Waste generated by port operations and shipping activities can have negative impacts on the receiving marine and terrestrial ecosystems as well as on water quality and amenity if not managed appropriately. Waste can be generated on vessels and in facilities at the port. It is important that this waste be managed with respect to reducing, re-using, recycling and finally disposing of wastes.

POTL manages wastes in the common areas of the port under its EMS, which includes waste management practices in accordance with legislation and regulations. This system seeks to reduce waste, prevent pollution, promote efficient use of resources, reduce environmental impacts, and continually improve environmental and management system performance.

The current waste management practices and requirements under POTL's EMS will be extended to port operations in the common areas of the PEP. Future tenants will be required to implement waste measures in accordance with separate approvals sought prior to commencing individual operations.

Port Expansion Project EIS

Part B

Section B13 – Social Environment

AECOM BMT WBM

B.13 Social

B.13.1 Relevance of the Project to Social Values

The Port Expansion Project (PEP) represents a major expansion of port land area and infrastructure adjacent to the CBD of Townsville. The port has played a significant role in the economic development of Townsville and has influenced its social characteristics in the process, both adjacent to the immediate port area and more broadly across the city as a whole. The port has also played a significant role in supporting much of the prosperity in the region by providing access to larger markets overseas and interstate for its products.

The principal aim of this social impact assessment is to identify potential changes in the social characteristics of the area resulting from the PEP at the local, district (i.e. across broader Townsville), regional and state levels. Potential adverse impacts are identified and mitigation measures have been recommended in order to safeguard social values of the local and regional community

Townsville's capacity to accommodate growth of the scale that is represented by the PEP is an important factor in it enabling to realise the beneficial impacts that are expected to result from the PEP and in helping to mitigate the magnitude of any adverse social impacts. The principal benefits are expected to primarily result from the strengthening of Townsville's job and housing markets through additional direct and indirect employment that is to be provided by the PEP. Further indirect social benefits are expected to result from increased trade potential through greater port capacity resulting from the PEP.

The PEP has been assessed in terms of existing social assessment frameworks and statutory policies. These have helped establish the framework for social value sets and responses, through land use and other strategic plans for the area. Community consultation has also played a significant role in the evolution of the PEP's concept stages leading up to the Environmental Impact Statement process. Key findings of the community consultation have been summarised and used to identify social values and perceived impacts that are considered important to the community in the vicinity of the PEP.

Community baseline information has been compiled representing the social footprint of the local area of influence (Study Area), including information about the demographic and existing social infrastructure characteristics, as well as settlement, land use and tenure patterns that are most likely to influence key social values. This information has been used to supplement the overall description of the social characteristics of the Study Area. Additionally, workforce characteristics are assessed in terms of the Project's needs and Townsville's projected available labour force. Additional demographic data has been collated using Australian Bureau of Statistics 2011 Census data where it was available at the time and used to compare against the information for the Study Area.

B.13.2 Assessment Framework and Statutory Policies

This section reviews key state, regional and local strategic frameworks and policies that aim to influence social values and characteristics of the Study Area through visions, objectives, desired planning outcomes and key principles that are focused on sustainable growth management and service provision. The frameworks and policies represent preferred government objectives that take into account and balance a range of policy objectives that have been tested and amended as a result of their own public consultation processes. The key frameworks and statutory policy documents align with those that influence land use considerations affecting the PEP and the Study Area as discussed in Chapter B1 (Land).

B.13.2.1 Queensland Regionalisation Strategy

The *Queensland Regionalisation Strategy* (DLPG, 2011b) identifies key economic objectives for regional growth and economic development. The PEP has a key role in facilitating many of the economic objectives of the *Queensland Regionalisation Strategy* through its intended role to enable expanded trade of bulk goods (including minerals) from the region. This growth and economic development is also expected to influence the region's capacity to provide increased employment opportunities and access to a greater variety of goods and services for the region's communities.

The *Queensland Regionalisation Strategy* sets state-wide social outcomes that focus on promoting sustainable regional communities as centres offering residents the full range of opportunities in life through career and education, housing affordability options and provision of amenities that contribute to liveability. It also has a specific objective focused on 'supporting Townsville to develop as a vibrant integrated metropolitan city, with strong inter-regional and international connections' (DLPG, 2011b). Development of the PEP is consistent with this objective.

B.13.2.2 Queensland Infrastructure Plan

Although the *Queensland Infrastructure Plan* (DLPG, 2011a) does not directly identify key social outcomes, it represents a potential delivery tool for the prioritisation, funding and progression of key infrastructure projects of state interest. These projects, including large infrastructure projects such as the PEP, can be used as a catalyst for other social benefits that flow through to the community. In the case of the PEP, these benefits relate to economic growth and prosperity, which in turn can lead to greater potential for government and private sector investment into the region, thereby contributing to the enhancement of amenity, safety and wellbeing through civic works, services and improved management. Development of the PEP is consistent with this objective.

B.13.2.3 North West Regional Plan

The *North West Regional Plan* (DLPG, 2010) is focused on encouraging sustainable growth in the region, much of which is expected to come about through its mineral and agricultural wealth. The plan identifies social planning, improved social infrastructure and social services as key needs of the region. Facilitation of further mining and minerals exports as well as increasing agricultural diversity and production for export are identified as key ways of creating additional wealth and investment for the region.

The port has a strong relevance to the *North West Regional Plan* through the other planning documents that it recognises, including the *Northern Economic Triangle Infrastructure Plan 2007–2012* (DI, 2007b). The PEP has the potential to directly facilitate economic growth, consistent with that which the *North West Regional Plan* identifies as being important to the provision of better social services and facilities for the region and in turn contributing to the improved wellbeing of the region's residents.

B.13.2.4 Townsville Futures Plan: A Second Capital for Queensland

The *Townsville Futures Plan*: *a second capital for Queensland* (TFPT, 2011) identifies a vision for Townsville that is based on economic prosperity, sustainability, and liveability. The vision is for a 'second capital' in which its people, lifestyle, need for more employment and skills diversity and social equity principles play important roles in addition to recognising the need for growth. Good urban design is recognised as an important factor in the city's future development not only for land use efficiency purposes but also to maintain a vibrant city that promotes social and cultural creation, diversity and wellbeing amongst its residents.

The port is recognised as important in this vision as it has the potential to play a key role in facilitating a significant part of the growth that can contribute to the area's economy and the ability to enable injection of capital into secondary additional employment and services.

B.13.2.5 Northern Economic Triangle Infrastructure Plan

Social and community development forms a key part of the *Northern Economic Triangle Infrastructure Plan 2007–2012* (DI, 2007b) vision for North West and North Queensland. The plan recognises Townsville as the key centre for social services and infrastructure for the northern economic triangle. The other points of the 'triangle' are Mt Isa and Bowen. The port is seen as a critical factor in the implementation of the plan.

B.13.2.6 Port Development Plan 2010–2040

The *Port Development Plan 2010–2040* establishes the strategic principles and directions for the port's development. Although much of the plan is focused on development aspects for the port's expansion, the directions that it identifies have been based on stakeholder liaison and negotiation in an effort to ensure that the port's future and growth also reflects business and social outcomes sought by the community. This forms an important part of the plan's '*Working Together*' approach (POTL, 2010a).

B.13.2.7 Port of Townsville Land Use Plan 2010

Integration and enhancement of the port's development with the surrounding community forms a key part of the *Port of Townsville Land Use Plan 2010* (POTL, 2010b) strategic vision. Recognising and reducing the impacts of development on the character, amenity and heritage of the area form the basis for the plan's strategic outcome focused on 'community identity and diversity'.

Specific outcomes to achieve this include:

- continued cooperation with Townsville City Council, relevant state authorities and adjacent residential and commercial communities to reduce adverse impacts
- reducing amenity impacts from development (including, but not limited to noise, light, odour, dust and stormwater)
- the provision and maintenance of buffers between port facilities and adjacent urban development
- a high standard of design that incorporates good site layout, building design, landscaping and sustainability principles
- the management, protection and conservation of Indigenous cultural heritage management areas by traditional owners and other Indigenous groups through cultural heritage management plans
- cooperation with the port community to assist in compliance with security and safety requirements for operations in the port

The port also seeks to ensure that social and environmental impacts associated with transport systems development and operations are reduced (POTL, 2010b).

B.13.2.8 Townsville Community Plan 2011–2021

The *Townsville Community Plan 2011–2021* (TCC, 2011a) provides the underlying direction for Townsville's development as a community and the role played by the Townsville City Council. The plan establishes the community objectives for the area, based on extensive consultation and is expected to translate into and throughout the council's operations. The objectives of the four themes identify key social values considered important to the community:

- Strong, connected community
  - *The Townsville community has a diverse make-up of cultures, community groups and backgrounds which are recognised as key strengths in the community and these elements need to be embraced and nurtured. It is also identified that a well-connected community builds a strong community.*
- Environmentally sustainable future
  - *The community values the natural environment of Townsville and recognises it as a key aspect of their lives. The community wants Townsville to be a leader in environmental sustainability, including embracing the use of renewable energy.*
- Sustained economic growth
  - *The community identified the importance of continuing to build a strong, balanced economic base for the city. This vision can be achieved by continuing to embrace new technology and providing avenues for skill development and employment opportunities.*
- Shaping Townsville
  - *The community believe it is important that Townsville is well-designed, taking into account the local climate, while also preserving heritage and traditional characteristics. The community also believe it is important that any planning for the city is done proactively and facilitates lifestyle choices, including transportation, diversity of services and open space facilities.*

B.13.2.9 Townsville City Plan 2005

The *Townsville City Plan 2005* outlines desired environmental outcomes that reflect values and qualities that are regarded as important to the Townsville community (TCC, 2005a). Desired environmental outcomes that have social implications include:

- Economic vitality

    - *A prosperous, productive and sustainable economy that is diverse and equitable, fulfilling and a major servicing role for the North Queensland region.*
- Infrastructure and services
    - *A community with an appropriate level of access to services, where infrastructure is provided efficiently and effectively, contributing to a high standard of living for residents and meeting ESD* [ecologically sustainable development] *responsibilities.*
- Transport and mobility
    - *Relationships between land uses, and the facilitation of mobility between places supports an efficient and sustainable transport system that provides a high level of access to services and facilities to all members of the community.*
- Health and safety
    - *Built form and design addresses the need to sustain safe, clean and healthy living environments and also recognises the climatic and geophysical conditions of Townsville and their potential extremes.*
- Sense of place and community
    - *An enriched feeling of sense of place through the recognition of the cultural diversity and identity of the community and inherent city character.*
- Equality and equity
    - *All sectors of the community have convenient and equitable access to employment and recreation opportunities, commercial and community services, facilities and activities.*
- Environmental management
    - *The city has a sustainable natural environment comprising genetic diversity, a range of healthy habitats, biological communities and ecological processes which can be enjoyed by residents and passed on to succeeding generations.*
- Heritage and character
    - *Development complements the prominent character of the city and recognises the need to conserve or enhance the areas and places of special aesthetic, architectural, cultural, historic, scientific, social or spiritual significance.*
- Settlement pattern
    - *Development occurs in a manner that reflects the structure plan and transport networks (of the plan).*

The desired environmental outcomes provide the overall direction for new development that is impact assessable under the provisions of the *Sustainable Planning Act 2009* and much of the general direction for the *Townsville City Plan 2005* as a whole. In addition to desired environmental outcomes, the *Townsville City Plan 2005* divides the area over which it has jurisdiction into districts and precincts, which are intended to group development and specify precinct outcomes and controls through codes. Specific code controls are set for certain types of development, irrespective of the planning precincts in which they are intended to occur (TCC, 2005a).

Chapter B1 (Land) provides a description of the planning districts and precincts that are in the vicinity of the port. The precincts provide a basis for the aggregation of land use units (e.g. residential, commercial, industrial) that heavily influence the type of social values that are likely to be characteristic of those areas.

Under the provisions of the *Transport Infrastructure Act 1994*, development on Strategic Port Land is not affected by the provisions of the *Townsville City Plan 2005*. POTL recognises the importance of the *Townsville City Plan 2005* in integrating port development with the surrounding areas, including managing social impacts.

B.13.2.10 Townsville Land Use Proposal (2011-2036)

The council has prepared a draft *Townsville Land Use Proposal 2011-2036* (TCC, 2011c), which identifies the strategic intent that will inform the preparation of its new planning scheme. The proposal recognises the need to maintain economic, environmental and social sustainability for the city through appropriate land use planning controls. Key strategic outcomes of the proposal that affect the city's social sustainability are:

- the character and identity of communities in urban and rural areas of Townsville is protected and enhanced
- the unique architectural, cultural, historic, scenic, natural, social or spiritual qualities of places are conserved and enhanced
- high levels of accessibility are provided to community services and facilities, open space and opportunities for active and passive recreation, as well as places to celebrate culture, history and identity
- a high quality network of open space and recreational opportunities provides for the diverse recreational needs of the community, facilitates social interaction, enables connection to nature and the landscape and reinforces the city's core identity
- good urban design reinforces community spirit and identity, together with the creation of public space and streetscapes that are attractive, safe, accessible and usable.

Although port land, once it is included as Strategic Port Land, is not subject to the provisions of a local planning scheme, it is useful to consider the intent of the intended local planning scheme to determine the consistency of proposed port infrastructure with the overall planning of the city.

B.13.2.11 CBD Master Plan

The *CBD Master Plan* (TCC, 2011e) seeks to ensure that Townsville's CBD is positioned as the vibrant 'second capital' of Queensland and Australia's 'Tropical Gateway' to the world. The master plan seeks to guide the revitalisation of the CBD and its surrounding areas through more responsive planning and development. The master plan seeks to ensure that the location and interaction of future development occurs in a way that maximises social, economic and environmental benefits through a number of key principles:

- a city of experience
- an accessible and connected city
- a liveable city
- lifestyle through natural amenity
- a compact, active and vibrant city heart
- safety and security
- a sustainable city
- historical built form

As a 'sustainable city' the CBD is to encourage efficient resource consumption, reducing impacts on the environment and providing strong social and cultural engagement. The master plan recognises that social concerns about environmental issues have become a driver for development outcomes. Social issues should be considered more holistically with other development considerations as part of the CBD's planning and decision-making and to leverage existing environmental and social strengths (TCC, 2011e).

Locations around the port, including the Palmer Street Precinct, parts of South Townsville, the Ross Creek eastern foreshore linking Palmer Street to the port (i.e. near Berth 10A) and the Breakwater Marine Precinct are identified as important locations in the master plan and the intended revitalisation of the CBD area (TCC, 2011e).

B.13.3 Existing Values, Uses and Characteristics

The existing social values and characteristics potentially affected by the PEP are described and assessed below in terms of:

- social and cultural area of influence

- community engagement process
- social baseline assessment, which includes:
  - demographic characteristics
  - land use and land tenure characteristics
  - Indigenous social and cultural characteristics
  - significant social infrastructure
  - key social values
  - settlements or locations most likely to be affected
  - workforce profile.

Workforce information for the PEP and Townsville has been assessed to predict the likely impact on availability of sufficiently skilled people required during the construction and operational phases of the PEP and potential impacts on the requirement for housing, services, or on other social characteristics of the area surrounding the port.

B.13.3.1 Social and Cultural Area of Influence

This section identifies the Project's social and cultural area of influence at the local, district, regional and state levels. It takes into account:

- the potential for social and cultural impacts to occur
- the location of other relevant proposals or projects
- the location and types of physical and social infrastructure, settlement and land use patterns
- social values that might be affected by the Project
- Indigenous social and cultural characteristics
- use of the harbour/port area for commercial and recreational boating and fishing.

The PEP has the potential to affect social values at different scales in terms of its area of influence, which have been assessed at the state, regional, district and local levels. Social values that are likely to be affected at the state and regional levels tend to be economically focused, while those at the district and local levels have a greater emphasis on environmental, amenity and lifestyle issues. Economic issues still play a role in determining social values at these levels. The regional, district and local areas of influence are shown in Figure B.13.1 and are further described below.

PORT EXPANSION PROJECT
EIS

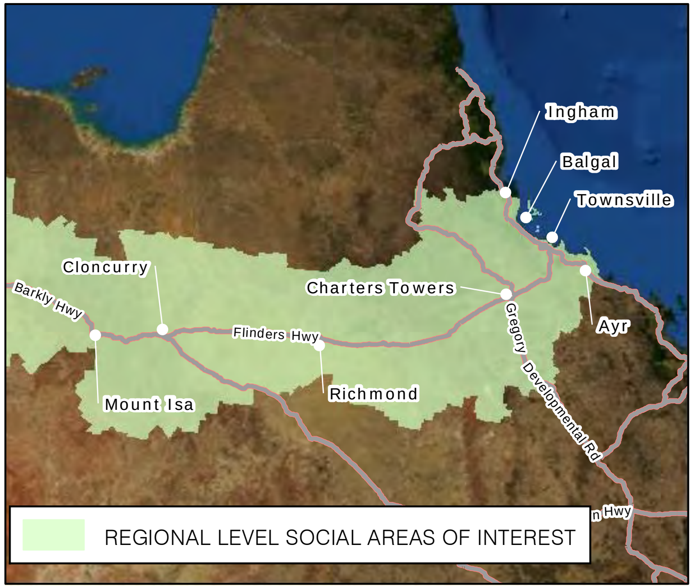
Regional, District and Local Social Areas of Influence of the PEP

Figure B.13.1

Regional Level Social Areas of Interest

Scale: 1:13,500,000 (when printed at A4)

0 250 500 Kilometres



District Level Social Areas of Interest

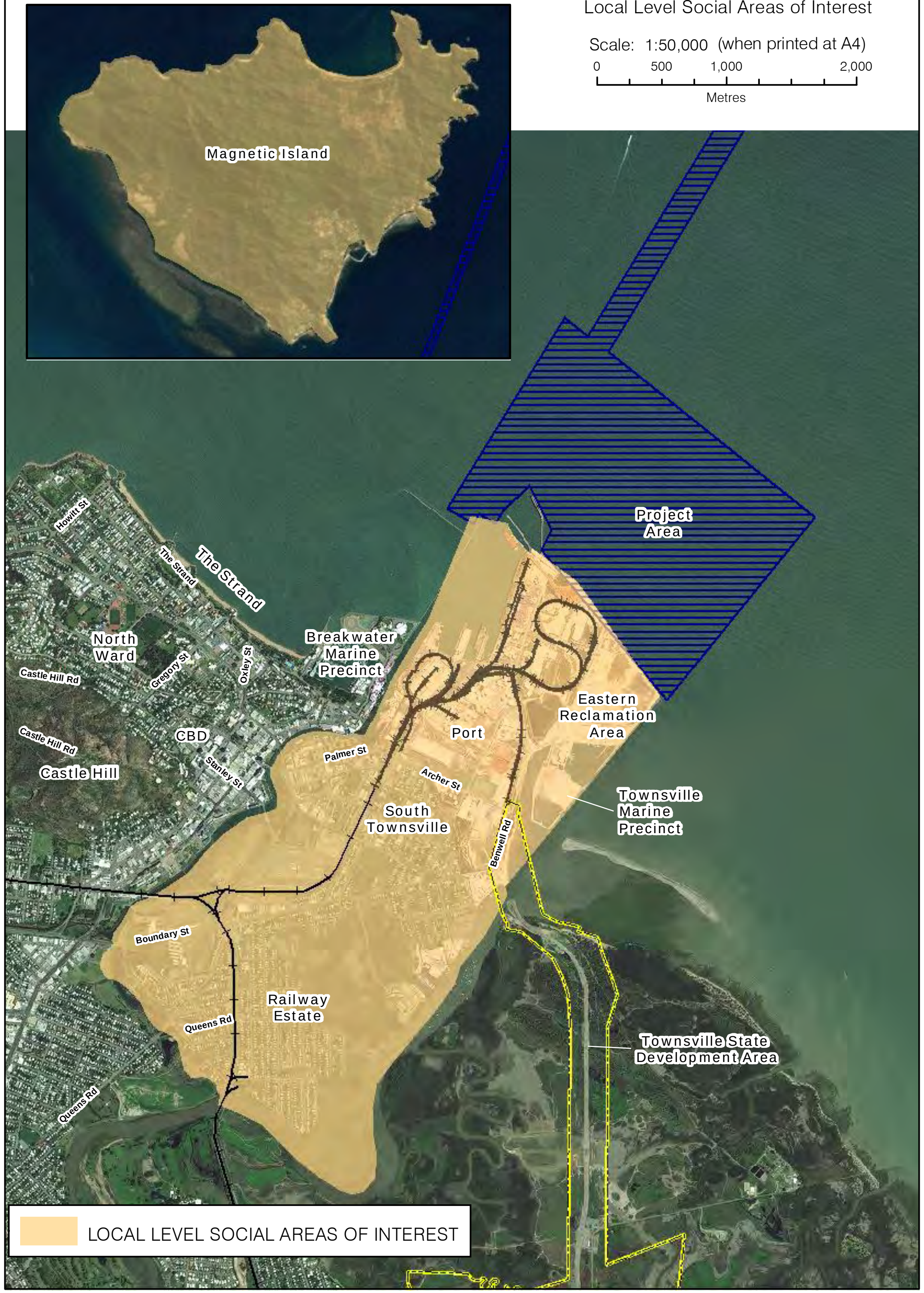
Scale: 1:3,000,000 (when printed at A4)

0 50 100 Kilometres

Local Level Social Areas of Interest

Scale: 1:50,000 (when printed at A4)

0 500 1,000 2,000 Metres



Legend

- Highways
- Railway Line
- Project Area
- Townsville State Development Area

PROJECT ID 60161996

LAST MODIFIED CFS 23-Oct-2012

FILE NAME 60161996_PLN_089

B.13.3.1.1 State Area of Influence

State social significance of the PEP is primarily reflected through its economic effects on the state's capacity to derive revenue from:

- Increased royalties through increased mining and associated mineral production for trade
- state taxes and charges on businesses that benefit from increased trade and associated economic growth
- potential additional port dividends
- increased state domestic product.

In principle, increased trade is expected to lead to increases in state revenue providing the state with greater capacity to invest in infrastructure and services across the state.

Increased trade through the port is directly linked to the capacity of the surrounding region to supply goods for export and the demand created for imports. The mining sector's need to get minerals to overseas markets, particularly from the North West Region is likely to be a major driver in the demand for port capacity to meet increased demand. Increased mineral production is also expected to lead to a corresponding increase in royalties, which has a direct effect on the state's budget and its capacity to pay off debt and fund social service and infrastructure initiatives at the state level.

Major infrastructure, such as the port, also plays a significant role in the creation of direct and indirect employment opportunities for the state. Apart from the additional services that can be provided through additional employment in areas, increases in the workforces and their families contribute to an increase in the size of the state's economy, the trade of goods and services and the ability to generate additional wealth in communities for further investment. Growth associated with increasing market size can also have a significant impact in terms of thresholds that can be reached for different levels of service to become available which might otherwise be difficult to sustain.

B.13.3.1.2 Regional Area of Influence

The *Queensland Regionalisation Strategy* identifies Townsville as being located in the North Queensland region (DLPG, 2011b). This region includes the local government areas of Townsville, Hinchinbrook, Burdekin, Charters Towers, Palm Island, McKinlay, Richmond, Flinders, Cloncurry and Mount Isa, and coincides with the regional level of influence shown in Figure B.13.1. Townsville is the main centre for this region and the port is key to the region's trade linkages to external markets for products produced and consumed in the region.

The North Queensland region characteristics are described in Appendix P1 (Community Profile and Demographic Data). The region stretches for a distance of approximately 905 km between Townsville and Mount Isa. The majority (72%) of the region's residents reside either in Townsville, the coastal councils of Burdekin and Hinchinbrook, or Charters Towers Regional Council. The remainder is located in a number of small settlements along the Flinders Highway between Mount Isa and Townsville, including Charters Towers, Hughenden, Richmond, Julia Creek and Cloncurry. Mount Isa is the largest western centre with an estimated resident population of just over 22,300 people in 2011 (OESR, 2012c). It provides services to much of the north-west parts of the region. Land uses in the region, other than in Townsville and the other town centres, is largely agriculturally based with cattle grazing being the main agricultural pursuit west of Charters Towers and sugar cane and other cropping being the main activities in coastal locations.

Mining for minerals also plays a significant role in helping to shape the region's land uses with major mines being located at Cannington near Julia Creek, Ernest Henry near Cloncurry and at Mount Isa adjacent to the main town centre. Mining is predominantly for base-metals including copper, lead, silver and zinc. Gold mining is also undertaken in the Charters Towers Regional Council area. Other minerals that exist in the region include magnetite (a form of iron ore), uranium and phosphate. Presently most minerals are transported by rail to Townsville for processing and/or shipping to overseas markets through the port, with some minor amounts transported by road.

Prosperity and maintenance of population levels (many centres in the western parts of the region have experienced declining populations) as well as encouraging growth are important factors for western towns as is maintaining affordability for housing and goods. The *North West Regional Plan* (Section B.13.2.3) reflects this situation by deliberately focusing on growth issues and by not introducing additional regional planning controls through state planning regulatory provisions (DLPG, 2010). In comparison, the coastal areas, focusing on Townsville, are more about managing growth.

Key social issues facing the communities of the region are the retention of populations in the smaller centres, lack of and access to services, as well as the cost of living due to remoteness of the area and lack of capacity to cater for rapid changes in demand (e.g. housing) resulting from sudden changes in economic activities such as mining. Economic prosperity is seen as key to achieving social wellbeing and efficient access to markets for products is an important part of this.

Key social issues confronting the coastal councils in the region include ensuring that adequate services can be kept commensurate with population growth and that character and local identity, preservation or enhancement of amenity, lifestyle integrity and social wellbeing are maintained and balanced against the benefits of growth.

B.13.3.1.3 District Area of Influence

The district level of influence is represented by the Townsville City Council area and includes the Townsville CBD as the key regional centre, as shown in Figure B.13.1. The Townsville City Council area has the largest population in Northern Queensland, with an estimated 2011 resident population of just below 190,000 people and is expected to have a growth rate of 2.2% per annum until 2031. The council area is approximately 3,733 km^2.

The port is a major infrastructure facility that not only services the district and region, but is also a key land use feature that influenced the settlement pattern of Townsville.

Current key residential growth areas include along the ‘Northern Beaches’ (including Bushland Beach) of Townsville (some 25 km from the port) and continued growth in other parts of the city. Future urban expansion is expected to take place at Rocky Springs, approximately 15 km to the south-east of the port. This location includes new residential development, commercial centres and community services with some industry, although industrial development (including manufacturing and service industries) are principally concentrated in Garbutt and Bohle. Major mineral processing facilities are also located at Yabulu (nickel) and Stuart (copper processing and zinc).

The location of the port and the PEP, being physically removed from the urban expansion areas in Townsville, is expected to primarily have a social and an economic influence on the communities of those areas and on much of the population of Townsville. This is expected to manifest itself in the potential to directly generate additional employment opportunities during the construction and operational phases of the PEP and through additional indirect employment. Growth in the regional economy that the PEP is expected to facilitate is also likely to lead to greater investment potential in the district, and for services and community infrastructure, which would lead to an improved lifestyle. The PEP, due to its distance from the key urban growth centres of Townsville is not expected to directly affect the amenity or lifestyle of the residents of those areas.

The CBD is the main business and entertainment area for the district and is identified as the ‘city heart’ by the *Townsville Futures Plan* (TFPT, 2011). The CBD is also a significant focus for the district with the location of the Museum of Tropical Queensland and the Reef HQ Aquarium. The Breakwater Marine Precinct, apart from providing medium density housing, is also one of Townsville’s key marina facilities and the Jupiters Townsville Hotel and Casino is a regional entertainment, convention and tourist accommodation facility.

The CBD is socially important, not only as a place of employment, but also as a centre for entertainment, culture and services. This is reflected in the land uses, which include major offices, cinemas, theatres, entertainment centres, social venues (including clubs, bars and pubs) and cultural venues. The CBD has a direct link to the natural marine environment of Cleveland Bay and the Great Barrier Reef. Ongoing planning of the CBD by the council and others (e.g. through the *CBD Master Plan* (TCC, 2011e), which has been substantially supported by the Townsville Chamber of Commerce) continues to identify these roles as being fundamental to the CBD’s ongoing development and to the social wellbeing of the city as a whole (TCC, 2011e).

The role of the CBD as a link to recreational and commercial opportunities has been important to Townsville’s development as a centre and plays a significant role in helping to define Townsville’s northern tropical lifestyle. Ongoing access to Cleveland Bay and the Great Barrier Reef and the maintenance of these environments is expected to continue to play a significant role in the wellbeing of much of the community who use the marine environment as a means of recreation through boating and other water and shore based activities.

The social role of the CBD is reinforced by its land use planning as contained in the *City Plan 2005*. This has resulted in the identification of 'functional precincts' that focus on business/employment, entertainment, culture, recreation and services (TCC, 2005a). The port is recognised as a key part of the urban landscape of the CBD. The need to ensure that the built and social environment of the CBD and the port, as a key industry, remain complementary to each other is also recognised. This approach continues to remain strong with more efforts being focused on ensuring physical integration of the port's Berth 10 facilities with the Palmer Street Precinct along the Ross Creek foreshore through the identification of additional transitional uses, enhanced urban design and the creation of additional public spaces in a pedestrian friendly, landscaped foreshore setting.

Key social values of the district that are significant to the port and the PEP are the desire to maintain the CBD as a vital, business, residential and business heart for the district and to ensure that the integrity of this aim is not compromised by inappropriate development. Ongoing management of potential environmental and other effects on the communities that live in proximity to the port and visit the area will be important in maintaining the integrity of the social values of the CBD.

B.13.3.1.4 Local Area of Influence

The local area of influence (Study Area) includes the suburbs of South Townsville, Railway Estate and Magnetic Island, as these are the most likely to be directly affected. The mainland suburbs are bordered by Ross Creek to the west, Ross River to the east and south, and the port to the north (Figure B.13.1). Magnetic Island forms a separate unit in Cleveland Bay. South Townsville and Railway Estate have a strong association with the port, having been the original location of its workforce as well as those workers in other industries that were either dependent on or complemented the port during the its early formation and development. Although parts of North Ward and the CBD may also experience 'localised' effects from the PEP, they have not been included in the Study Area due to their partial affectation.

The Study Area has many older residences that date back to the late 1890s and early 1900s, making it sought after for its 'character precinct' values. This feature is important both from a land use perspective and also in terms of how the residents relate to their community. Protection of heritage and character from incompatible new or excessive development is recognised as an important aspect of the area's planning needs. Maintaining a vibrant social character forms a part of this objective.

Magnetic Island has a number of small coastal village centres that are used for residential development and short-stay accommodation for visitors. The island is a popular holiday and day-trip destination for people wishing to relax, socialise at a number of entertainment venues or enjoy the diverse natural beauty of the island. Much of the island is steep, vegetated and undeveloped reserve land. The island plays an important role as a means of escape for much of Townsville's population.

The Ross River and Ross Creek waterways have become important locations for recreational boating and marine commercial activity. Chapter B1 (Land) has identified key land uses that are located on the waterways.

Foreshore reserves also play a significant part in contributing to the access and amenity of the waterways and are located along the western foreshore of Ross Creek (some of which is identified as Strategic Port Land with the rest as a Council maintained reserve), Ross River and Magnetic Island.

Visual amenity, liveability, wellbeing, safety and a sense of community are social values that are most likely to be significant in the Study Area. These values are also reflected in the planning principles of the *City Plan 2005* (Section B.13.2.9) and the *CBD Master Plan* (Section B.13.2.11).

The outer harbour and reclamation area for the PEP currently forms part of Cleveland Bay. This area is occasionally used for commercial and recreational fishing purposes; however, data for these activities is not readily available (Chapter B1). Fishing and boating represent important social activities for people in Townsville. This is balanced against other priorities and needs such as employment and access to services.

B.13.3.2 Community Engagement Process

Consultation and community engagement was used to gather information from stakeholders including government agencies, relevant interest groups and local residents about their attitudes regarding existing conditions and interests relating to the port. Community engagement included:

- consultation with state agencies, including briefing sessions
- community information sessions held in Magnetic Island and Townsville
- a 1 800 phone number for callers to leave comments
- Community Consultation Feedback Form
- radio announcements, letter box drops and newspaper notices advertising the community information sessions
- dedicated webpage material
- preparation and distribution of fact sheets

A full list of stakeholders, methods used to engage with stakeholders, content of the material distributed, and the responses received from the consultation process are considered in Section A2. The information received has been used in the assessment of potential social impacts that may result from the PEP.

The Community Consultation Feedback Form was a key tool in identifying general community values and qualities considered important by respondents. The survey was designed to obtain responses concerning:

- important community qualities (i.e. regarding the ‘ideal community’)
- likes and dislikes about the existing community
- most important issues presently facing the community
- perceived impacts of the PEP

The summarised responses reflect community perception of values and priorities by respondents at the time irrespective of the PEP. This information has been included in the social baseline study presented below and has also been summarised and used to assess potential social impacts associated with the PEP.

B.13.3.3 Social Baseline Study

The social baseline study includes reference to community profile and demographic data that has been prepared for the EIS as a separate technical report (Appendix P1). It also draws on the assessment of the characteristics of the social and cultural area influenced by the PEP identified in Section B.13.3.1 and the findings of the community engagement process described in Section A2. The community profile information identifies the key demographic characteristics of the Study Area and compares the area with the broader Townsville City Council area, the North Queensland region and Queensland, where relevant data is available.

The information used in Appendix P1 is based on ABS (2011a) census information using published community profile information for small statistical areas or Office of Economic and Statistical Research (OESR) tables contained in their *2012 Queensland Regional Profiles* (OESR, 2012a). Where 2011 census data or 2012 OESR estimates were not available, ABS 2006 census data has been used. The full suite of 2011 census demographic data will not be available until November 2012. The community profile and demographic data provides a quantitative analysis of the population likely to be affected by the PEP and compares the information across the different levels of social and cultural areas of influence. The matters assessed in the community profile and demographic data in Appendix P1 are:

- population and households
- labour force
- housing and accommodation
- socio-economic indices for areas
- population and community profile projections

Apart from the demographic characteristics of the area, the following matters have been considered for the social baseline study as required by the *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement* and are discussed below:

- current social infrastructure
- settlement patterns
- land use and land ownership patterns
  - number of properties directly affected by the Project
  - number of families directly affected
- use of social and cultural areas for recreation, culture and business
- community values and characteristics

B.13.3.3.1 Population and Households

The estimated resident population of the Study Area was 7,838 persons in 2011. This was an increase of 1,007 people from 2006 (OESR, 2012d; OESR, 2012b). The increase in population is indicative of the strong growth in the construction of residential apartments during this time.

There were 3,120 occupied dwellings in the Study Area in 2011, which equates to a ratio of 2.51 persons per occupied dwelling. This is lower than the 3.11 ratio at the district and regional level and 2.96 ratio for Queensland during the same time. This lower occupancy ratio is likely to reflect the generally older population and higher proportion of households with no children living at home.

The ratio of households with no children has increased in the area since the 2006 census from 44% to 47%. This has been against the trend of a corresponding decrease in households with no children at the district, regional and state level. The increase in households with no children is likely to be reflective of the area's higher proportion of apartment style development; a large proportion of which only have 1 or 2 bedrooms. This trend is expected to increase over future years as the area is identified for significant growth in high density residential development, which is based on similar types of development. Families with children are expected to concentrate in the largely outer urban growth areas of the district. The Study Area is expected to be increasingly characterised by a middle to older aged population that have fewer (if any) children living at home and who are able to afford accommodation (mortgage or rents) for units in the area. The demographic characteristics of the Study Area are also likely to be reflected in other social characteristics and needs of the Study Area over time.

Overall, the Study Area already has a significantly older population with 42% of the population aged over 45, compared to 33% at the district and regional level, and 38% at a state level.

In 2011, the local community was predominantly English speaking (86%) with the majority (76%) of people being born in Australia. Although the area is heavily influenced by people with an Australian background, it also has a higher proportion of people that were born elsewhere (17%) compared to the district (13%) and region (14%), but not as high as the state (21%).

Based on the 2006 census information, 39.1% of the local community has a certificate level qualification or better, compared to 37.7% at the district level, 34.9% at the regional level and 37.6% at the state level (Table 5, Appendix P1). This higher level of qualification is not reflected in income levels for the area. There was a slightly higher combined proportion of people with weekly incomes of less than $999 (64%) than the district and region (both 61%), but lower than the state (67%) (Table 6, Appendix P1). The higher proportion of people with a lower income is likely to be reflective of the age of the population of the area, with 12% of the population aged over 65 compared to 10% at the district and regional level (Table 3, Appendix P1).

B.13.3.3.2 Labour Force

Labour force characteristics for the areas of influence are shown in Tables 7 to 10 of Appendix P1. The Townsville labour force is diverse in terms of the level of skills available and the sectors that the labour force services. No one sector holds more than 11% of the total labour force. This is comparable to the state average for employment in different sectors. The Study Area has a higher proportion of people employed in the accommodation and food services sector compared to the region and state (Table 9, Appendix P1). This is likely to be indicative of the area's close proximity to the short-stay accommodation and entertainment precincts of the CBD, the Breakwater Marina Precinct (including Jupiters Townsville Hotel and Casino) and the Palmer Street Precinct.

The Study Area also had a slightly higher proportion of people employed in the construction industry than for the other areas of influence. This may be indicative of a range of factors including the proximity of the area to construction activity, the likely higher disposable income of construction workers who are likely to be single or with no children and the attractiveness of the area as a place of residence in terms of its proximity to entertainment and services. The area is likely to be able to benefit from these characteristics of in terms of its ability to attract a construction based labour force.

Since the 2011 Census, Townsville has seen a considerable increase in military personnel moving into the city, which has traditionally had a role as a 'garrison city' and as a staging post for military activity in overseas theatres of engagement. Since the beginning of 2012 approximately 1,500 people that are associated with the Australian Army's 3RAR battalion have moved into Townsville, including 680 soldiers who have not been accounted for in census figures. It is expected that many of the single military personnel are likely to have taken up residence in apartments, including some around the port. Many of these personnel will be classified as 'public administration and safety', which makes up 10.5% of the labour force for the Study Area, compared to 12.6% and 6.7% for the district and state respectively.

Reliable unemployment figures for the Study Area that are based on the 2011 census are not yet available. The 2006 census estimated that the Study Area had an unemployment rate of 5.1%. This was higher than the district (4.4%), region (4.3%) and state (4.7%) at that time. More recent figures for 2011 made available through the OESR (Appendix P1) indicate that the unemployment rate for the district and region has risen since 2006 to 6.0% and 5.9% respectively. Based on past trends, this is also likely to be reflected in the figure for the Study Area.

Of the local labour force, 61.7% works within 5 km of the Study Area (Table 11, Appendix P1). The dominant mode of transport to and from work is by private vehicle (63.2%), although a higher proportion of workers use public transport (9.4%) compared to the district (2.5%), region (2.6%) and Queensland (7.1%). The use of active transport (walking or cycling) is also higher at 10.7% compared to 6.3% in the district, 7.2% in the region and 5.2% in the state. This is likely to be due to proximity to a range of employment opportunities in the CBD and surrounding area. The high rate of public transport use is likely to be reflective of the inclusion of Magnetic Island residents who are dependent on ferry transport (classified as public transport) and who may also use buses once on the mainland. The Study Area is also well serviced with bus transport to other parts of the city.

B.13.3.3.3 Indigenous Representation

Townsville and nearby Palm Island have significant Indigenous populations in their respective communities. Indigenous peoples are generally integrated throughout the Townsville community, with a separate Indigenous community on Palm Island. Townsville acts as an important service centre for Indigenous communities throughout the region, providing health, counselling, training and representation services and assistance. Regional Indigenous service requirements are also recognised at a government level and a number of government agencies have units located in Townsville that provide Indigenous services and implement government Indigenous services and programs (e.g. Department of Aboriginal and Torres Strait Islander and Multicultural Affairs).

The Indigenous history of Townsville is extensive, both in terms of the peoples' association with land and sea and their interaction with non-Indigenous history and European settlement of the area. Chapter B15 provides a more detailed assessment of Indigenous history and cultural association in the area.

Indigenous social values relating to the area surrounding the PEP are now largely through spiritual association only; much of the area has been transformed through previous port development. This spiritual association also applies to the PEP development footprint. Stronger and more active associations apply to the natural foreshores, estuaries, creeks and inshore reefs of Cleveland Bay, which are used for fishing, hunting, other food gathering and meeting purposes. These areas will not be affected by the PEP.

Approximately 355 residents of the Study Area were classed as Indigenous in 2011, based on OESR data for the area. This represents 4.5% of the population and is significantly lower than at the district (6.1%) and regional (7.3%) level, but higher than the state level (3.6%). Higher proportions of Indigenous people live in the South Townsville and Railway Estate areas (5.8% of the population), than on Magnetic Island (2.7% of the population.

The *Indigenous Employment Policy for Queensland Government Building and Civil Construction Projects* (*IEP 20% Policy*) (DEEDI, 2008) applies to all Queensland government-funded buildings and civil construction projects in specified Aboriginal and Torres Strait Islander communities. Townsville is not deemed to be an applicable community under this policy. All other state funded projects to a value of over $250,000 for buildings or $500,000 for civil construction are to have a minimum of 10% of labour hours undertaken by Indigenous workers under the *Queensland Government Building and Construction Contracts Structured Training Policy* (*10% Training Policy*) (Skills Queensland, 2008).

The Commonwealth Department of Education, Employment and Workplace Relations, *Indigenous Opportunities Policy* (DEEWR, 2011) prescribes that where the Project involves Commonwealth expenditure of over $5 million ($6 million for construction) in regions where there are significant Indigenous populations, officials must consult with the Department, the Commonwealth Indigenous Coordination Centres and the community council or group in the planning stages of the project and require tenderers to submit in their tender a plan to provide employment and training opportunities for local indigenous communities and for the use of any small to medium enterprise indigenous suppliers.

The *Indigenous Opportunities Policy* applies to activities associated with projects that are conducted under a contract that is the result of a Commonwealth procurement process. Should POTL or individual prospective suppliers become associated with any Commonwealth procurement processes for the Project that exceed the threshold, the provisions of the policy may apply.

Although Commonwealth and state government policy frameworks may apply to the port to different extents depending on circumstances, POTL has had a practice of continuing to actively engage with the local Indigenous communities through port-based training and employment initiatives for port operations. These practices are consistent with the objectives of the *Indigenous Opportunities Policy* and the *10% Training Policy* and will form a key part of the port's further and ongoing engagement with Indigenous communities, in addition to its fulfilment of any of its statutory responsibilities, as discussed in the Cultural Heritage Management Plan referred to in Chapter B15 and the employment analysis in Chapter B19 (Economic Environment).

B.13.3.3.4 Housing and Accommodation

Housing in the Study Area comprises predominantly single dwellings, but also has a higher proportion of apartments (25%) compared to the district (13%), the region (1%) and Queensland (12%). This is reflective of the area's close proximity to the CBD and the suitability of areas adjacent to the CBD for high density residential development. Increases in the proportion of apartments are likely to continue due to the limited opportunity for further single house lots and strategic intent by the council to enable apartment-based development to increase in key locations in the area (e.g. adjacent to Ross Creek on the Southbank development site).

Median house prices for the area at $343,000 were lower than for Townsville overall ($365,000) during 2011. Median unit prices were significantly higher for the area; $450,000 compared to Townsville at $325,000. This is likely to be reflective of the largely older style dwelling houses in the area and the more modern, higher quality apartments, many of which have views of the city or Cleveland Bay and are in close proximity to the CBD and its associated services and entertainment. The higher price for apartments indicates an acceptance to pay a premium for apartments in the area. This can also have an effect of making the area less affordable compared to others.

Household tenure for the area indicates a higher proportion of people renting (43%) compared to the district (37%), the region (36%) and Queensland (33%), which is likely to be reflective of a more transient population. This was demonstrated in the 2006 census where only 65.8% of the population resided at the same address one year previously, compared to 70.2%, 71.2% and 74.1% for the district, region and state level, respectively. People that do stay in the area for longer than five years, tend to stay marginally longer (39%) than people in the district (38.5%).

B.13.3.3.5 Socio-economic Indices for Areas

Socio-economic Indices for Areas for the Study Area indicate that it generally experiences a higher level of disadvantage compared to the district with the exception of the education and occupation indexes. Although these indices provide an overview of the socio-economic conditions for the area, it is likely to be difficult to attribute change to the effects of the PEP over the life of the Project compared to other socio-economic influences during the same period.

B.13.3.3.6 Population and Community Profile Projections

Tables 21 and 22 of Appendix P1 indicate that the population of the Townsville is forecast to grow strongly to an estimated population of around 295,500 by 2031. This represents an average annual (compound) growth rate of some 2.2% per annum, which is higher than the 1.8% forecast for Queensland over the same period. The Study Area is expected to have a lower growth rate (1.23% per annum), which is expected to translate to a population of just over 10,000 people by 2031 compared to the present population of nearly 7,900 people. Notwithstanding that some additional development capacity is expected for the area, the lower forecast growth rate for the Study Area is likely to be a result of the overall more limited capacity for additional dwellings into the future than was able to occur for the same length of time previously.

As the population of Townsville grows, the city is also expected to become progressively more 'aged' increasing to an average of 38.5 years of age from 33.5 years of age in 2011. This is expected to occur with fewer people in households, decreasing from an average occupancy rate for all dwellings of 2.58 to 2.42 by 2031. Although an increase in the number of dwellings is expected for the area, an agreed figure is yet to be determined. At present, the need estimated by council's *Townsville Residential Land Use Study 2011* (Urbis, 2011) is more than double that predicted for the area using OESR population growth estimates to 2031(2,373 dwellings versus approximately 905 dwellings). The higher figure includes short-stay accommodation, especially for tourists, which may account for some of the discrepancy. Most of the growth for the area is expected to be centred on the Palmer Street Precinct and the South Bank development on Ross Creek in Railway Estate.

B.13.3.3.7 Current Social Infrastructure

There are no formal state-wide social infrastructure assessment guidelines or definitions for Queensland. The practice of the state in the past, including for this EIS, has been to rely on the definitions in the social infrastructure planning guideline of the superseded *South East Queensland Region Plan 2005–2026* (DIP, 2009), which identifies such infrastructure as including community facilities, services and networks that help individuals, families, groups and communities meet their social needs, maximise their potential for development, and enhance community wellbeing. This includes specific uses such as child care centres, art galleries, emergency services, schools, medical facilities and community sport and support groups.

Social infrastructure for the Study Area has been classified into six categories: educational, cultural, recreational, medical, civil and open space. Table B.13.1 outlines the identified social infrastructure in the Study Area.

Table B.13.1 Social infrastructure in the Study Area

Category	Railway Estate	South Townsville	Magnetic Island
Educational	Education facilities in the area range from preschools to secondary schools. Three kindergartens, three preschools, three primary schools and one high school operate in the area. Each suburb in the area has access to a preschool and primary school. The only high school is in Railway Estate. There are no adult education facilities in the area, although the CBD has a campus of the Great Barrier Reef Institute of TAFE. Larger educational facilities located outside of the Study Area include James Cook University in Douglas (approximately 13 km from Railway Estate) and the Great Barrier Reef Institute of TAFE at Pimlico (approximately 4 km from Railway Estate). There are also a number of privately operated specialist education facilities for hair dressing, beauty treatment and performing arts located in the CBD.		
	▪ Townsville State High School ▪ Railway Estate Primary ▪ Village Kids Kindergarten ▪ Wee Care Family Inc.	▪ Townsville South Primary and Preschool ▪ C and K Koolkuna Kindergarten and Preschool	▪ C and K Magnetic Island Kindergarten ▪ Magnetic Island State School ▪ Magnetic Island Preschool
Cultural	The principal cultural facility located in the area is the Townsville Civic Theatre located in Railway Estate along Boundary Street. This facility hosts a range of performances and exhibitions that attract local and international performers and artists. South Townsville is also home to the Townsville Maritime Museum, which operates on Palmer Street and the Townsville 400 V8 Races. The pit facilities at Reid Park for the races serve as a place for carols and music festivals during non-race times. The nearby CBD has additional cultural facilities including the Dance North Dance Theatre, which is a leading North Queensland dance academy and the		

Category	Railway Estate	South Townsville	Magnetic Island
	Perc Tucker Art Gallery. Magnetic Island's History and Craft Centre Inc. and Magnetic Museum are the premier cultural facilities on the island. The History and Craft Centre seeks to preserve the history and cultural heritage of Magnetic Island and to establish, maintain and promote an active museum facility.		
	▪ Townsville Civic Theatre	▪ Maritime Museum of Townsville	▪ Magnetic Island History and Craft Centre Inc ▪ Magnetic Museum
Recreational/ entertainment	The area has a number of recreational facilities for the local community. These facilities include two lawn bowls greens, two marinas (including the Townsville Yacht Club Marina), the Townsville 400 V8 Raceway Track and a range of passive recreation parks through the area. The area is also close to cinema facilities in the CBD, with the Townsville Entertainment Centre and Jupiters Townsville Hotel and Casino located in the Breakwater Marina Precinct next to Ross Creek next to the Study Area (note: facilities that are not within the Study Area are not listed in this table). The Study Area near the port also has a strong tradition of pubs and hotels that stems from early stevedores and sailors frequenting the area during times when ships were in port. Many of these pubs still remain and have been supplemented through new hotels, bars and restaurants along Palmer Street. Collectively, this provides a diverse range of pubs and other social venues in the Study Area, which also provide important recreational and entertainment opportunities including live music, eating and beverages for the district as a whole. Magnetic Island has a number of venues that provide similar opportunities in a largely unique island setting that is within close proximity and with ready access to the CBD.		
	▪ Townsville 400 V8 Raceway ▪ Various hotels and pubs	▪ Townsville Yacht Club Marina ▪ South Townsville Bowls Club ▪ Various pubs, bars, restaurants and hotels	▪ Magnetic Island Golf Course ▪ Magnetic Island Bowls Club ▪ Magnetic Island Marina ▪ Hotels, bars, restaurants
Medical/Dental	Seven medical facilities and allied health service providers were identified in the area. Magnetic Island has the highest concentration of medical services, which is most likely a result of its distance and constrained access to the mainland. There are three hospitals that are within 8 km of Railway Estate and South Townsville: Mater Women's and Children's Hospital, Mater Hospital Pimlico and Townsville General. There are no operational hospitals within the Study Area While residents on Magnetic Island would have difficulty accessing these hospitals, the island's Health Centre in Nelly Bay caters for accident and emergency treatments. No aged care or retirement facilities were identified in the area.		
		▪ Townsville Surgical Centre ▪ North Queensland Therapy Services ▪ All About Teeth, Boundary St	▪ Magnetic Island Health Centre ▪ Magnetic Island Medical Centre ▪ Horseshoe Bay Medical Centre ▪ Sullivan Nicolaides Pathology Magnetic Island Collection Centre ▪ Magnetic Island Pharmacy
Community	A number of community facilities operate in the area. These facilities range from community meeting centres, emergency services and a post office. Residents in the suburbs of Railway Estate and South Townsville are located close to other community services located in the Townsville CBD, which include government welfare offices, council chambers and charity agencies. While Magnetic Island has limited access to the community facilities located on the mainland it is the only suburb in the Study Area to have all three emergency services. The Study Area is close to CBD-based Indigenous representative groups that are involved in Indigenous welfare, employment services or cultural representation. They are Aboriginal and Torres Strait Islander Advisory Council, Inclusion Support Agency, 'Yarnin' Circle, and The North Queensland Land Council.		

Category	Railway Estate	South Townsville	Magnetic Island
	▪ Railway Estate Community Centre	▪ South Townsville Neighbourhood Police Beat ▪ South Townsville Fire Station	▪ Magnetic Island Police Station ▪ Magnetic Island Fire and Ambulance Station ▪ Magnetic Island Post Office Shop
Open Space/Recreation	Residents in the Study Area have access to 12 identified open space areas, parks, environmental reserves and natural features. The largest of these is the Magnetic Island National Park, which is approximately 2,790 ha. This national park acts as an important breeding and feeding ground for listed species. Other prominent public spaces in the area include Central Park, Victoria Park, Reid Park and Horseshoe Bay Park (Magnetic Island). In addition to the listed facilities, a major boat ramp facility is located in close proximity to the port on port land at the Breakwater Marine Precinct on the western shore of Ross Creek.		
	▪ Reid Park ▪ Railway Estate Park ▪ Lou Lister Park ▪ National Park ▪ National Park Boat Ramp (Barnacle Street)	▪ Foley Park ▪ Victoria Park ▪ Dean Park ▪ Central Park ▪ Neville George Maritime Park	▪ Picnic Bay Foreshore ▪ Horseshoe Bay Park ▪ Magnetic Island National Park ▪ Boat ramps (various)

Other key cultural, entertainment and recreational facilities that are outside of the area but in close proximity include:

- cinemas (CBD)
- dance and performance theatres – various (CBD)
- Museum of Tropical Queensland and Reef HQ Aquarium (CBD)
- performance venues for live bands – various (CBD)
- Jupiters Townsville Hotel and Casino (Breakwater Marine Precinct)
- Townsville Entertainment Centre (Breakwater Marine Precinct)
- picnic and children’s water park facility (The Strand)
- beaches (The Strand)

These facilities play a significant social role in providing diverse activities for the local, district and regional communities and form a key part of the city’s planning. Their distance from the PEP is likely to ensure that the social values that these facilities address will not be adversely affected.

B.13.3.3.8 Settlement Patterns

The PEP, which will form a key part of the port, is contiguous with South Townsville, which provides the mainland access to the port. The port is a key part and determiner of the city’s settlement pattern characteristics through its attraction of port-dependent and complementary industries that have established around the port and a corresponding need to have other non-compatible uses, including residential uses, located away from the port or be designed in a manner that is not adversely affected by port activity.

Transportation routes have also played an important role in shaping settlement patterns especially in South Townsville and Railway Estate. As the port has grown, so too has the amount of rail and road traffic that has accessed it. Over time, the level of vehicle movements to and from the port has grown with the overall increase in traffic throughout Townsville, including significant increases in heavy vehicle movements along Boundary Street. Rail traffic associated with the port has also increased to 24 hours per day, 7 days per week operations. Residential properties located along these routes may have progressively experienced a diminution of residential amenity compared to times where the level of transport to the port was far less.

As the demand for transport to and from the port has increased, controls influencing settlement patterns have come into effect aimed at reducing land use conflicts. This has gradually led to, and is likely to continue to see, restrictions on further residential intensification along such routes and a replacement of residential-based uses away from these locations. At the same time, growth of the port has tended to see an abandonment of port land close to residential areas to prevent conflict with the port moving further seaward through reclamation and modernisation of port facilities to meet changing demands.

The construction of the TPAR through the TSDA is expected to alleviate some of the impacts of heavy traffic to and from the port along Boundary Street through South Townsville. Other vehicular traffic is not expected to significantly impact the area as a result of the TPAR, especially along Boundary Street or other streets through South Townsville that connect with Boundary Street as no left turns from TPAR into Boundary Street or right turns from Boundary Street into TPAR are anticipated to be permitted. This is intended to reinforce TPAR’s role as a heavy road haulage route to the Port and not as a commuter road connecting southern parts of the city with its CBD through South Townsville.

Magnetic Island holds a special place in the settlement pattern of Townsville as a place of recreation and relaxation. Limited opportunity exists for significant change in development on Magnetic Island due to its isolation (in terms of development infrastructure) and its significant amount of natural areas and national park habitat. The island consists of a number of small village communities. The level of isolation that exists with these communities has led to a well-defined sense of place and belonging for their residents. The development of the PEP would not affect the continuation of these communities as discrete social entities on Magnetic Island.

B.13.3.3.9 Land Use and Land Ownership Patterns

The local land use patterns are assessed in Chapter B1 and are generally reflective of the land use controls of the *Townsville City Plan 2005*. The well-defined precincts and separation of conflicting land uses (e.g. port activities and non-port-related urban uses such as residential, commercial and recreational land uses) is likely to be a contributing factor to the port’s success over the coming years as well as its acceptance as a well-regarded, important and integrated land use in the broader urban fabric of Townsville and its surrounding areas.

The PEP is not expected to have a significant effect on social values attributable to Strategic Port Land as the land is intended for port-related activity. The PEP is consistent with this objective and will not alter the port’s ability to continue to use its existing land in this manner. Potential impacts on the port’s workforce are controlled through code assessment criteria for new development and more detailed, strict licence and workplace health and safety requirements that already apply to the port’s operations.

Adverse social impacts have the potential to arise from secondary effects due to heavy vehicle and rail transport to and from the port, through increased risk to safety and loss of amenity from greater numbers of vehicle movements (particularly along Boundary Street). Environmental effects on surrounding residences in South Townsville and the Breakwater Marine Precinct resulting from potential increased dust exposure during PEP construction and noise both during construction and operational phases are likely to be factors that may lead to secondary adverse social effects if they are not appropriately managed.

The development of the PEP as an expansion to the existing port also has the potential to affect the social values that are associated with The Strand. The port and the PEP will both be visible from The Strand. An increase in the size of the port through the PEP has the potential to change the scale of the port relative to the largely natural background of Cleveland Bay and change the visual amenity of the area. This is addressed in greater detail in Chapter B17.

There are no properties that are likely to be directly affected by the PEP other than existing port land. A number of properties may be affected along Boundary Street due to the potential for some increase in port-based traffic. The number of heavy transport vehicles coming from the west and south is expected to significantly decrease once the Townsville Port Access Road is opened. Additional lighter traffic has the potential to increase through the area, especially as development at Rocky Springs starts to grow. Chapter B14 assesses likely impacts on the local road network in greater detail. There is no readily available data that provides an estimate of the number of families that are expected to be affected along Boundary Street or elsewhere around the port.

Land tenure patterns are not expected to play a significant role in influencing social characteristics or values around the PEP. Tenure over Strategic Port Land has been established with the view of facilitating port activity, including port expansion through the PEP. Tenure around the port is largely freehold and under multiple ownerships (a fragmented ownership pattern exists that is indicative of a developed area with a strong emphasis on residential development). The relatively high number of persons renting property in South Townsville and Railway Estate is likely to be indicative of a more transient population with potential for less attachment to the area and a higher level of ambivalence towards the port's long-term plans. This situation is also likely to be more prevalent amongst occupants of newer apartment developments and is also likely to include those located in the Breakwater Marine Precinct.

Indirect impacts on tenure can relate to the perceived effects on land values due to other activities such as industrial construction and land use. The Community Feedback Survey did not rate this as a potential impact and it is not expected to be a likely impact from the PEP. This is further supported by the historical presence of the port during periods when significant residential growth has occurred in the CBD and along Ross Creek with no appreciable negative impacts on land values. Many of the developments that have taken place represent some of Townsville's premium market for higher density living opportunities.

POTL currently has a Cultural Heritage Management Plan in place covering the port expansion project area that was negotiated with Townsville Traditional Owners. Although the project area is subject to native title legislation, there is no registered native title claim covering the Port, the PEP or adjacent waters or land areas. Nonetheless, POTL intends to embark upon an ILUA negotiation process in coming years to appropriately address native title and eventually seek freehold title over reclaimed land areas. The expansion project can however proceed, prior to an ILUA being negotiated, under the future act provisions of the native title legislation if a perpetual lease is obtained over the project area.

B.13.3.3.10 Use of Social and Cultural Areas

Error! Reference source not found. identifies existing land uses over land and marine areas in proximity to the PEP and the manner in which the PEP has the potential to affect social values through impacts on the use of land and marine areas. Those members of the community most likely to be affected are residents in close proximity to the port (notably those along transport corridors and those living near to the port such as those at the Breakwater Marine Precinct, Palmer Street Precinct and adjoining parts of South Townsville), recreational boaters and fishers who use or are likely to want to use the PEP reclamation footprint area and commercial fishers who may from time to time use the existing PEP reclamation footprint. There is also potential for visitors to the area, including those to the Palmer Street Precinct, Jupiters Townville Hotel and Casino and people visiting friends and relatives, to have their social values affected by the PEP if potential impacts are not adequately managed.

Positive economic effects are likely to benefit North West Region communities and the coastal council communities around and including Townsville as a result of increased employment, income and investment potential in the region by the public and private sectors. Increased investment in the region is also likely to contribute to improved services or better access to such services (e.g. through improved telecommunication or transport).

Townsville stands to gain the most as a result of its existing size, economies of scale and its existing role as a major regional service provider, which are expected to make Townsville an attractive option for further investment.

B.13.3.3.11 Other Projects

The PEP is predicted to provide additional capacity for the trade of bulk goods and minerals resulting from expected increased mineral production in the North West Region and potential expansion of existing mineral production from the North West Mineral Province. Potential also exists for coal export trade to be increased from future production in the Northern Galilee Basin, subject to upgrading of rail infrastructure to the port and any relevant environmental and other investigations being undertaken.

Although the port deals with general cargo and livestock, by far the biggest effects from other projects are likely to be associated with mining projects and the processing of minerals, in terms of tonnages, nickel ore, mineral concentrates (i.e. lead, zinc and copper), sugar, and oil and petroleum products are the four largest tonnage products traded through the port. The ongoing viability of expansion and venture projects associated with these products will play a significant role in the projected demand for the PEP.

Table B.13.2 Port of Townsville Cargo Trade – 2010/2011 Annual Report (POTL, 2010)

Product	Import (t)		Export (t)	
	2009/10	2010/11	2009/10	2010/11
Cement	453,124	466,668		
Fertiliser	113,691	87,775	779,810	828,105
General cargo	188,726	211,621	159,974	148,663
Mineral concentrates	158,341	258,309	1,464,865	1,664,714
Motor vehicles	28,166	19,329		
Nickel ore	3,680,603	3,719,507		
Oil and petroleum products	1,016,206	941,103		
Refined mineral products	98,964	43,942	558,804	827,592
Sulphur/sulphuric acid	103,812	127,813		
Cattle and meat products			60,160	51,076
Molasses			185,237	233,710
Sugar			1,190,898	958,720
Totals	**5,841,634**	**5,876,067**	**4,411,181**	**4,725,069**

Key recent major projects and developments in the region that are expected to influence demand for the PEP as well as others are referred to in Table B.13.3. The listed projects are regarded as complimenting the PEP and are likely to further positively contribute to economic benefits for the region.

Table B.13.3 Key Projects/Developments Affecting the PEP

Factor Affecting Trade	Description of Project/Development	Effect of Changes in Project/Development
Nickel	Yabulu Nickel Refinery, Townsville	The ongoing viability of the Yabulu Refinery contributes to the largest tonnage percentage of product that presently passes through the port, contributing 63% of all imports and 35% of all products traded (imports and exports). Any change in the processing capability of the refinery is likely to have an immediate effect on the tonnage of products traded through the port. The refinery is susceptible to overseas situations, the availability of nickel ore to be processed and the relative cost of transportation and processing in Australia versus other options.
Mineral concentrates	CuDECO copper mineral concentrate plant for Cloncurry	This facility commenced construction in 2011 and is expected to lead to an extra 350,000 tonnes p.a. of concentrate to be exported through the port with further increases expected.
	Xstrata Townsville Copper Refinery	Possible closure of the refinery in 2016, as a result of the proposed closure of the Xstrata Mount Isa Smelter, will reduce the amount of copper cathodes exported through the port. This is expected to lead in a corresponding increase in export of copper concentrate to overseas refineries.
Coal	Possible expansion of the North Galilee Basin	Possible future expansion of the North Galilee Basin may, in the absence of alternative rail-port routes, lead to a demand for coal export through the Port of Townsville. This is likely to be subject to the vagaries of external markets and will require significant upgrading of the rail network to the port to cater for longer and larger tonnage trains.
Port of Townsville development	Inner harbour Berth 10 and Berth 8 upgrade	This project is currently underway and is intended to facilitate better general cargo handling capability and provide for a dedicated cruise and military ship terminal (Berth 10A). The project also involves the concurrent upgrade of Berth 8 to accommodate bulk commodity

Factor Affecting Trade	Description of Project/Development	Effect of Changes in Project/Development
		handling capacity.
	Berth 10B and C (Berth 10X)	Planned reclamation and construction of Berth 10B and C and realignment of Ross Creek to improve capacity for and management of general cargo demand.
	Berth 12 construction	Approved new berth to accommodate enhanced bulk commodity handling capacity.
	Berth 4 upgrade	Planned upgrade to provide for improved cement and bulk commodity handling capacity.
	Demolition of Berth 6/7	Planned demolition of Berths 6/7 forms part of the rationalisation of the inner harbour facilities to improve access by larger ships to Berths 4 and 8.
	Townsville Marine Precinct	This development has provided for the relocation of commercial fishing and other smaller craft marine commercial businesses in the port's Strategic Port Land and is located on Ross River. This purpose-built area shares access with other port users along Benwell Road and falls within the control of POTL's *Land Use Plan 2010*. Stage 1 of the development has been completed.
Development at/of other ports	Abbot Point Port Expansion	Abbot Point is a large coal shipping terminal located near Bowen, approximately 150 km south of Townsville. Abbot Point is expected to play an increasingly important role in the state's future growth of coal exports, notably from the Bowen Basin with further demand for coal export capacity from the Galilee Basin as additional rail facilities between the port and the Galilee Basin mines are completed. Planned expansion of coal loading berths at Abbot Point are expected to cater for much higher tonnage capacity ships than will be catered for at the PEP.
Urban development	Townsville CBD revitalisation	The ongoing revitalisation of the Townsville CBD, including the construction of additional office space is likely to attract further businesses to the area and strengthen the region's ability to produce goods and trade. Recent developments include the construction of the Ergon and Verdi mixed use commercial/residential towers for the Townsville CBD. Residential development in the city's out-lying areas also has a significant effect on its social characteristics. Many of these areas have been suited for younger first home buyers and the areas have significantly contributed to the population of Townsville, increasing from 165,278 people in 2006 to 189,931 people in 2011 (OESR, 2012e). This represents 4,930 people per annum.
Transportation	Completion of the Eastern Access Corridor, including the Townsville Port Access Road and future rail link to the Port	The Townsville Port Access Road enables increased heavy road transport to directly access the port through the Townsville State Development Area for any increases in trade activity (especially from the south and west of the Port). The road was constructed to reduce any growing reliance on the use of Abbott Street (from the south) and Boundary Street into the port and was opened on 18 November 2012. Subject to additional need generated from increased trade in bulk commodities, a rail-line is also planned to the port and the PEP.
Energy	Townsville –north-west energy connection	This proposal emanated out of the previous CopperString Project. The project folded in its then form due to an inability to secure sufficient commercial support from energy users at the time. Interest is still strong in sectors of the community to see a similar concept develop for the region in the future. The concept would connect Mount Isa to Townsville via the state's power grid and enable the development of

Factor Affecting Trade	Description of Project/Development	Effect of Changes in Project/Development
		sustainable energy supplies to the North West Region. The provision of cost competitive energy to the region has been identified as a major requirement to expand its mineral processing and value-adding capability. Increased processing and value-adding capability is likely to place greater export demand on the port's facilities in line with those facilities proposed by the PEP.

B.13.3.4 Community Values and Characteristics

Community social values have been identified from the different responses received from the Community Feedback Survey used in the community consultation process. Initial responses from government agencies received as part of the preparatory work for the PEP and the EIS have been accounted for in the revised proposal that is the basis for this EIS. The list of government agencies consulted is provided in **Error! Reference source not found.**. Community values are described in the following sections in terms of important values, community likes and dislikes, the community's perceived most important issues and perceptions about the PEP's potential impacts.

B.13.3.4.1 Important Community Values

Results of the Community Feedback Survey indicate that the three most important values identified by the community were environment and air quality (28%), lifestyle and amenities (22%), and employment and economic opportunities (19%). Figure B.13.2 shows the range of values identified by respondents as important to them and their community, together with their relative frequency.

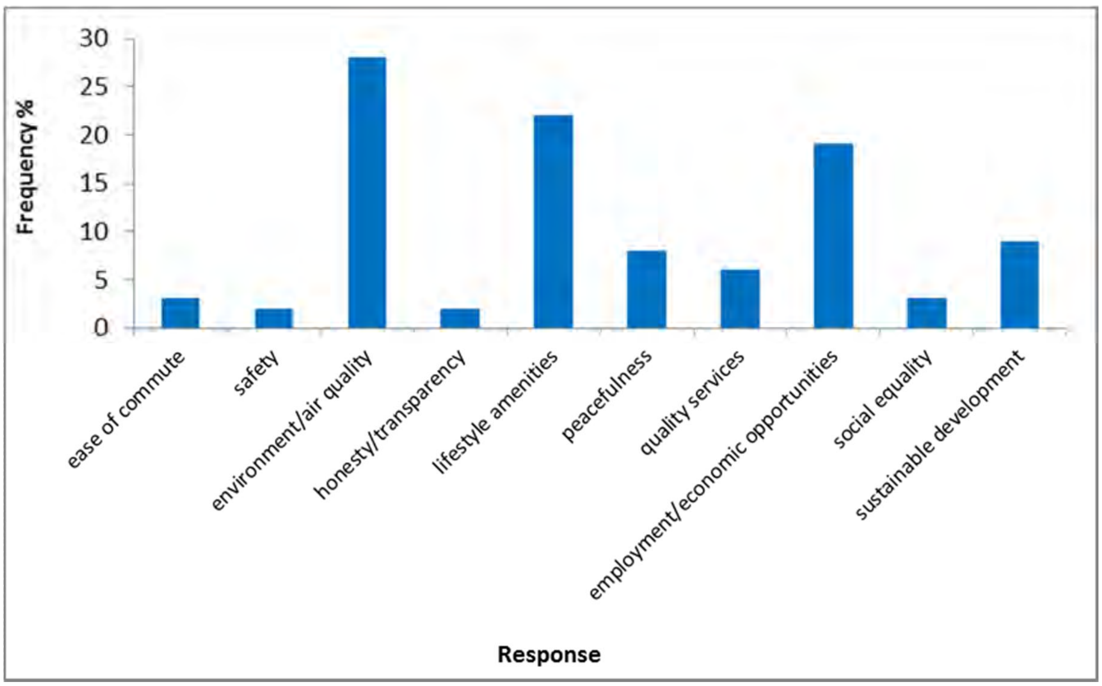


Figure B.13.2 Qualities important to respondents and their community

B.13.3.4.2 Likes and Dislikes About the Existing Community

The Community Consultation Feedback Form respondent survey results revealed that lifestyle (24%), proximity and access to amenities (23%) and friendly people in the community (15%) were what people most liked about living in their community.

Of the respondents who indicated they liked the proximity and access to amenities, 57% were neighbouring residents to the Study Area. These respondents also made up 54% of those who indicated the coastal aspect as a principal reason for liking the community and the area. Peacefulness was an important factor for neighbouring residents, making up 67% of this category. Respondents from the local community made up 100% of those who stated that the ease of commute was important, while 100% of the respondents who indicated that a sustainable community was important were local business owners.

Figure B.13.3 shows the distribution of the principal community 'likes' expressed by respondents during the survey.

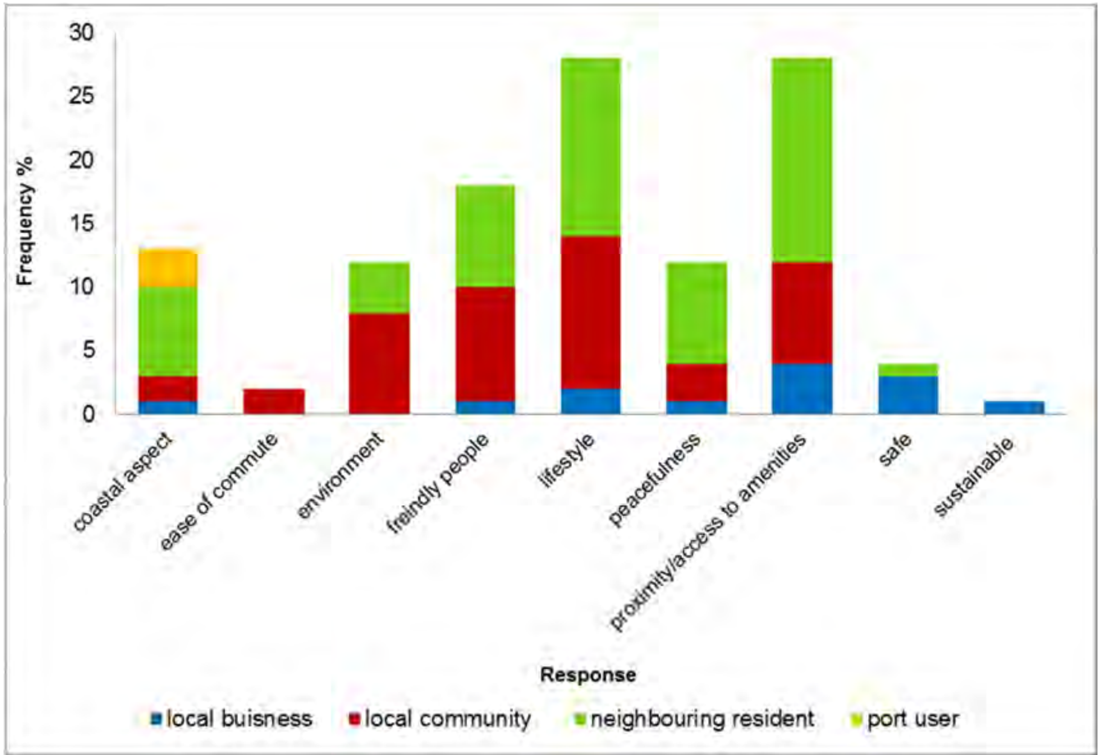


Figure B.13.3 What respondents like about living in their community

Figure B.13.4 indicates that the top three community 'dislikes' were noise from trucks and other nuisances (23%), pollution from the port and other industry (17%) and inappropriate planning and poor development (13%).

All of the respondents who indicated that traffic was an issue were neighbouring residents. Neighbouring residents also comprised the majority of respondents who indicated 'noise from trucks and other nuisances' and 'pollution from the port and other industry' (83% and 85% respectively).

For local community members, the most important issues were inappropriate development/poor planning and antisocial behaviour. Local community members made up the majority of those who indicated public transportation (100%), inappropriate development and poor planning (80%), lack of transparency amongst key decision-makers, including the port (75%) and social inequality (75%) were qualities they do not like about living in their community.

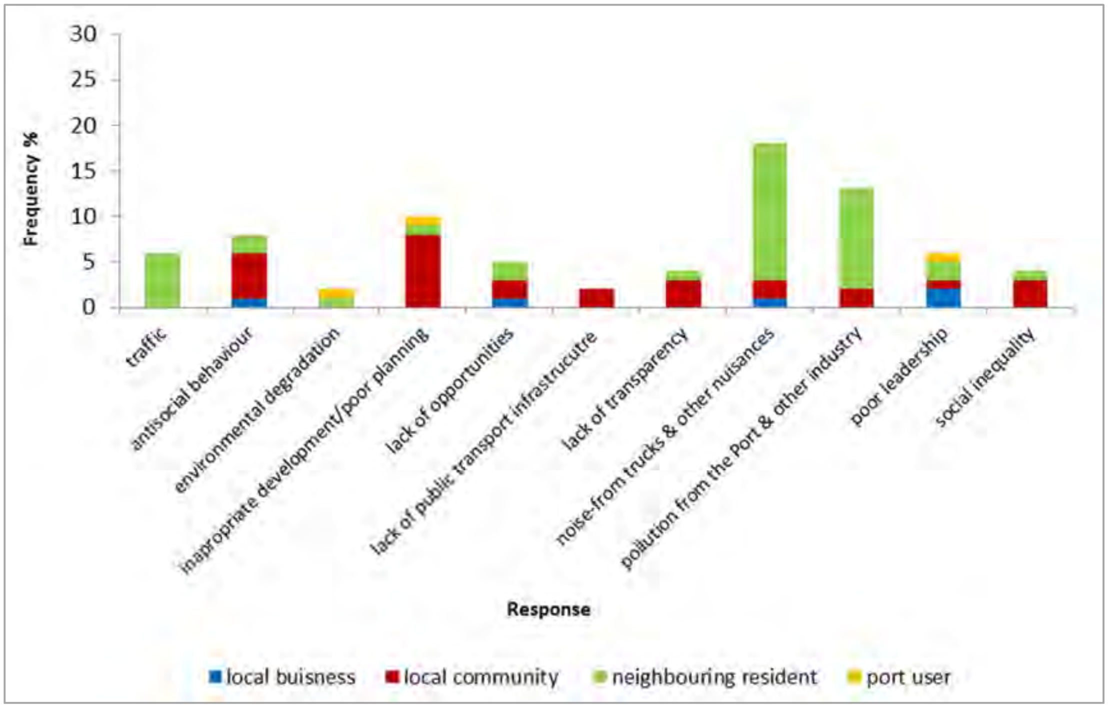


Figure B.13.4 What respondents dislike about living in their community

B.13.3.4.3 Most Important Issues Facing the Community

The three most important issues facing the local community that were identified by respondents to the Community Consultation Feedback Form were the need for transportation and other infrastructure to accommodate growth (20%), creation of employment and economic opportunities (19%) and access to quality services (18%). The summarised list of issues and their relative scores are shown in Figure B.13.5 and the full range of issues identified by respondents is assessed in more detail in **Error! Reference source not found.**.

Generally, the most important issues facing the local community were fairly evenly distributed among interest groups. Dust and noise was raised more often by neighbouring residents (comprising 60% of this response) and selecting appropriate industries for the area was an issue raised by a neighbouring resident. Skills shortages was raised by a local business owner.

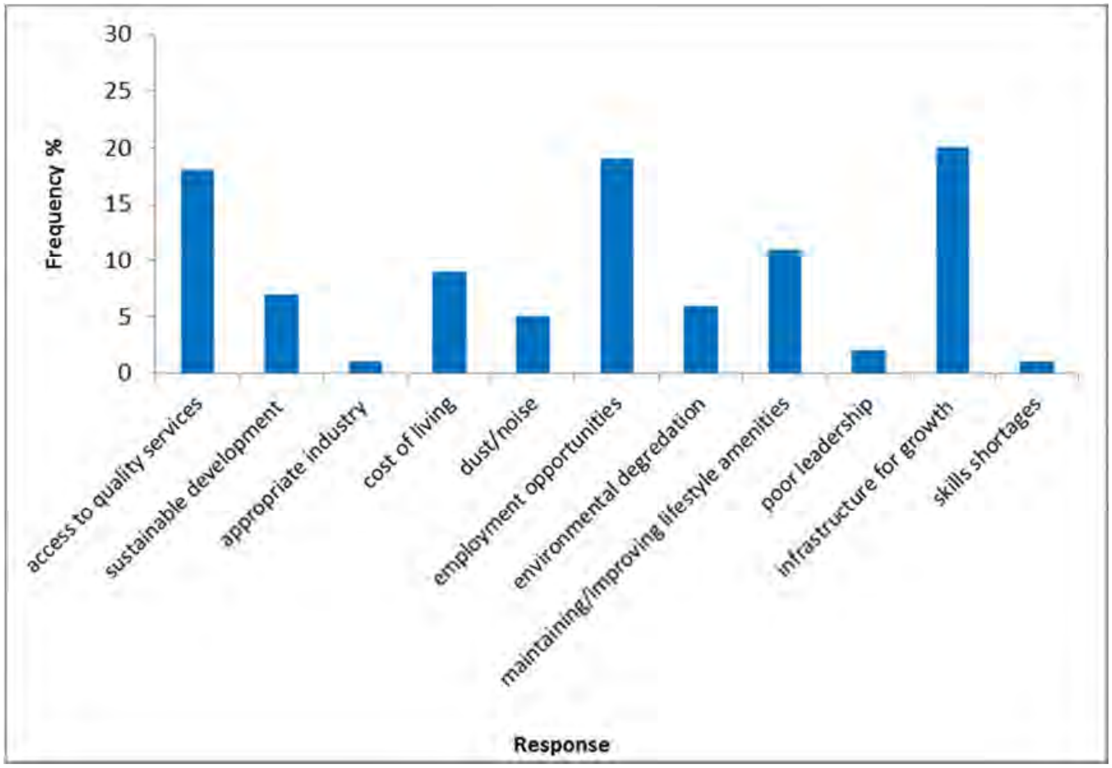


Figure B.13.5 Important issues facing the local community

B.13.3.4.4 Stakeholder Perceived PEP Impacts

Perceived impacts of the PEP on the community as identified by respondents to the Community Feedback are shown in Figure B.13.6. Impacts were expressed in terms of a sliding scale with responses rated as:

- very positive (5)
- positive (4)
- neutral (3)
- negative (2);
- very negative (1)
- unsure (0).

The results indicate respondents generally believed the PEP will have mixed effects with positive impacts on the local economy and employment opportunities, neutral impacts on lifestyle and community aspects, and potentially negative impacts on the environment.

The two highest scoring Project impacts were the local economy and employment, at 4.3 and 4.2 respectively (both positive). Of the responses received, just over 46% of the total respondents stated that the economy would be positively impacted by the PEP and 36% stated that local employment opportunities would be very positively impacted.

Environment was the lowest scoring Project impact, with 21% of respondents believing the environment would be very negatively impacted by the PEP. Conversely, approximately 5% of respondents stated the PEP would very positively impact the environment. Although many respondents indicated that the PEP may negatively impact the environment, they believed POTL would act responsibly in managing the PEP and the potential impacts.

The two main environmental impacts noted were noise and dust. Other community concerns raised included the impacts on roads and rail, the potential increase in traffic, products to be transported through the port and the potential impact on the Great Barrier Reef.

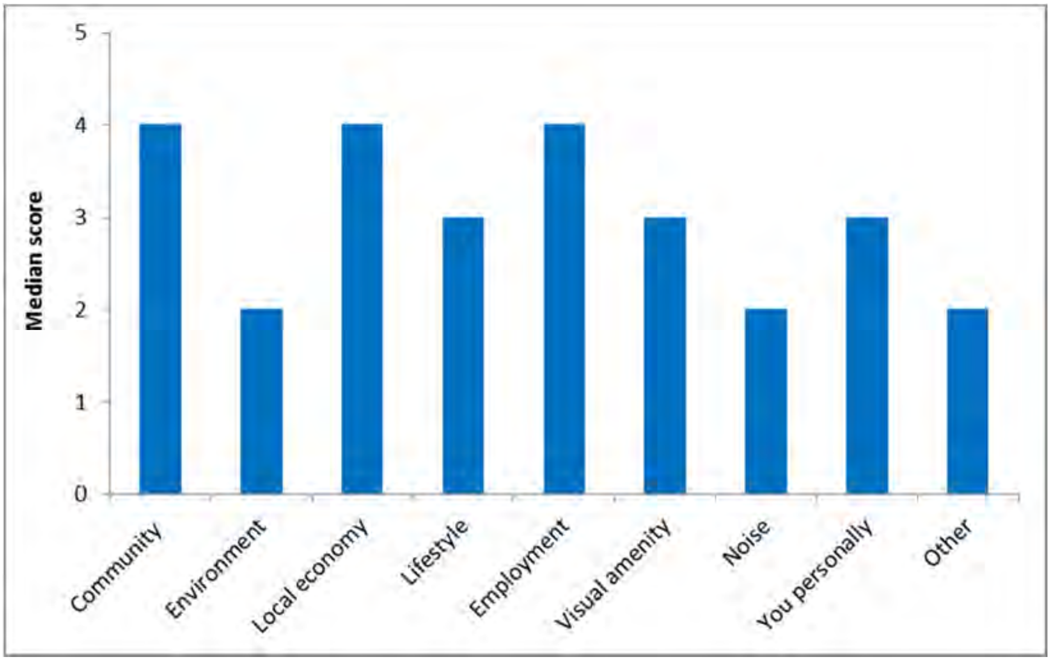


Figure B.13.6 Stakeholder perceived impacts of the PEP

B.13.4 Assessment of Potential Impacts

Drawing on the results of the social baseline study, the outcomes of the community consultation program, an analysis of other projects in the region and the comparative scale of the PEP relative to the size of Townsville's population and expected growth in its workforce, potential impacts associated with the development of the PEP have been identified. These potential impacts are assessed in terms of the assessment and risk rating framework that is described in **Error! Reference source not found.**. Potential social impacts are described in terms of the following impact classes:

- economy and employment
- housing and accommodation
- noise, dust and visual amenity
- transport
- communication and consultation
- maintenance of lifestyle.

These headings represent the general groupings of issues and concerns raised by respondents during the community consultation process for the preparation of the EIS and also accord with key social values identified in strategic framework and policy documents identified in Section B.13.2. This assessment considers only those impacts that are directly attributable to social values and that are likely to impact on people who either reside around the port or are likely to visit the areas affected by the PEP.

Potential impacts for each impact are assessed in terms of:

- description of impact
- nature of impact (positive or negative)
- existing policies or procedures that apply (including key existing POTL policies and procedures)
- potential magnitude (consequence) of impact

- likelihood of impact
- overall risk classification.

The risk classification used is that adopted for the EIS as outlined in **Error! Reference source not found.**. Only potential adverse impacts are assessed in terms of their risk classification.

B.13.4.1 Economy and Employment

B.13.4.1.1 Workforce Profile

Appendix P1 shows that the PEP construction and operational work force (direct or indirect) relative to the available labour force for Townsville will be insignificant in terms of any impact or influence for other projects or work to proceed in Townsville during that time. This is directly related to Townsville's large population as the most significant regional centre in Northern Australia (including compared to Darwin), its diverse economy and expected continued growth in population. Appendix P1 shows that, based on current trends, the labour force is expected to grow by another 44,268 people by 2026 (although this figure is expected to be slightly reduced due to an increasingly ageing population). The PEP workforce will be very small compared to the overall labour force for Townsville.

Section 3.4.3 estimates the maximum number of construction workers employed on the PEP site is likely to peak at approximately 150 during Stages A and D of the construction phase. This is estimated to equate to 96 full-time equivalent (FTE) workers. Chapter B 19.0 (Economic Development) estimates that over the period to 2040, the PEP creates an additional on-going 640 FTE employees per annum in Townsville after 2040, with a peak impact of 2,295 and 1,840 FTE (direct and indirect) employees required in 2015 and 2016 respectively. The economic development assessment in Chapter B 19.0 estimates Townsville's workforce size and strong growth of its population and diverse economy position it so as to be well placed to accommodate the workforce needs of the PEP and benefit from the added employment opportunity and demand for housing and services that it is expected to bring to the area.

Strengthening of direct and indirect employment opportunities due to the PEP is likely to positively contribute to a stronger economy at the social and cultural area levels affected by the PEP and act as a catalyst for further private and public sector investment in the region and district, leading to increased services and further employment opportunities as the economy grows.

B.13.4.1.2 Indigenous Employment Opportunities

The creation of Indigenous employment opportunities forms a key part of Commonwealth and state policy. The population of Indigenous people in the Study Area is low and there is likely to be limited demand for employment opportunities associated with the PEP. POTL has existing programs in place that facilitate Indigenous employment opportunities in the port, which have resulted in greater than 10% Indigenous employment during construction of the Marine Precinct and the Berth 8-10 projects. This principle is expected to be extended to the PEP when it is ready to proceed. Although employment opportunities are expected to be project specific, the existing *Local Industry Participation Plan* and *Employment and Procurement Policy* are likely to be used as a template for any further specific employment initiatives associated with further construction and operational phases. The likelihood of adverse indigenous employment or training effects occurring as a result of the PEP is rated as 'unlikely' based on the processes that POTL already has in place and its past results with the indigenous community. The corresponding overall magnitude of the impact is expected to be 'minor'. The overall unmitigated risk of the impact is 'low'.

B.13.4.2 Housing and Accommodation

The establishment of an additional workforce due to PEP construction and operation has the potential to impact on the demand for housing in the district and in the Study Area. At the district level this impact is expected to be masked by the larger housing market, but it is likely to have a more pronounced impact cumulatively, when considering the PEP in the context of multiple other projects.

More pronounced impacts are likely to be experienced in the Study Area and other adjacent locations. There is a likelihood that parts of an additional long-term workforce in the area, generated by the PEP, may find living options close to the port attractive, especially when considering the large range of services and entertainment options that the area offers. This is considered to represent a positive impact for the district and Study Area.

B.13.4.3 Visual Amenity, Noise and Dust

B.13.4.3.1 Visual Effects of PEP on Foreshore Amenity

The PEP is to be located in what is currently open water in Cleveland Bay next to the existing port. In view of its size and location, little scope exists to provide significant visual screening of the development. Potential exists for the PEP to have an adverse effect on visual amenity especially when viewed from The Strand, although the illuminated port at night is viewed as an attractive scenic outlook by sectors of the community and visitors alike. Adverse visual impacts can affect the character of an area and the perceived relationship between its inhabitants or visitors and the area. This can, in principle, affect social wellbeing of individuals or a community.

The visual amenity of the PEP did not rate highly as an issue of concern with respondents that provided feedback through the Community Consultation Feedback Form. The PEP is also expected to be visible from the east and south-east (along the Townsville State Development Area foreshore with Cleveland Bay). These areas are comparatively more sparsely occupied by people with only limited foreshore access along the Townsville State Development Area. A detailed assessment of the visual impact of the PEP is provided in Chapter B17.

The likelihood of visual impacts from the PEP having adverse social effects is ‘possible’. Due to the lesser scale of the PEP to that of the existing port development and the time frame over which the PEP is expected to gradually take shape, the magnitude has been assessed as ‘minor’ on the social values of people who live along The Strand, or on higher areas near the CBD, which are likely to have the highest potential for risk. The overall risk of the impact in terms of the effects on social values is expected to be ‘low’.

B.13.4.3.2 Noise and Dust During the Construction and Operation of the PEP

The greatest potential exists for dust and noise to be generated during earthworks associated with reclamation works and construction of wharfs for the PEP. This has the potential to occur intermittently over a number of years during each of the staged construction campaigns for the PEP. Noise can be generated from plant and machinery involved in works including earthworks, concreting and pile driving. Although these activities will form a significant part of the PEP construction works, the relative distance from nearby residences is likely to be a mitigating factor for noise impacts generated from the work site. Dust can also have an adverse visual impact on the area. Air quality (dust) and noise impact assessments are provided in Chapter B9 and Chapter B10, respectively.

The likelihood of noise and dust impacts from the PEP adversely affecting the social character or values of people in surrounding areas is considered to be ‘possible’ with a likely ‘moderate’ magnitude. The overall, unmitigated risk of the impact is considered to be ‘medium’.

Environmental standards, including many licence requirements, and workplace health and safety regulations require strict standards to be imposed to ensure that noise and dust nuisance is abated to acceptable standards. These standards and requirements will apply to the PEP where relevant. Dust suppression will be a key aspect of the Construction Environmental Management Plan (see Section C 2.2) to ensure that nearby residential and recreational amenity is safeguarded.

B.13.4.4 Transport

B.13.4.4.1 Increasing Transport Related Noise and Dust Affecting Amenity of Residents of South Townsville

Increased traffic generated by heavy-haulage truck movements using the port create existing perceived adverse social impacts on amenity, safety, sense of place and wellbeing. An increase in the capacity of the port is expected to generate higher numbers of truck movements, in particular along Boundary Street and Benwell Road. This is expected to have potential adverse impacts for the affected area.

Impacts from heavy vehicle traffic through South Townsville and Railway Estate is expected to reduce significantly as a result of the opening of the Townsville Port Access Road in November 2012. This will relocate movements from the west along Flinders Highway and from the south along the Bruce Highway through the Townsville State Development Area and is expected to lead to significant traffic impact amelioration.

Likely social impacts due to increased noise and dust from heavy road traffic are expected to be adverse through loss of amenity and lifestyle. The likelihood of such an impact is ‘likely’ with the estimated magnitude of the impact effect being ‘moderate’. The overall risk of the impact on this basis is expected to be ‘medium’.

B.13.4.4.2 Potentially Increasing Heavy Road Transport Effects on Pedestrians and Cyclists

Increased heavy-haulage along Boundary Street and Benwell Road in South Townsville and Railway Estate has the potential to increase the risk of accidents and make it more difficult for pedestrians and cycle users to make use of, or cross, the roads if no form of mitigation is implemented. This is likely to be most noticed in locations where pedestrian and cycle routes cross the roads in the vicinity of nearby social infrastructure (e.g. schools) or as part of routes that link to the CBD.

The overall risk to pedestrians and cyclists, while present, is not expected to be significant. This is partly due to traffic and pedestrian management systems and infrastructure that are in place and the anticipated opening of the Townsville Port Access Road, which is expected to alleviate much of the additional heavy transport demand that is likely to be generated by the PEP.

Social impacts from the movement of heavy-haulage and other vehicles due to the construction and subsequent operation of the PEP are secondary impacts and have the potential to adversely affect safety, amenity and wellbeing. Direct transport related impacts are assessed in greater detail in Chapter B14. The likelihood of this impact is estimated to be ‘likely’ with the magnitude of the effect estimated to be ‘moderate’ with an overall risk category of ‘medium’.

B.13.4.4.3 Denied or Impeded Access to Waterway Locations for Recreational and Commercial Boat Operators

Reclamation works for the PEP will both remove an area of water that is currently available for small craft passage, fishing and other marine recreational activity and restrict the passage of craft in and around the harbour areas that are to be created. Use of the dredge material placement area is only likely to be restricted during spoil placement operations, in accordance with existing maritime navigation legislation. Use of the main Sea Channel will not significantly change as a result of the PEP. Restrictions regarding the passage of small craft and other vessels in the vicinity of larger ships are regulated by legislation and are not matters that can be mitigated by actions of POTL or other users.

The estimated likelihood of the impact is ‘possible’ with the estimated magnitude being ‘minor’. The overall risk category is estimated to be ‘low’.

B.13.4.5 Communication and Consultation

The PEP is a project of complexity and duration that may not be readily understood or appreciated by the broader community. In particular, the need for further approvals and the detailed assessment processes and licensing requirements that are associated with these processes may not be fully understood by some community members. Respondents to the Community Consultation Feedback Form indicated that lack of transparency and poor decision making were potential adverse impacts of the PEP.

POTL is required to have a range in systems in place under its corporation obligations and in accordance with a range of legislative requirements. POTL also has a record of close cooperation with different levels of government, the community and other stakeholders through a range of additional policies, procedures and practices that are not specifically required under legislation. Key existing policies used by POTL that contribute towards the establishment of an environment of transparency and good governance practices include:

- *Disclosure of Interests Policy*: principles and procedures for handling conflicts of interest or conflicts of commitment (POTL, 2011f)
- *Safety Policy* (POTL, 2012a)
- *Insider Trading Policy*: communicate the requirements of the *Corporations Act 2001* (Cth) (POTL, 2009a)
- *OHS Fitness for Work Policy and Procedures* (POTL, 2009b)
- *Code of Conduct* (POTL, 2011b)
- *Complaints Handling Policy* (POTL, 2011c)

- *Corporate Entertainment and Hospitality Policy*: in line with the Queensland *Government Owned Corporations Corporate Entertainment and Hospitality Guidelines* (September 2008) (POTL, 2011d)
- F*raud and Corruptions Control Policy* (POTL, 2011g)
- *Public Interest Disclosures (Whistleblowers) Policy* (POTL, 2011h)
- *Port Community Partnerships Forum* (POTL, 2007)
- *Environment Policy* (POTL, 2011)
- *Customer Service Policy* (POTL, 2011e)

The existing policies, procedures and practices will need to incorporate the PEP once it is approved. Key issues for focus in further stakeholder engagement processes involving the PEP are expected to include informing people about further approvals including legislative and statutory requirements affecting decision making, timetables for construction works, environmental management, safety, workforce participation opportunities and leveraging opportunities for other businesses and residents (e.g. housing accommodation).

The likelihood of lack of transparency and poor decision making occurring is estimated to be 'unlikely' with the magnitude of the impact in an unmitigated form (should it occur) being 'minor' due to the existing policies, procedures and practices that are in place. The overall risk category is estimated as being 'low'.

B.13.4.6 Maintenance of Lifestyle

Lifestyle impacts are primarily secondary impacts arising from other environmental impacts. These are most likely to relate to impacts associated with the generation of dust, noise, other pollutants and vehicular movements, primarily heavy haulage vehicles. These particular impacts are assessed in individual technical chapters of the EIS and discussed in terms of their social impact implications.

The likelihood of adverse social lifestyle impacts associated with the PEP is estimated to be 'possible' with the likely magnitude of unmitigated impact effects estimated to be 'moderate'. The overall unmitigated impact risk category is estimated to be 'medium'.

B.13.4.7 Cumulative Effects

The PEP represents a significant project in terms of its potential social impacts for communities at the region, district and local levels. Beneficial cumulative secondary social impacts are likely to be derived through increased trade, resultant revenues and potential increased investment into the region. This is likely to be significant over time as the port is recognised as an important trade facilitator for products derived from the regional hinterland. The supply chain for these products, of which bulk minerals based goods form a key component, is heavily focused and reliant on the port. The PEP represents a key part of the port's managed growth and intention to help facilitate economic growth in the region and for Queensland.

Although the beneficial cumulative social impacts of the PEP are likely to be significant for the region and Townsville in the long term, the cumulative impacts on the population, housing, workforce and use of community infrastructure and services, while still beneficial, are likely to be modest with only a slightly higher impact likely to be noticeable at the start of construction when some additional temporary workers may need to brought into the area. This would be quickly masked by the overall expected growth of Townsville.

Townsville's existing population, its moderately high growth rate, diverse economy and planned capacity for growth are significant factors in enabling it to absorb projects of the scale of the PEP.

Longitudinal cumulative effects relate to those effects that may occur as a result of a project not proceeding or failing over an extended period of time. Inherently these impacts are usually considered as adverse impacts. The magnitude of adverse effects is likely to be a function of the location's ability to absorb those adverse impacts. Townsville's role as a large regional centre servicing North Queensland with a diverse economy and strong growth has provided it with a much stronger capacity than smaller less diverse centres. Potential direct longitudinal cumulative social effects of the PEP over an extended period of time are unlikely to be significant for Townsville provided other projects continue to be supported in the region and growth is maintained at the rate predicted by OESR. The scale of the PEP in terms of its workforce in particular, has been shown to be of minor significance relative to the size of Townsville's overall workforce.

The cumulative indirect effects on social characteristics of the region are likely to be more significant, especially for smaller regional centres that are dependent on growth in the mining sector. The PEP plays a direct role in facilitating this growth by providing access to markets for mining products. The effect on the social characteristics of regional centres of PEP failing or not proceeding is likely to be more pronounced, especially in the absence of alternative access to markets should demand for the region's mining products increase and capacity exists to win further resources. This is likely to manifest itself in terms of less employment opportunities, local investment and access to services than might otherwise be the case if growth is maintained. A more detailed assessment of the overall economic effects of the PEP is provided in Chapter B19.

B.13.5 Mitigation Measures and Residual Impacts

Mitigation measures have been identified to manage potential impacts. Anticipated residual impacts have been predicted using the methodology identified in Section A2. Mitigation measures have not been identified for potentially positive impacts. Where possible, the identified mitigation measures seek to use existing frameworks, plans and practices that have been adopted and implemented by POTL as proven mechanisms to achieve identified environmental outcomes.

Residual impacts are those that potentially remain once the mitigation measures have been implemented. The residual impact is classified in terms of the same system adopted for the unmitigated impacts classification. Residual social impacts resulting from the PEP are expected to be either 'low' or 'negligible' once the mitigation measures have been applied. The mitigation measures and residual impacts are shown in Table B.13.4.

Table B.13.4 Mitigation Measures for Identified Potential Social Impacts

Ref	Potential Impact	Initial Impact Classification	Mitigation Measure	Residual Impact Classification
Economy and Employment				
1	Lack of Indigenous employment opportunities.	Low	Amend: existing *Local Industry Participation Plan*, POTL *Employment and Procurement Policy* to incorporate PEP, as required. Develop: *Local Industry Participation Plan* in collaboration with Indigenous representative groups in Townsville to ensure that implementation of the plan can make use of existing organisational structures, networks, programs and procedures that have been established for Indigenous people in the district.	Negligible
Noise, Dust and Visual Amenity				
2	Visual effects of PEP on foreshore amenity	Low	Amend: POTL *Environment Policy*, POTL *Environmental Management System* and *Stakeholder Engagement Management Plan* to incorporate PEP, as required. Implement: mitigation measures identified in Chapter B17 and incorporate reference to such measures in stakeholder engagement parts of above policies and plans.	Low

Ref	Potential Impact	Initial Impact Classification	Mitigation Measure	Residual Impact Classification
3	Noise and dust during the construction and operation of the PEP	Medium	Amend: POTL *Environmental Policy*, POTL *Environmental Management System*, *Complaints Handling Policy*, and *Stakeholder Engagement Management Plan*, as required, to incorporate PEP with reference to noise and dust control or stakeholder engagement provisions. Implement Construction EMP and Operations EMP noting specific requirements regarding noise and dust mitigation.	Low
Transport				
4	Increasing transport related noise and dust affecting amenity of residents of South Townsville	Medium	Continue implementation of POTL *Environmental Policy*, POTL *Environmental Management System*, *Complaints Handling Procedure*, *Contractor Code of Conduct* and *Stakeholder Engagement Management Plan* with respect to any increases in traffic to and from the Port resulting from PEP related activity. Implement: mitigation measures identified in Chapter B14, including the DTMR adopted *Road Use Management Plan* and the Construction and Oparations EMPs. Liaise with Townsville City Council to continue to advocate restrictions on any further incompatible residential land uses along Boundary Street or Benwell Road as part of council's preparation of its new planning scheme.	Low
5	Potentially increasing heavy road transport effects on pedestrians and cyclists	Medium	As per Ref. 4.	Low
6	Denied or impeded access to waterway locations for recreational and commercial boat operators	Low	Security requirements will not permit access to the port area during port operations in accordance with POTL's *Maritime Security Plan*, other than to authorised persons. Workplace, health and safety regulations requiring the protection of general public (non-port personnel) make it impractical to permit access for the general public during the construction phase. Engage with media to make potential users aware of PEP restrictions that may need to apply from time-to-time well in advance of requirement during construction stages.	Negligible
Communication and Consultation				
7	Lack of transparency and poor communication	Low	Maintain awareness of and continue to implement POTL *Environmental Policy*, *Complaints Handling Procedure* and	Negligible

Ref	Potential Impact	Initial Impact Classification	Mitigation Measure	Residual Impact Classification
			Stakeholder Engagement Management Plan. Ensure that the media is informed about significant decisions made by agencies regarding approval stages of the PEP.	
Maintenance of Lifestyle				
8	Maintenance of lifestyle	Medium	Implement mitigation measures identified in management plans recommended in this EIS (i.e. notably CEMP and OEMP) regarding human health issues. Use Port Community Partnerships Forum, *Stakeholder Engagement Management Plan* or *Complaints Policy* as avenues to regularly convey information and receive feedback regarding POTL's practices to maintain high standards of community health and wellbeing for adjoining residents and visitors to the area. Ensure that above plans recognise the application of standards to PEP.	Low

B.13.6 Assessment Summary

Overall, the PEP is expected to have a range of positive social impacts across the different area levels (i.e. regional, district and local) that it is expected to influence. This is largely expected to be as a result of the strengthening of the economies of these different levels towards which the PEP is expected to contribute. Unmitigated potential adverse social impacts are expected to have a 'medium' risk rating at worst and are all secondary effects relating to port-related heavy vehicle transport activity likely to affect amenity and the potential generation of dust and noise, which has the potential to affect lifestyle.

The assessment has identified that the port has a range of strategies, procedures and practices in place which, once applied to the PEP and its future operation, are expected to sufficiently mitigate any potential adverse social impacts and bring the risk levels down to 'low' or 'negligible' for all of the potentially adverse social impacts. A key aspect of this, particularly during the 'start-up' stages of the PEP's construction phase is the implementation of an overarching *Stakeholder Engagement Management Plan* and continuation of the Port Community Partnership Forum.

A three-tiered strategic approach to the achievement of good social outcomes has been identified:

- the effective management of physical environmental impacts (through identified mitigation measures referred to in other chapters of the EIS)
- the effective management of potential adverse social impacts
- provision of support for the realisation of local development opportunities.

Activities in these three areas will be guided by practice, policies, standards, guidelines identified in Section B.13.4.5.

Port Expansion Project EIS

Part B

Section B14 – Transport & Infrastructure

AECOM BMT WBM

B.14 Transport and Infrastructure

B.14.1 Relevance of the Project to Transport and Infrastructure systems

Port of Townsville Limited (POTL) is currently planning an expansion of the port to address current capacity constraints to the efficiency and productivity of the existing port and to accommodate forecast growth in trade over a planning horizon to 2040. The Port Expansion Project (PEP) includes the development of up to six additional vessel berths (Berth 14 through Berth 19), channel modifications (deepening and minor widening in sections) and land reclamation (approximately 100 ha), provided through a program of staged construction that will support maritime and land-based port operations to enable the forecast increase in trade throughput and the advent of new trades. The expansion may be developed on a sequential berth-by-berth basis or in stages that include development of multiple berths.

The Project involves the development of additional core port infrastructure in the outer harbour. The trades to be handled through the PEP are not known at this time and are dependent on future port tenants; however, the trade forecast is anticipated to primarily comprise dry bulk and bulk liquid commodities.

The main PEP infrastructure components are:

- harbour dredging and channel deepening (the Platypus and Sea channels)
- widening of the approach channel near the outer harbour entrance
- creation of approximately 100 ha of land reclamation, predominantly through the placement of dredging material to provide for bulk cargo storage and a rail loop
- capping material and armour rock materials from quarry
- installation of new breakwater and revetment structures
- development of new internal bunds to facilitate effective land reclamation
- installation of new wharf structures
- construction of up to six additional vessel berths in the new harbour (Berth 14 through Berth 19)
- installation of new aids to navigation
- construction of new road and rail infrastructure
- installation of new services infrastructure.

The PEP will allow POTL to:

- satisfy its responsibility under the *Transport Infrastructure Act 1994*, including establishment, management, and effective and efficient operation of port facilities
- respond to forecast trade growth and provide essential trade pathways for current and future trades
- provide competitive market conditions for import and export of bulk materials and general cargo through the Port of Townsville
- establish and maintain strong links between the local, regional, state and global economies
- accommodate future trends in global shipping practices
- facilitate rationalisation and expansion of the port

This report addresses Section 5.10 (Transport) of the *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement* and the *Guidelines for an environmental impact statement for the Port of Townsville Port Expansion Project, Queensland (EPBC 2011/5979/GBRMPA G34429.1)* and specifically describes:

- the existing transport infrastructure that may be affected by the Project
- the planned transport infrastructure on which the Project will depend
- expected traffic routes and traffic volumes generated by the Project

- the potential impacts to transport infrastructure from the construction and operational related traffic and proposed mitigation measures to maintain safety, efficiency and condition, and to input into a Transport Management Plan.

This chapter addresses the road and rail construction and operations requirements for the PEP. Shipping and its interface with port operations is assessed separately in Chapter B18 (Port Operations). The assessment has been undertaken for the surrounding road network and key intersections.

The Project related traffic generation includes the transportation of rock armour from quarry, plant and equipment, products, wastes and personnel for both the construction and operational phases. A summary of the projected traffic volumes for the Project, including the traffic generation assumptions adopted to derive the PEP traffic for project phases are included in Appendix Q1 and Appendix Q2.

The Townsville Port Access Road (TPAR) will link the Flinders and Bruce highways to the Port of Townsville. The 10 km project consists of two key sections:

Section 1: Stuart Bypass (2.5 km)

Section 2: Eastern Access Road (7.5 km)

A key assumption adopted for this traffic analysis is that the road element of the Eastern Access Corridor (EAC), Section 2 of the TPAR, the Eastern Access Road, scheduled to be completed in 2012, will be in operation prior to any construction for the PEP.

The TPAR will provide the long-term strategic highway connection to the port; providing direct access to the port from the west and south, as well as reduce heavy vehicle traffic in residential areas to the south.

Substantial previous studies of the capacity and constraints of road access to the Port of Townsville have been undertaken by the Department of Transport and Main Roads (DTMR) as part of the TPAR project. Traffic assessments prepared as part of that project formed the basis for evaluation of road capacity and constraints for the PEP in this assessment.

A road transport study was also carried out as part of the *Preliminary Engineering and Environment Study* (AECOM, 2009). This work involved:

- reviewing existing traffic and transport reports to establish the road transport operations and constraints
- reviewing the implications of the TPAR on the existing road transport operations and the capacity of this road over the planning horizon for the PEP
- developing a conceptual road layout for the PEP, with consideration of the interface between the PEP and other developments at the Port of Townsville
- summarising the key issues for further consideration as part of ongoing planning and development at the port.

Reports reviewed as part of this current study include:

- *Townsville Port Access Road – Traffic Impact Assessment* (Maunsell, 2005b)
- *Stuart Bypass – Traffic Assessment Summary* (Maunsell, 2008b)
- *Townsville Port Access Road – Traffic Assessment Study* (Maunsell AECOM, 2008a)
- *Townsville Marine Industries and Recreation Boating Precinct – Road Access Location Study* (Maunsell, 2008c)
- *Townsville Marine Precinct Environmental Impact Statement – Traffic Impact Assessment* (GHD, 2009g)
- *Preliminary Engineering and Environment Study* (AECOM, 2009).

B.14.2 Assessment Framework and Statutory Policies

Legislation that enables DTMR to set conditions for PEP project impacts are the *Sustainable Planning Act 2009* and the *State Development and Public Works Organisation Act 1971*.

The *Transport Infrastructure Act 1994* has a direct power to set conditions for development proposals and defines a process to be followed. From this DTMR's *Guidelines for Assessment of Road Impacts of Development 2006* (DTMR, 2006) was developed as a tool to assess the road impact of development proposals.

B.14.3 Existing Values, Uses and Characteristics

B.14.3.1 General

The current primary road access to the port is via Boundary Street and Benwell Road. Boundary Street is bounded by a mix of residential and non-residential uses, including industrial, commercial and shop-type uses. Benwell Street is the main access to Port lands.

Both Boundary Street and Benwell Road form part of the Principal Road Freight Network as defined in the *Townsville City Plan 2005* (TCC, 2005). Other connections to the port also exist via Archer Street and Ross Street, which forms part of the Secondary Road Freight Network. This access links on to Lennon Drive, which is part of the Principal Road Freight Network as defined in the plan. Boundary Street will continue to be the main port entry, providing access to the PEP from the north and possibly from the west.

The TPAR directly links the Flinders and Bruce highways to the port. Overall, the TPAR is a 10 km corridor consisting of two key sections:

- Section 1: Stuart Bypass, 2.5 km in length with a posted speed of 80 km/h, linking the Flinders Highway to the Bruce Highway; opened to traffic in January 2010
- Section 2: Eastern Access Road, 7.5 km in length with a posted speed of 80km/h, is under construction and due to be completed in 2012.

The key benefits of the TPAR are to provide direct access to the port from the west and south, with the effect of reducing heavy vehicle traffic in the residential areas in South Townsville.

Section 2 of the TPAR will be a new two-lane, 7.5 km road extending from the Bruce Highway, 600 m south of the Visitor Information Centre, generally northward to the port. There will be six new bridges along this section of the TPAR, including the bridge across the Ross River that terminates at a new signalised intersection with Boundary Street, Benwell Road and the future access to the Townsville Marine Precinct.

Initially, the TPAR will be built as a two-lane road with allowance for a further two lanes to be constructed in the future. Although there is no firm construction date to increase the road corridor to a four-lane configuration, for the purpose of this traffic analysis, it has been assumed (and consultation with DTMR indicated) that this upgrade would be in place by 2035. The first stage of PEP will occur after the completion of the TPAR, which is scheduled to be completed in 2012.

The other elements of the EAC include rail and other infrastructure services such as telecommunications, power and conveyors. It is envisaged that the current rail route will continue as a rail transport corridor to and from the port. Development of the EAC is expected to eventually provide an alternative rail transport corridor to and from the port. The new road/rail link over the mouth of the Ross River will improve port accessibility between the port and areas such as the Townsville State Development Area at Stuart.

B.14.3.2 Transport Analysis

An assessment of the potential traffic and transport impacts has been considered and the assumptions and findings are included in the following sections of this report.

B.14.3.2.1 Methodology

The potential impacts from the PEP on the transport systems were investigated to determine the magnitude of impact from the construction and operational phases of the PEP. The predicted increase in both construction and operational traffic volumes and the potential impact of heavy vehicle access have also been considered as part of the Environmental Impact Statement (EIS). To assess the road impact of the PEP, the traffic impact assessment has been carried out in accordance with the *Guidelines for Assessment of Road Impacts of Development 2006* (DTMR, 2006).

The DTMR as well as the Townsville City Council (TCC) were consulted to identify the current and future infrastructure provisions, including ultimate intersection configurations for the key intersections likely to be utilised by the PEP related traffic.

B.14.3.2.2 Desktop Review

To determine the baseline road traffic volumes, TCC and DTMR were consulted to agree upon the appropriate version of the strategic traffic model, Townsville Thuringowa Traffic Model (TTTM), to be adopted as part of the road traffic impact assessment for the PEP.

The TTTM is an EMME transport planning modelling software that is jointly owned by DTMR and TCC. The model is used extensively by TCC , who have developed future scenarios taking into account the future land use assumptions in accordance with the town planning schemes.

The future design years from the TTTM are 2016, 2021, 2026 and 2031. The model has included the TPAR from 2016, which provides conservative analysis against the anticipated completion date of 2012. The port related heavy vehicles will be able to use the TPAR as a direct access route to the port and avoid travelling through the residential areas as they currently do.

An update of the TTTM was completed by AECOM in 2008, including using the 2006 census data and updating the current and proposed road network known at the time. The updated 2008 TTTM was used in the traffic assessment for the TPAR. The latest version of the TTTM, used in this traffic assessment, has the following key differences when compared with the 2008 version:

- The Rocky Springs development, located approximately 15 km south-east of the Townsville CBD, was not included in the 2008 TTTM.
- Archer Street was terminated in the 2008 model to prevent through-movement (from TPAR and Benwell Road to Townsville CBD). This connection with Archer Street and the TPAR is maintained in the current TTTM. This will allow Townsville CBD related traffic to use the TPAR and Archer Street as an access route.

The daily traffic demand using the TPAR varies significantly between the two versions of the TTTM. The differences listed above are likely to be some of the main reasons for this variation. In particular, Rocky Springs, which is a substantial proposed development planned for an area the size of five Townsville suburbs and located approximately 15 km south-east of the Townsville CBD on the Bruce Highway, will generate a large number of trips in the Townsville region. This development is estimated to be home to 35,000 to 38,000 people with an expected 12,000 to 15,000 residential dwellings in addition to a planned town centre, neighbourhood hubs and community, education and employment facilities. Construction of the development is expected to begin in 2014 with an approximate completion date of 2047.

B.14.3.2.3 Analysis

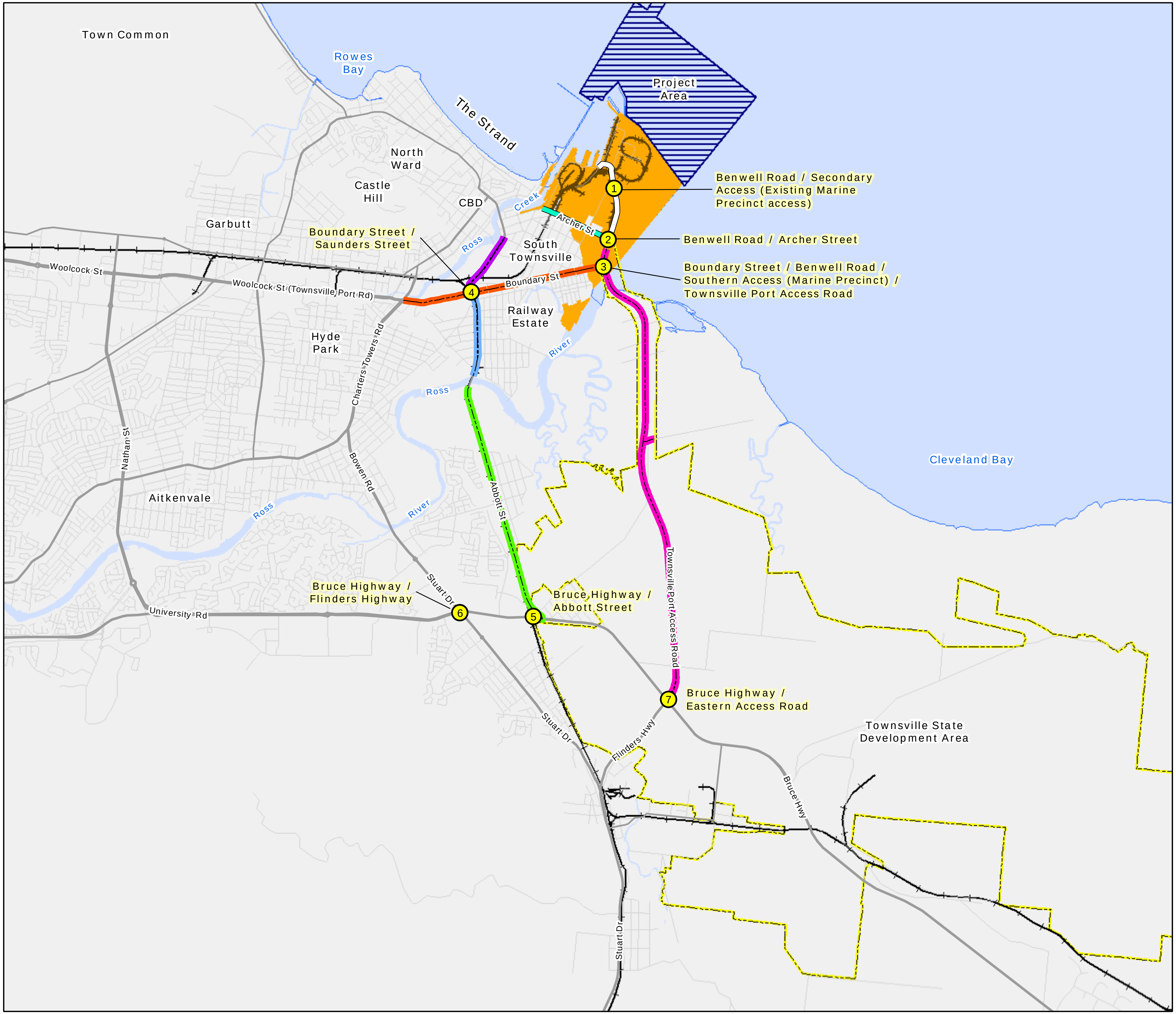
For this road related traffic impact assessment, traffic analysis of key intersections in the Study Area has been undertaken to determine the likely impact that the PEP will have on the surrounding road network. SIDRA Intersection (Version 5) (Sidra Solutions, 2011) software has been used to evaluate the intersections. SIDRA is considered to be the appropriate analysis package for these intersections due to their operational isolation.

Figure B.14.1 shows the road network surrounding the Port of Townsville, including the TPAR.

PORT EXPANSION PROJECT
EIS

Surrounding Road Network and Key Intersections

Figure B.14.1



Legend

- 1 keyIntersections
- Highways
- Main Roads
- Minor Roads
- Railway Line
- Project Area
- Townsville State Development Area
- Existing Port Land

Council Roads

- Archer Street
- Benwell Road

State-Controlled Roads

- Abbott Street
- Boundary Street
- Railway Avenue
- Saunders Street
- Townsville Port Access Road

N

Scale: 1:80,000 (when printed at A4)

0 0.5 1 2 3

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_120

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd

State Controlled Roads

State controlled roads in the Study Area potentially affected by the PEP include:

- TPAR
- Boundary Street
- Abbott Street/Railway Avenue
- Saunders Street

Council Roads

The council controlled roads in the Study Area that are potentially affected by the PEP include:

- Benwell Road (Boundary Street to Archer Street) (Urban Arterial Road)
- Archer Street (Sub Arterial Road)

The portion of Benwell Road from Boundary Street to Archer Street will become a state controlled road once TPAR is operational.

Key Intersections

Seven key intersections have been considered in the assessment:

- Intersection 1: Benwell Road/Secondary Access (existing Marine Precinct access)
- Intersection 2: Benwell Road/Archer Street
- Intersection 3: Boundary Street/Benwell Road/Southern Access (Marine Precinct)/TPAR
- Intersection 4: Boundary Street/Saunders Street
- Intersection 5: Bruce Highway/Abbott Street
- Intersection 6: Bruce Highway/Flinders Highway
- Intersection 7: Bruce Highway/Eastern Access Road

The PEP will be a staged construction subject to port needs and, as such, during later construction stages the already completed sections were assumed to be operational. Construction for Stage A of the PEP is proposed to commence in 2014 and the anticipated final Stage D completed by 2035.

The traffic analysis was carried out to determine the intersection performance under the following traffic demand scenarios during the morning and afternoon peak hours:

- base case (without the PEP traffic)
- with the PEP traffic
  - first construction stage (Stage A)
  - worst case construction stage (year to be determined)
  - PEP’s first fully operational year - opening year (2036)
  - opening year plus 10 years (2046).

The derivation of background traffic used in the analysis is discussed in Section B.14.3.3.

As the PEP stages are developed, it is necessary to include the operational traffic in the traffic analysis for the subsequent construction stages. The construction staging and timings used in this analysis are summarised in Table B.14.1.

Table B.14.1 Port Expansion Project Construction Stages

Construction Stage	Description of Works	Timing
Stage A	▪ Breakwater and reclamation bunding ▪ First stage channel deepening ▪ Partial harbour dredging and reclamation filling ▪ Two berths	2014 to 2016
Stage B	▪ Additional harbour dredging ▪ Reclamation filling ▪ One berth	2018 to 2019
Stage C	▪ Final channel deepening ▪ Complete harbour dredging and reclamation filling ▪ Continue berth construction and operation (as demand grows)	2026
Stage D	▪ Complete berth construction	2030 to 2035

Traffic generated by each construction stage varies as does that associated with the port operations. For the purpose of the traffic analysis, the total trip generation for each construction stage was estimated based on the likely employee, material, plant and support staff requirements. The trip generation for the operational phase was based on the possible employee numbers and assumed proportion of commodities that will be transported by road.

Traffic has been generated separately for the following vehicle classes and trip types:

- passenger vehicles related to construction activities
- passenger vehicles related to movement of construction related workers (i.e. to/from work)
- passenger vehicles related to operational aspects
- heavy vehicles related to construction activities
- heavy vehicles related to operational aspects

B.14.3.2.4 Assumptions

The following assumptions were applied when calculating the trip generation and directional splits for the Project.

- General assumptions
  - Average car sharing of two persons per vehicle.
- Construction related assumptions
  - Construction related traffic (both passenger and heavy vehicles) complete a return trip during each peak hour (counted as two single trips).
  - Passenger vehicles related to the movement of construction workers only complete a single trip during the peak hour, travelling to the port during the morning (AM) period and then outbound during the afternoon (PM) period. No other trips occur during peak times.
  - Construction will typically occur 24 hours per day, seven days per week. Some selected work components operate 12 hours per day, six days per week
  - The material used for the reclamation will be supplied by a nominal quarry located at Hervey’s Range, Granitevale area approximately 30 km south-west of Townsville plus other existing quarries in the Townsville Area. These quarries will supply the fill and armour rock materials (approximately 2.5 Mt maximum of fill and rock per annum for Stage A). The materials will be transported to the Project Area via heavy vehicles along Upper Ross River Road, Douglas Arterial, University Road, Abbot Street, Railway Avenue and Boundary Street. The other quarries will use Bruce Highway and the TPAR.

- Operational related assumptions
  - Operational related passenger vehicles only complete a single trip during the peak hour; travelling to the port during the morning period and then outbound during the afternoon period. No other trips occur during peak times.
  - Operational related heavy vehicles complete a return trip during each peak hour (counted as two single trips).
  - Operations will occur 365 days per annum with 12-hour shifts.
  - Once the PEP is operational the associated trips will be by either road or rail. The assumed modal splits adopted in the analysis are given in Appendix Q1.

Some of these assumptions are preliminary estimates and are considered to be relatively conservative. A proportion of the commodities have been assigned as road traffic instead of being transported by rail.

The trips generated during each construction stage vary depending on the type of work occurring at any one time. Calculations were made to determine the trips generated for each five week period throughout the construction phase. The time period that yielded the highest trip generation was then identified and the associated traffic has been used in the analysis. This has been adopted as the worst case trip generation for the construction stage.

The traffic associated with each construction stage, as well as the operational related traffic from the completed preceding stage, are summarised in Table B.14.2 and Table B.14.3, with details included in Appendix Q2. These tables provide a summary of the trips to/from the PEP during each construction stage for the morning and afternoon peak respectively. The trips generated on completion of the PEP (i.e. operations only) are included in the tables under the heading Post Construction.

Table B.14.2 Summary of Estimated Port Expansion Project Traffic –Morning Peak (vehicles/hour)

Vehicle Type	Stage A		Stage B		Stage C		Stage D		Post Construction	
	To	From	To	From	To	From	To	From	To	From
Cars – construction	12	12	8	8	8	8	12	12	0	0
Cars – workers	123	0	60	0	60	0	99	0	60	0
Cars – operations	0	0	30	0	45	0	60	0	90	0
Trucks – construction	12	12	1	1	1	1	2	2	0	0
Trucks – operations	0	0	6	6	11	11	17	17	20	20
Total Vehicles	**147**	**24**	**105**	**15**	**125**	**20**	**190**	**31**	**110**	**20**

Table B.14.3 Summary of Estimated Port Expansion Project Traffic – Afternoon Peak(vehicles/hour)

Vehicle Type	Stage A		Stage B		Stage C		Stage D		Post Construction	
	To	From	To	From	To	From	To	From	To	From
Cars – construction	12	12	8	8	8	8	12	12	0	0
Cars – workers	0	123	0	60	0	60	0	99	0	60
Cars – operations	0	0	0	30	0	45	0	60	0	90
Trucks – construction	12	12	1	1	1	1	2	2	0	0
Trucks – operations	0	0	6	6	11	11	17	17	20	20
Total Vehicles	**24**	**147**	**15**	**105**	**20**	**125**	**31**	**190**	**20**	**110**

The tables show that Stage D generates the highest traffic volume (221 total vehicles per hour). This stage can be considered the critical construction stage in terms of traffic generation and potential impacts on the surrounding road network. Subsequently, traffic generated during Stage D is referred to as the worst case for PEP traffic and the final year of Stage D has been assigned as the assessment year for the construction phase (i.e. 2035). The post construction, i.e. without the construction related traffic, there is an overall reduction in total traffic associated with the PEP (from 221 to 130 vehicles per hour).

Traffic generated by the PEP was distributed onto the surrounding road network based on the locations of the residential areas in Townsville (workforce), the location of the quarry (construction material) or where more detailed data were not available (other construction related material and various commodities from the operational phase), the distribution was assumed.

Construction related trips were distributed onto the road network based on the origin/destination assumptions shown in Table B.14.4. Operation related trips were distributed onto the road network based on the origin/destination assumptions shown in Table B.14.5.

For the purpose of the traffic analysis, a potential worst case traffic distribution has been assumed to determine the operational efficiencies of the key intersections. Vehicles that originate or have a destination in the south have been assumed to travel via the TPAR. Other vehicles (accessing to/from the north and west) were assumed to travel to/from the port via Boundary Street. Although traffic to/from the west are likely to use the Stuart Bypass and TPAR to access the port, the assumed distribution will provide the worst case in terms of PEP related traffic travelling to and from the port via Boundary Street.

Table B.14.4 Trip Distribution – Construction Related Traffic (Peak Periods)

Vehicle Type	North (%)	West(Townsville) (%)	South (%)
Cars	10	80	10
Cars - workers	10	80	10
Trucks-	0	0	100

Table B.14.5 Trip Distribution – Operations Related Traffic (Peak Periods)

Vehicle Type	North (%)	West(Townsville) (%)	South (%)
Cars	10	80	10
Trucks	16	45	39

Guidelines for Assessment of Road Impacts of Development 2006 (DTMR, 2006) state that, in general, a development's road impacts are considered to be insignificant if the development generates an increase in traffic on the surrounding road network of no more than 5% of background traffic levels (DTMR, 2006). This assessment only considered those intersections where the PEP related traffic is greater than 5% of the background traffic volumes.

Calculations were undertaken to identify which of the seven key intersections require assessment to determine the impact from the PEP. Table B.14.6 summarises the contribution the PEP will have on the existing road network traffic volumes for the morning peak in 2035, 2036, and 2046. Table B.14.7 summarises the afternoon peak existing road network traffic volumes. The volumes in the tables represent total intersection volumes. The percentage of additional traffic was also calculated for each vehicle movement at the intersections (Appendix Q2).

Table B.14.6 Contribution of Development Traffic to Intersections – Morning Peak (vehicles/hour)

Location	Background Traffic			Additional (PEP) Traffic			% Additional		
	2035	2036	2046	2035	2036	2046	2035	2036	2046
1) Benwell Road/Secondary Access	108	108	108	221	131	131	205	121	121
2) Benwell Road/Archer Street	244	245	261	221	131	131	91	53	50
3) Boundary Street/Benwell Road/TPAR	2,365	2,417	3,048	221	131	131	9	5	4
4) Boundary Street/Saunders Street	3,633	3,633	4,021	186	106	106	5	3	3
5) Bruce Highway/Abbott Street	3,009	3,053	3,520	0	0	0	0	0	0
6) Bruce Highway/Flinders Highway	4,420	4,475	5,073	0	0	0	0	0	0
7) Bruce Highway/TPAR	3,832	3,919	4,915	36	25	25	1	1	1

Table B.14.7 Contribution of Development Traffic to Intersections – Afternoon Peak (vehicles/hour)

Location	Background Traffic			Additional (PEP) Traffic			% Additional		
	2035	2036	2046	2035	2036	2046	2035	2036	2046
1) Benwell Road/Secondary Access	109	109	109	221	131	131	204	120	120
2) Benwell Road/Archer Street	255	257	274	222	131	131	87	51	48
3) Boundary Street/Benwell Road/TPAR	2,747	2,803	3,446	221	131	131	8	5	4
4) Boundary Street/Saunders Street	4,651	4,707	5,312	186	106	106	4	2	2
5) Bruce Highway/Abbott Street	3,895	3,958	4,655	0	0	0	0	0	0
6) Bruce Highway/Flinders Highway	5,300	5,368	6,095	0	0	0	0	0	0
7) Bruce Highway/TPAR	4,879	4,990	6,258	35	25	25	1	1	0

Due to the reduction in construction traffic, once construction is completed in 2036, the overall percentage of additional traffic will be less than that in 2035.

Table B.14.6 and Table B.14.7 show that, by considering the contribution the development will have on background traffic in 2035 (i.e. at or above the 5% threshold), four of the seven key intersections require assessment when the total intersection volumes are used in further calculations.

The data in Appendix Q3 show that when the percentage of additional traffic was calculated for individual movements, several movements at the Bruce Highway/TPAR intersection were above 5%. This intersection was also assessed. The five intersections assessed are:

- Intersection 1: Benwell Road/Secondary Access
- Intersection 2: Benwell Road/Archer Street
- Intersection 3: Boundary Street/Benwell Road/Southern (primary) Access/TPAR
- Intersection 4: Boundary Street/Saunders Street
- Intersection 7: Bruce Highway/TPAR

B.14.3.3 Road Traffic Modelling

The Townsville CBD SATURN[1] model is not appropriate to use in this assessment as it does not include the TPAR and areas south of the port. The background traffic volumes used in the traffic analysis were extracted from the TTTM (Version 3) created using the EMME platform.

In this version of the TTTM model, the TPAR is a two-lane, two-way carriageway for the future design years. It does not include the potential future upgrade to four lanes to cater for the increase in traffic demands. No changes have been made to the TTTM as part of this EIS, although the SIDRA analysis for 2035 and beyond has modelled the TPAR as a four-lane carriageway.

The model trip-ends for the port area were reviewed to determine whether the PEP, intensification of port activity on the existing port land and the Townsville Marine Precinct were included in the model. The model allows for some intensification of the existing port site, but does not include the traffic related to the Townsville Marine Precinct or the PEP. A conservative approach has been taken that assumes the outputs from the TTTM model do not include these aspects.

In order to determine the background traffic to be used in the analysis, the future traffic generated by the Townsville Marine Precinct was manually added to the outputs from the TTTM.

The Townsville Marine Precinct project involves port expansion consisting of mostly marine-related light industry uses on the eastern side of the port. This is also a staged development that will be fully operational in 2017. A Traffic Impact Assessment Report was prepared by (GHD, 2009g) for the Townsville Marine Precinct Project EIS. The report identifies that access to the development is at two

[1] SATURN is a suite of flexible network analysis programs developed at the Institute for Transport Studies, University of Leeds.

locations on Benwell Road. The primary access will be at the intersection of Boundary Street/Benwell Road/TPAR. The Townsville Marine Precinct access will form the fourth leg of the signalised intersection. The secondary access is to the north of Archer Street on Benwell Road.

The Townsville CBD SATURN model for 2031 includes the Townsville Marine Precinct, but only the primary access has been modelled. The traffic demand to/from the Townsville Marine Precinct was compared between the SATURN model and that presented in the GHD report. The demand estimated in the GHD report is slightly higher and can be considered a worst case traffic scenario. The estimated traffic volumes associated with the Townsville Marine Precinct development are based on the GHD report for 2027 when the precinct is fully operational (GHD, 2009g).

The TTTM was provided to AECOM for 2016, 2021, 2026 and 2031. The annual growth rate between 2026 and 2031 was calculated, based on compound growth, and was applied to the 2031 traffic volumes to obtain the background traffic for the analysis years 2035, 2036 and 2046. No growth was applied to either the Townsville Marine Precinct or PEP traffic volumes.

B.14.3.4 Rail Transport

The Port of Townsville is served by two major rail lines:

- Mount Isa Line transports cargo to and from the mining industry in the north west Queensland minerals province
- North Coast Line transports mainly sugar and molasses to the port, nickel ore to Yabulu refinery and zinc concentrates to Sun Metals located in the Townsville State Development Area.

Approximately 80% of the port's cargo was transported by rail (8.9 Mt of the 11 Mtpa of cargo) during 2010/2011. This high proportion of cargo is due to the dominance of bulk cargo that is handled through the port.

This section discusses:

- the existing rail infrastructure network and an outline of the key rail components in the existing inner harbour
- the planned development of the rail access to the port via the EAC
- the PEP rail layout and linkages to the rail network
- forecast rail traffic for the EAC

B.14.3.4.1 Existing Infrastructure to Port of Townsville

Rail access to the Port of Townsville is provided via the Townsville Jetty Line from South Yard. The Townsville Jetty Line travels alongside Perkins Street and crosses three level crossings (Morey, Allen and Archer streets) in South Townsville before entering the port precinct. Allen and Archer streets are both protected by boom gates and signals; Morey Street is protected by signals only, with no boom gates. A pedestrian level crossing, protected by warning signs, is provided to connect two sections of Cannan Street. The area alongside Townsville Jetty Line is predominantly residential. Train speeds are limited to 15 km/h.

South Yard is used for holding trains prior to entering the port and prior to joining the North Coast Line . It is also used for wagon maintenance, in particular refrigerated wagons, and for intermodal movements of shipping containers. It connects to the North Coast Line via a triangle that allows trains travelling north or south to directly access the yard. The maximum length of train that can be held in South Yard is approximately 850 m.

Trains accessing the port service a variety of locations on the rail network. Nickel ore imported through the port is destined for Yabulu, north of Townsville on the North Coast Line . Sugar arrives at the port from a variety of refineries surrounding Townsville, predominantly located along the North Coast Line . The majority of bulk materials exported through the port are transported to the port via the MIL. The Mount Isa Line connects to the North Coast Line south of Stuart Yard.

The line diagrams in Figure B.14.2 and Figure B.14.3 show the existing rail infrastructure leading to the port from the North Coast Line and Mount Isa Line.

B.14.3.4.2 Existing Port Rail Infrastructure

The historical development of the Port of Townsville has led to a complex and relatively ineffective layout of rail transport corridors in the port. There is currently competing demands of various port tenants for rail infrastructure access, which requires extensive coordination to maximise material throughput.

The main components of the existing rail infrastructure in the port (Figure B.14.2) are:

- balloon loop, unloader, and holding roads for sugar
- Xstrata tippler on siding and holding roads
- sidings along Berths 2 and 3
- siding for unloading fertiliser and loading of sulphur
- cement sidings
- balloon loop with Cannington inner track and nickel ore outer track with associated loaders/unloaders

There are a large number of level crossings in the port precinct. The level crossings are required to access lease areas in the balloon loops, and other areas isolated by the complex rail geometry. Currently many of the level crossings are blocked frequently and sometimes for extended periods as trains are shunted to stabling, loading, and unloading locations.

The level crossings reduce the capacity of both the road and rail networks to service the port. There are restrictions on the maximum train length for each section of the port due to the position of the loaders/unloaders relative to critical level crossings. As this restriction is less than the maximum allowable train length on the Mount Isa Line for some bulk materials, trains are separated at the Stuart Yard before entering the port. This creates inefficiency in the supply chain operations.

The current geometry of the rail infrastructure includes small radius curves (down to 130 m) and some reverse curves that result in increased maintenance costs for track and rolling stock. The power use of the locomotives is also increased due to the increased forces required to pull the train through the tight curves. The track between the Xstrata roads and the balloon loops is also a restriction on operations as there is only one track for movements in to and out of the balloon loops, cement sidings, and berth roads.

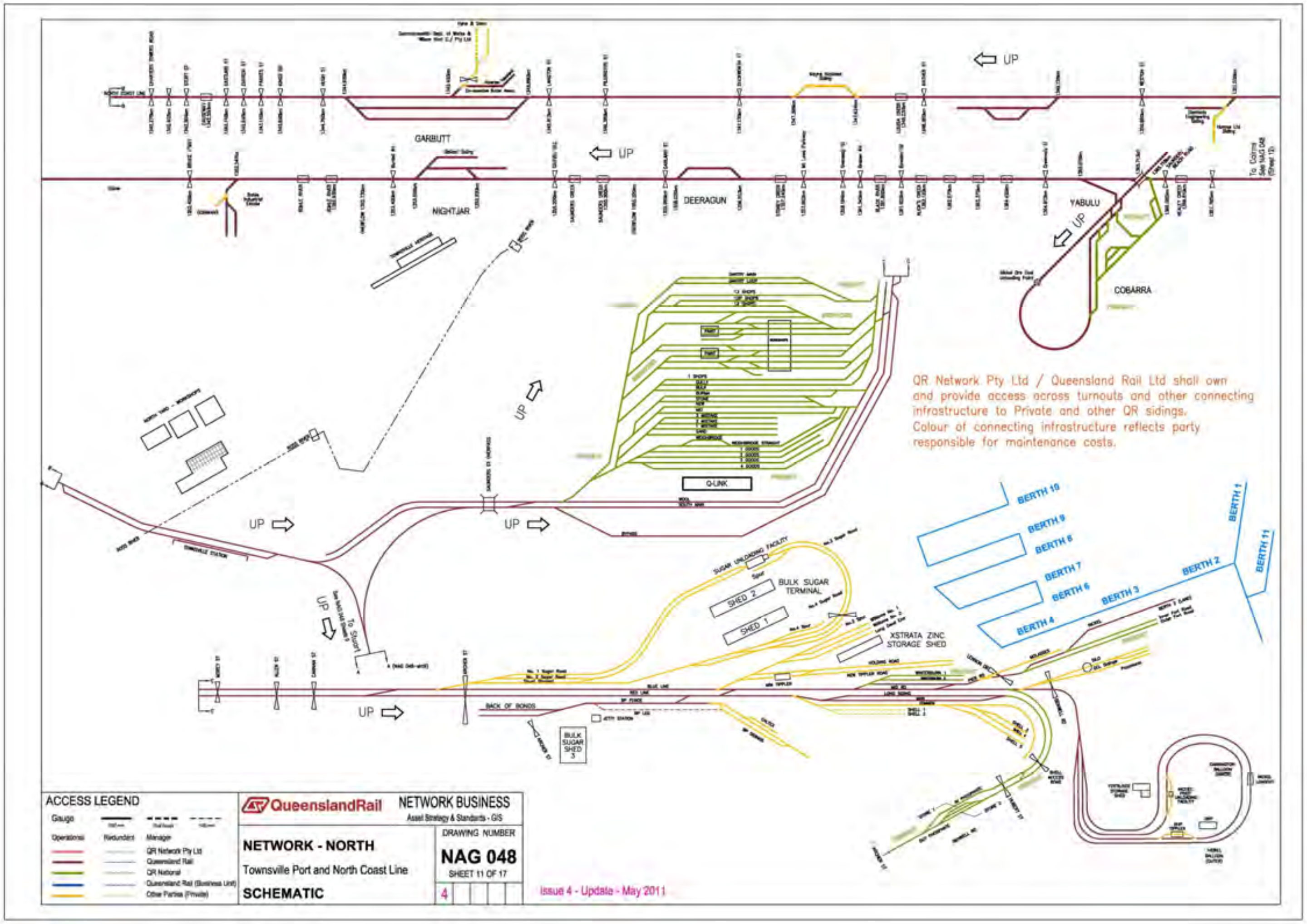


Figure B.14.2 Line Diagram of Existing Rail Infrastructure In and Around the Port of Townsville (QR, 2011)

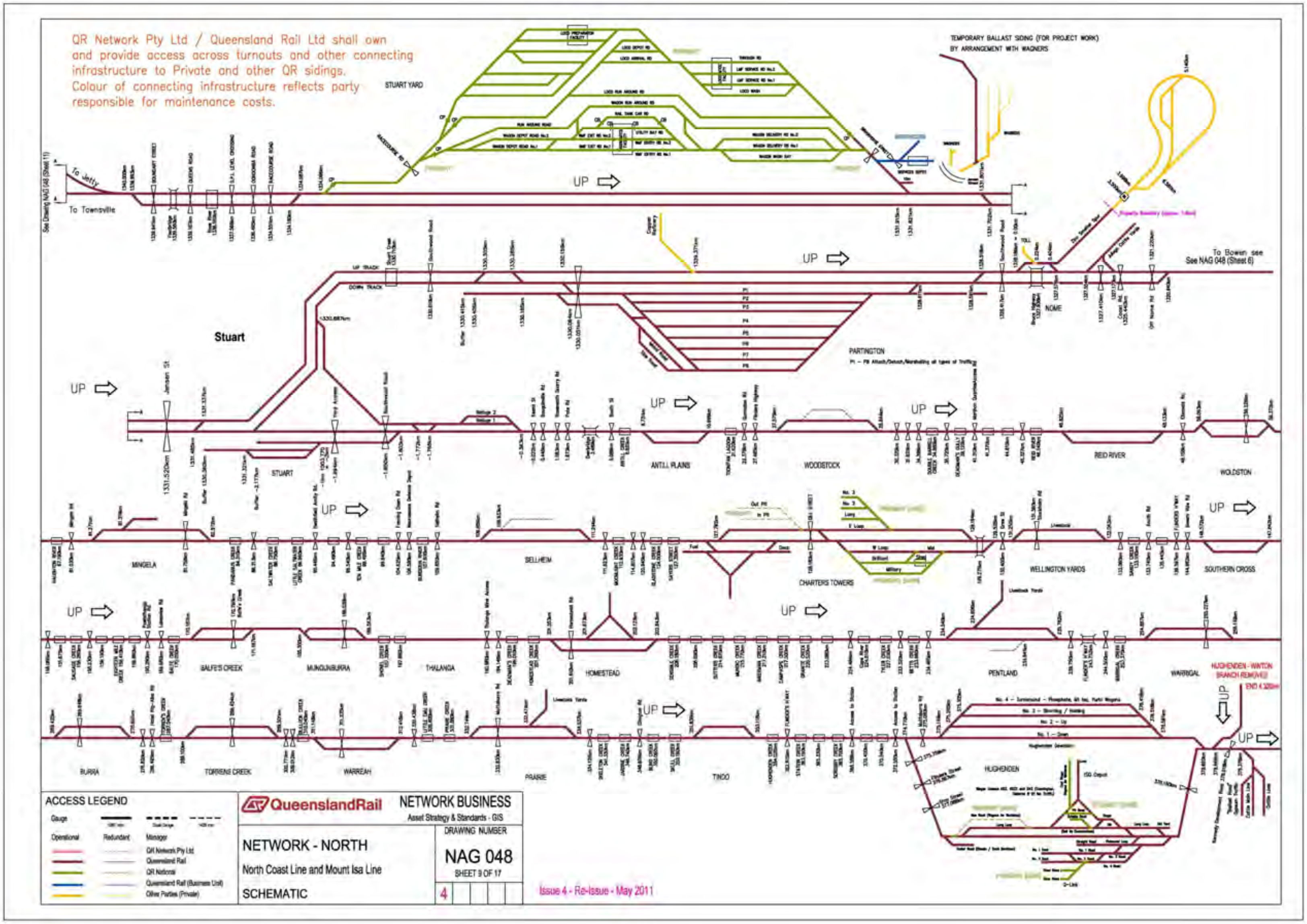


Figure B.14.3 Line Diagram of Existing Rail Infrastructure (North Coast and Mount Isa lines) Leading to the Port of Townsville (QR, 2011)

B.14.3.4.3 Rail Infrastructure Planning

Rail Access

The *Mount Isa Rail Infrastructure Master Plan* (QR, 2012) recognised the limitations of the port rail access in terms of its capacity and route through urban areas. It estimated that the port would be constrained to approximately 10 Mtpa of rail cargo. Thereafter a new rail access via the EAC would be required. Urban amenity would constrain major upgrades to the existing access. A rail corridor earmarked through the Townsville State Development Area will have significant benefits for the rail operations and the expansion of the port:

- level crossings are avoided for the rail access to port
- rail traffic along the existing network will relieve urban amenity issues
- longer train lengths can be accommodated resulting in a more efficient rail operation
- it provides an opportunity to re-direct some of the existing rail traffic away from urban areas.

Rail in the EAC will be an essential transportation link for the PEP development. The key drivers for the development of the PEP are likely to derive from high tonnage throughput bulk commodities as identified in the trade forecast e.g. coal, mineral concentrates, fertiliser and magnetite. These commodities will trigger the need for the development of rail access via the EAC because of the capacity limitations of the existing rail network. One or more of these commodities could be handled via Berth 12 from a terminal in the existing Eastern Reclamation Area prior to the PEP development, and could possibly require the development of rail access via the EAC prior to the PEP.

During the consultation with Queensland Rail, it was identified that there is a need to continue the collaborative development of a long-term strategy for the interface between rail and port infrastructure so the network can be made as efficient as possible. This expected to lead to

- a reduction in cycle times to deliver product from its origin to vessels for transport
- cost efficiencies for port and rail operations, which will benefit the client
- reduction of the quantity of assets to deliver the needs of the client.

The consultation opportunities derived as part of the EIS is another step towards achievement of this goal.

Outer Harbour Rail Loop

The reclamation area associated with the PEP has been configured to accommodate a rail loop that could have up to three separate tracks, each with a loading/unloading station. The size and layout of the rail loop was a significant consideration in the overall PEP layout, sizing the reclamation footprint and the construction sequencing.

The rail loop will be founded on a rockfill bund so that rail operations can be accommodated from Stage A. The actual development of the rail tracks and rail loading/unloading infrastructure will be done according to the need for capacity.

The preferred rail loop layout is shown in Figure B14.4. It has been configured so that:

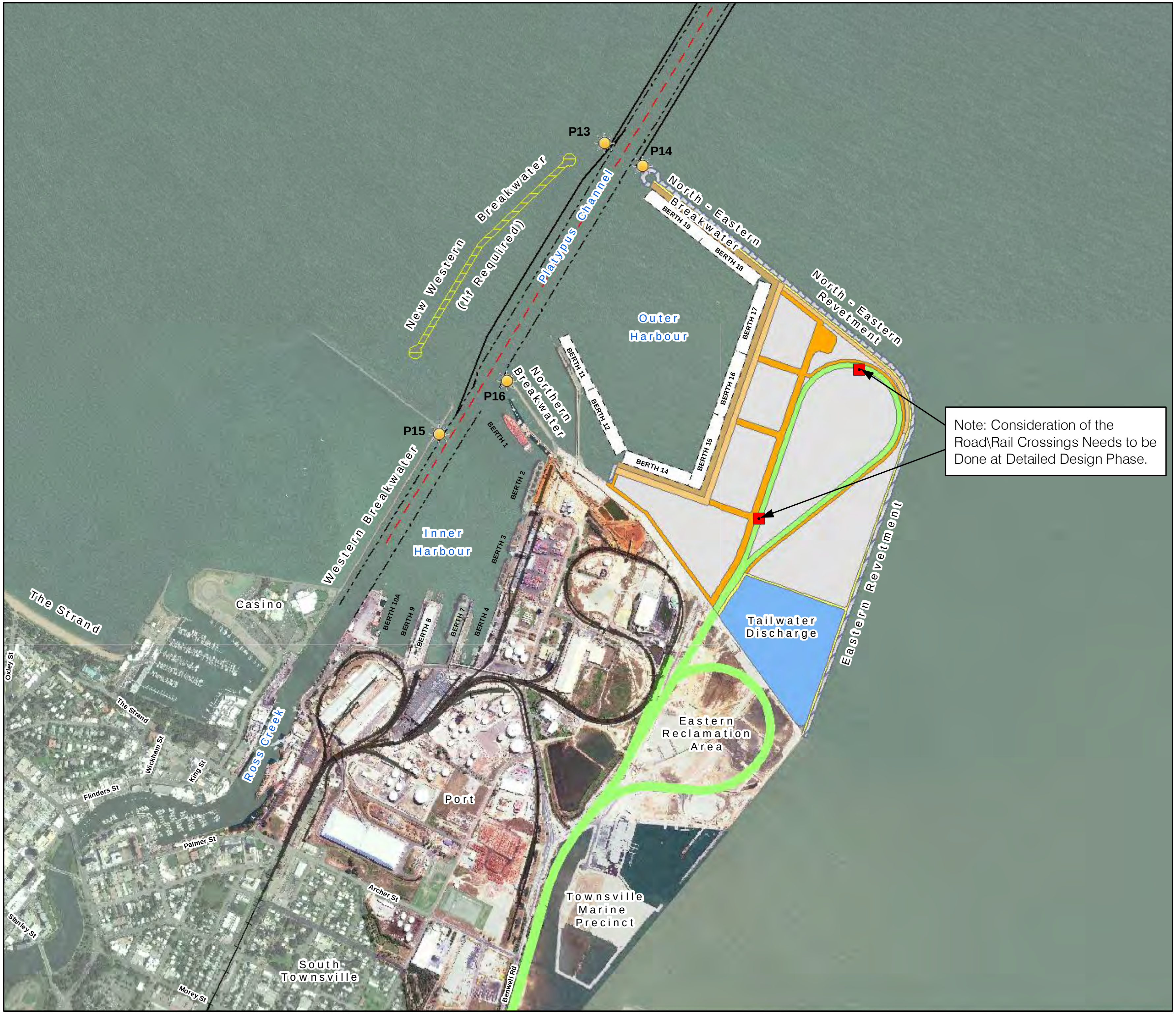
- It provides suitable interaction with the previously designed Eastern Reclamation Area. The loop layout is aligned to link to a rail corridor on the Eastern Reclamation Area adjacent to the existing rail loops for fertiliser, mineral concentrates (Berth 11) and nickel ore.
- Maximises the available radius given the constraints of the berth face clearance and channel restrictions for Ross River to the east.
- Grade crossings of the corridor in the expansion area are not required for general road traffic, and that land use in the balloon loop is focused on users of the rail network to reduce the number of crossings required.
- A 250 m clearance from the berth face is required to provide adequate operational and storage space for port operations that are best located close to the wharf.
- The loop will accommodate three separate tracks with service roads.

The rail loop will have a radius of 200 m and be able to accommodate trains of up to 1,500 m in length. Queensland Rail has accepted the adopted layout for purposes of a concept for consideration in the EIS.

The number and type of loaders/unloaders required for the outer harbour facility will be dependent upon a number of factors, including:

- tonnage, types and mix of bulk materials
- peak capacity requirements and the available storage area
- seasonal nature of the product, if any
- the loader/unloader material rate

The existing rail infrastructure in the Port of Townsville is owned by a number of parties (Queensland Rail, QR National and POTL). The ownership model for the PEP rail infrastructure has not been determined. POTL is planning to achieve far greater efficiency and use of rail facilities compared with the existing port rail infrastructure. POTL may elect to own the rail infrastructure in the PEP. This will be determined at the time of development.



PORT EXPANSION PROJECT
EIS

Layout of Rail Loop

Figure B.14.4

Legend

- Road\RailCrossing
- Navigation Beacon
- Railway Line
- Access Road and Service Corridors
- Berths
- Cargo Transfer and Operations
- Dredging Reserve
- Perimeter Access Road "2 Way"
- Port Operations
- Future Railway Corridor
- Revetment
- Western Breakwater
- Wharf

N

Scale: 1:20,000 (when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_90

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Image - Port of Townsville 2011
PEP Layout - AECOM 2012
Existing Rail - Schlencker Mapping Pty Ltd

B.14.3.4.4 Rail Traffic

Existing Network Traffic

The existing rail network access to the port is parallel to Perkins Street with the Townsville South Yard being used to makeup, breakup and stage trains. The existing train traffic in and out the port from Townsville South Yard (comprising bulk, freight, shunt and inspection trains) is estimated to be in the range of 40 to 50 trips per day outside of the sugar season, increasing to approximately 50 to 60 trips per day during the season. The bulk and freight trips comprise a wide range of train lengths depending on the port facility being serviced.

The average train payload is estimated between 1,000 to 1,200 tonnes. These relatively low train payloads are as a result of:

- multiple products of both containerised and general freight forms
- a complex rail infrastructure network with numerous rail and road interactions
- the need to breakup/makeup and shunt individual wagon strings
- low rate of cargo transfer at a proliferation of dedicated rail facilities.

Parts of the existing rail infrastructure servicing the Port of Townsville are not fully used under the current trade quantities. As a result of conflicts in the rail network, without detailed modelling of the existing infrastructure under various train movements, it is not possible to quantify the additional capacity that may be gained.

The *Mount Isa Rail Infrastructure Master Plan* (QR, 2012) presents a high level review of available capacity. In summary, the analysis shows that the most constrained sections of the port rail infrastructure are the outer balloon loop (QNI nickel load-out and BHP tippler) and the entrance to the port alongside Perkins Street. It is anticipated that the entrance to the port is more constrained than is presented in the master plan, as the sugar trade is concentrated over an approximate 6 month period, in contrast to the 12 month period assumed in the master plan.

Forecast Rail Traffic

A rail traffic forecast was prepared for the Port of Townsville using the following steps:

- a forecast of the likely mode of transport and a modal split undertaken for each commodity type in the trade forecast was considered
- each commodity type was allocated to either the existing port network or new rail access via the EAC
- a forecast of train payload was applied to each commodity that would be transported via rail along the EAC.

Figure B.14.5 shows the expected modal split for tonnages transported by rail, road and pipeline over the PEP planning horizon for the existing port and PEP facilities. Table B.14.8 presents the modal split as percentages. The dominance of rail transport increases (currently 80% and could increase to over 90% by 2040) for the port due to the high growth of existing dry bulk cargoes (mainly nickel ore and mineral concentrates) and new dry bulk export trades (particularly coal, magnetite and fertiliser), which will be transported by rail.

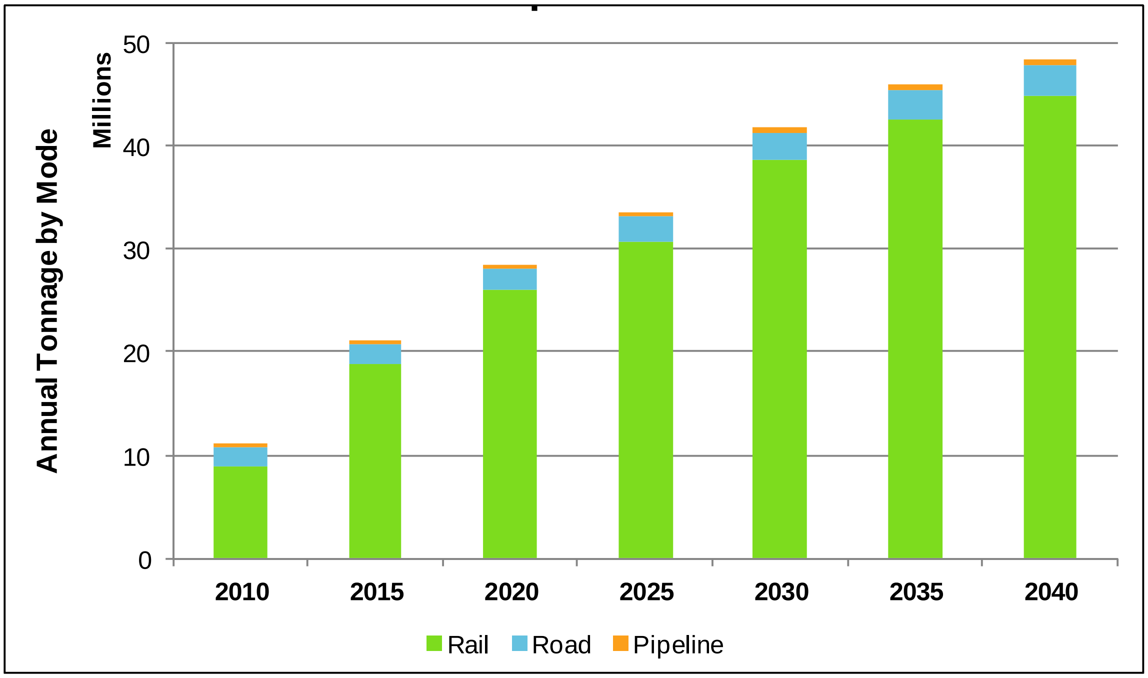


Figure B.14.5 Forecast Land Transport Modal Split

Table B.14.8 Forecast Land Transport Modal Split

Mode of Transport	Modal Split (%)						
	2010	2015	2020	2025	2030	2035	2040
Rail	81.8	89.3	91.4	92.0	92.3	92.7	92.6
Road	16.5	9.2	7.4	6.9	6.3	6.0	6.1
Pipeline	2.7	1.4	1.2	1.1	1.4	1.2	1.3

A forecast split of rail tonnages expected to access the port via the existing rail line and the EAC is shown in Figure B.14.6. This split assumes that a number of commodities transported through the existing port network will be directed through EAC, if it is feasible and beneficial for operations.

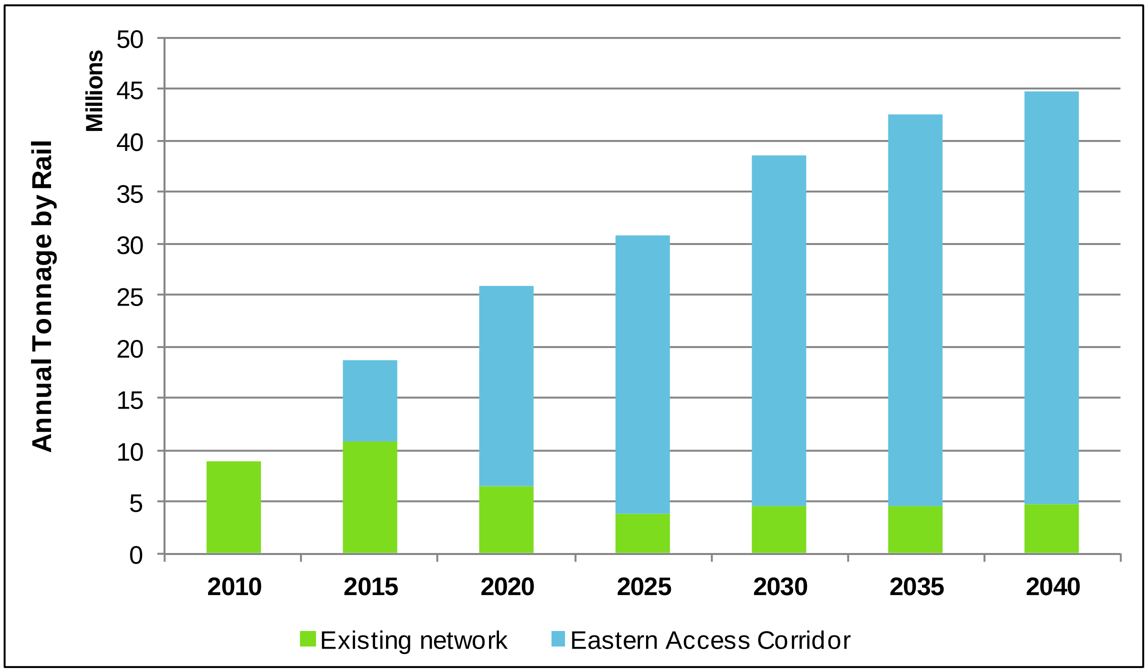


Figure B.14.6 Forecast Tonnages Transported via Existing Rail Network and EAC

Train payloads were estimated for the individual commodities expected to be transported along the EAC so that an indicative EAC traffic forecast could be estimated. There are a number of factors that affect the train payload, which can vary considerably depending on operating conditions. This can result in a wide range of daily rail trips. A summary of the rail forecast, a range inclusive of empty trips, is shown in Figure B.14.7.

The average train payload for cargo transported via the EAC will vary over the planning horizon depending on the cargo mix. It is expected that the average train payload will be in the order of 2,000 to 3,000 t, which will be substantially more efficient than the average payload of trains carrying cargo on the existing port network (range of 1,000 to 1,200 t). It would be possible to unload trains with a payload of up to 6,000 t in the PEP rail loop.

The EAC will create opportunity for some of the inner harbour rail traffic to be routed via this new link. This will reduce the rate of rail traffic movements on the existing network and reduce the level of impact on public amenity. A forecast of the traffic on the existing network is shown in Figure B.14.8.

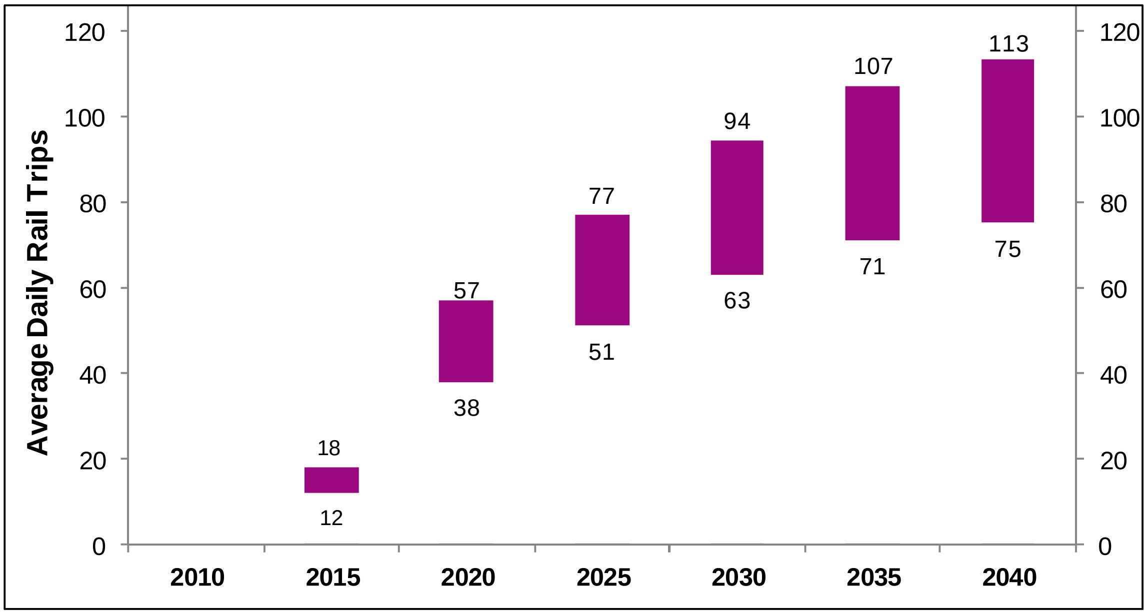


Figure B.14.7 Forecast Rail Traffic on EAC (range of loaded and unloaded trips to inner harbour and PEP)

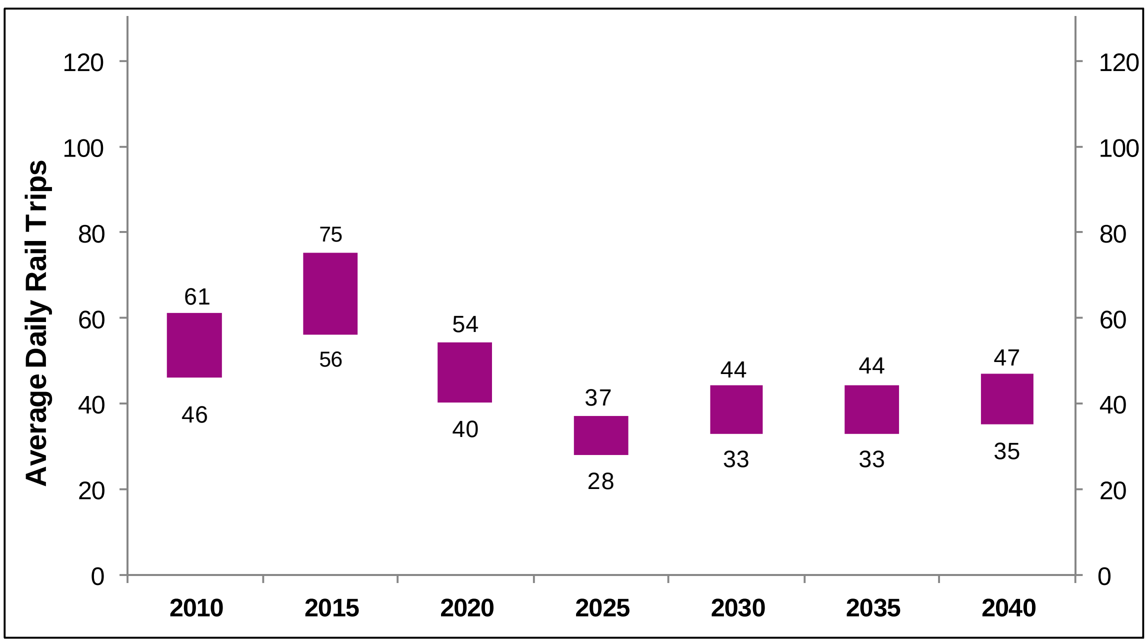


Figure B.14.8 Forecast Rail Traffic on Existing Network (range of loaded and unloaded trips to inner harbour)

B.14.4 Assessment of Potential Impacts

B.14.4.1 Intersection Assessment

The roadway intersection analysis was undertaken using SIDRA Intersection for 2014, 2035, 2036 and 2046. The analysis was carried out to determine the intersection performance during the morning and afternoon peak hours for the base case (without PEP traffic) and with PEP traffic. The conditions applied to the PEP scenarios were:

- 2014 - Stage A
- 2035 - Worst case scenario (Stages A to C)
- 2036 - PEP's first fully operational year, 'opening year'

- 2046 - 'opening year' + 10 years

Intersection performance summaries for each intersection are presented in the following section for the 'with PEP' (wPEP) and 'without PEP' (woPEP) scenarios.

The following assumptions were applied to the SIDRA models:

- all parameters were kept at default values, including the peak flow factor of 95% and lane widths
- no information was provided on future pedestrian volumes and a volume of 50 pedestrians per hour was applied to signalised pedestrian crossings.

As a starting point, the intersection layouts and signal phasing sequences from the *Townsville Marine Precinct Environmental Impact Statement* (GHD, 2009) were used in the SIDRA analysis. As noted in Section B.14.3.3 the traffic demand derived for the Townsville Marine Precinct Development Project is slightly higher when compared to the TTTM and can be considered as the worst case traffic scenario.

Four key intersection performance measurements (degree of saturation, average vehicle delay, queue length and level of service) are reported for each movement and approach in the detailed SIDRA results in the appendices.

These measures are defined as:

- Degree of Saturation (DOS): the ratio of demand flow (or number of vehicles) to the physical capacity of the intersection or approach, and is usually represented by a value that lies between zero and one. A DOS in excess of one indicates long delays and congestion. Also known as volume/capacity, v/c ratio.
- Average delay: the difference in seconds between interrupted and uninterrupted travel times through an intersection. The average delay means that longer delays will be actually experienced by some vehicles. An increase in traffic volumes through the intersection may result in a lower average delay if, for example, the additional traffic volumes are in the dominant intersection movements.
- Queue length: the length to the back of the queue for a particular approach, which 95% of observed cycle queue lengths fall below.
- Level of service (LOS): describes the operating conditions at an intersection and its perception by road users in terms of factors such as speed and travel time. The SIDRA analyses reports the LOS based on delay thresholds (in seconds) as defined in the *Highway Capacity Manual (HCM 2010)*. LOS is not calculated for two-way, sign-controlled intersections and 'not applicable' is displayed in the SIDRA outputs. The uncontrolled major road movements experience little delay and as a result the average intersection delay does not reflect the delay levels of minor movements subject to sign control. LOS is measured from A to F and is generally described as follows :

  A – excellent free flow operation

  B – good free flow operation

  C – fair free flow operation

  D – approaching unstable flow operation

  E – flow unstable, close to breakdown (forced flow)

  F – breakdown – forced flow with long queues and delays.

The following performance measurements for the intersection are presented in the SIDRA results summary tables in this section:

- intersection DOS: the maximum DOS for any movement in the intersection
- intersection average delay: the average delay for vehicles in the intersection
- intersection queue length: the maximum queue length for any movement in the intersection
- LOS average intersection delay: the LOS based on the average delay for vehicle movements in the intersection.

Intersections operating at unacceptable limits may require upgrading to manage the forecast traffic flow.

B.14.4.1.1 Intersection 1: Benwell Road/Secondary Access

This intersection was modelled for the Townsville Marine Precinct EIS under three different control types for the future year; priority control (give way/stop sign), roundabout and traffic signals. The results from this study showed that a priority-controlled (give way) intersection will operate in acceptable conditions under the traffic demand anticipated from the Townsville Marine Precinct. As a starting point for this analysis a give way controlled intersection was modelled in SIDRA. The indicative intersection layout modelled is shown in Figure B.14.9.

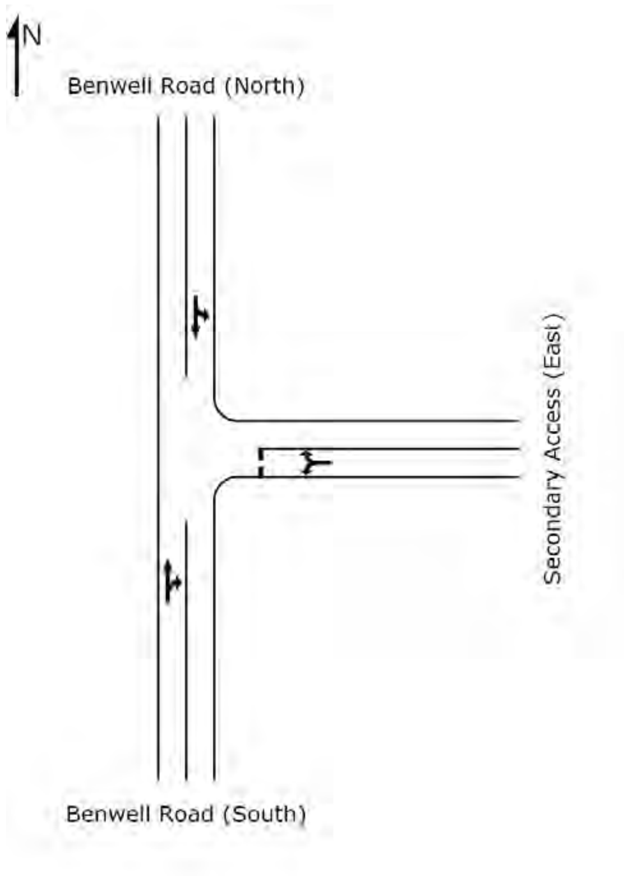


Figure B.14.9 Intersection 1: Indicative Intersection Layout

Under the projected traffic volumes Intersection 1 will operate acceptably for modelled future years as a simple give way, priority-controlled intersection (Table B.14.9). The detailed results from the SIDRA analysis are included in Appendix Q4.

Table B.14.9 Intersection 1: SIDRA Results Summary

Year	Scenario	Morning				Afternoon			
		Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS	Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS
2014	woPEP	0.074	3	9	N/A	0.201	9	8	N/A
	wPEP	0.127	7	5	N/A	0.252	12	6	N/A
2035	woPEP	0.047	2	6	N/A	0.056	2	6	N/A
	wPEP	0.158	8	2	N/A	0.120	3	2	N/A
2036	woPEP	0.047	2	6	N/A	0.056	2	6	N/A
	wPEP	0.115	6	3	N/A	0.078	2	3	N/A
2046	woPEP	0.047	2	6	N/A	0.056	2	6	N/A
	wPEP	0.115	6	3	N/A	0.078	2	3	N/A

B.14.4.1.2 Intersection 2: Benwell Road/Archer Street

This intersection was modelled for the Townsville Marine Precinct EIS under three different intersection control types for the future year: priority control (give way/stop sign), roundabout and traffic signals. The results from this study showed that a priority-controlled (stop sign) intersection would operate above acceptable limits under the traffic demand anticipated from the Townsville Marine Precinct traffic. As a starting point for this analysis, a stop sign controlled intersection was modelled in SIDRA. The indicative intersection layout modelled is shown in Figure B.14.10.

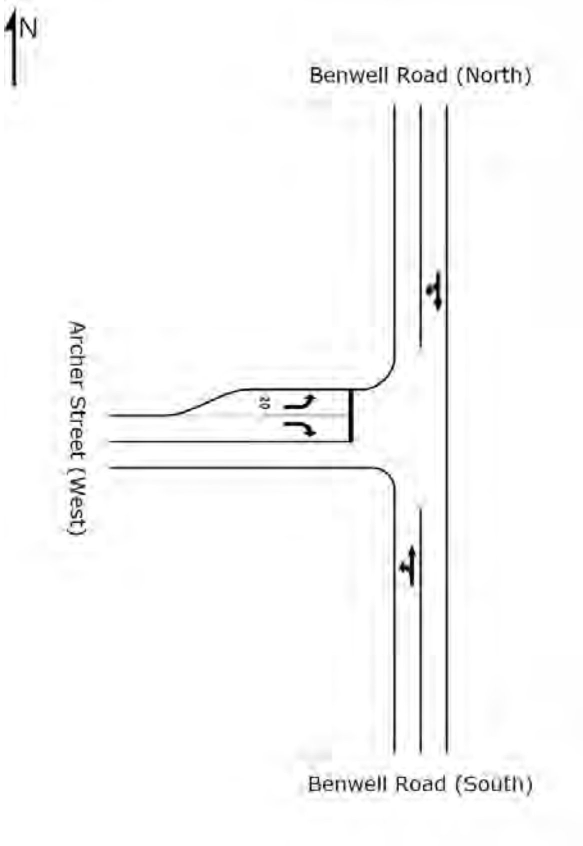


Figure B.14.10 Intersection 2: Indicative Intersection Layout

Under the projected traffic volumes Intersection 2 will operate acceptably for modelled future years as a simple stop sign, priority-controlled intersection (Table B.14.10). The detailed results from the SIDRA analysis are included in Appendix Q5.

Table B.14.10 Intersection 2: SIDRA Results Summary

Year	Scenario Without PEP × With PEP √	Morning				Afternoon			
		Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS	Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS
2014	×PEP	0.063	2	5	N/A	0.050	3	5	N/A
	√PEP	0.140	2	3	N/A	0.128	7	3	N/A
2035	×PEP	0.080	3	6	N/A	0.071	3	6	N/A
	√PEP	0.189	4	3	N/A	0.165	10	4	N/A
2036	×PEP	0.081	3	6	N/A	0.072	3	6	N/A
	√PEP	0.147	3	4	N/A	0.122	7	4	N/A
2046	×PEP	0.087	3	6	N/A	0.087	3	6	N/A
	√PEP	0.153	4	4	N/A	0.122	7	5	N/A

B.14.4.1.3 Intersection 3: Boundary Street/Benwell Road/Southern Access/TPAR

This intersection was modelled for the Townsville Marine Precinct EIS as a four-way, signalised intersection as shown in Figure B.14.11.

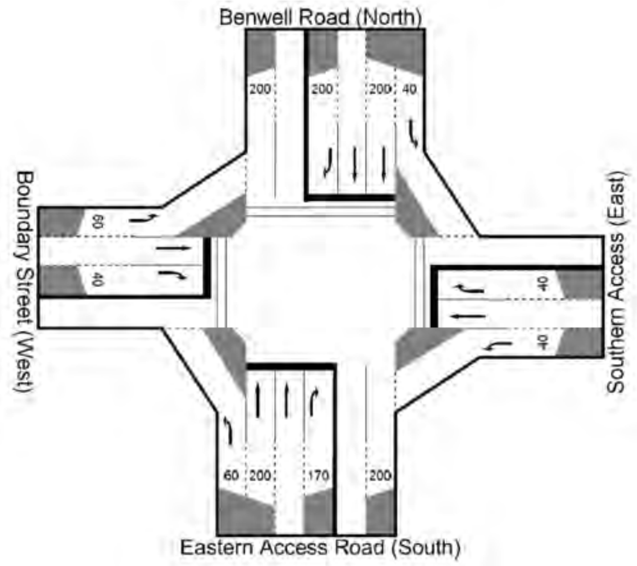


Figure B.14.11 Intersection 3: Indicative Intersection Layout (GHD, 2009g)

The left turn from TPAR into Boundary Street and the corresponding right turn from Boundary Street into TPAR shown in this layout will be banned. As such, for the assessment presented in this report this intersection has been modelled in 2014 with these turns banned and TPAR as a two-lane, two-way carriageway. The primary access (Southern Access) to the Marine Precinct will likely only be constructed once the EAC rail is constructed or once Stages 2 and 3 of the Marine Precinct are constructed. This access has been omitted from the 2014 layout. (Figure B.14.12).

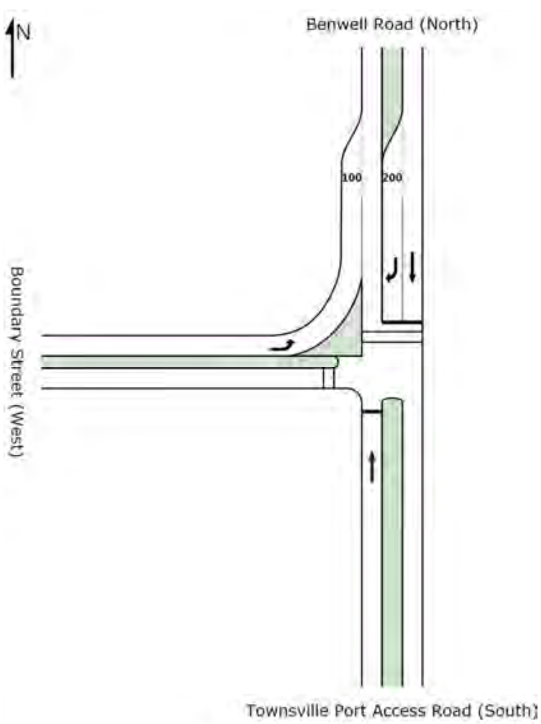


Figure B.14.12 Intersection 3: Indicative Intersection Layout (2014 Only)

From discussions with DTMR officers it was established that for analysis purposes the TPAR will be upgraded to four lanes by 2035 to cater for the future traffic demands. By 2035 the Southern Access to the Marine Precinct will also be in place. For the future years of 2035 and beyond the indicative intersection layout modelled in SIDRA is shown in Figure B.14.13.

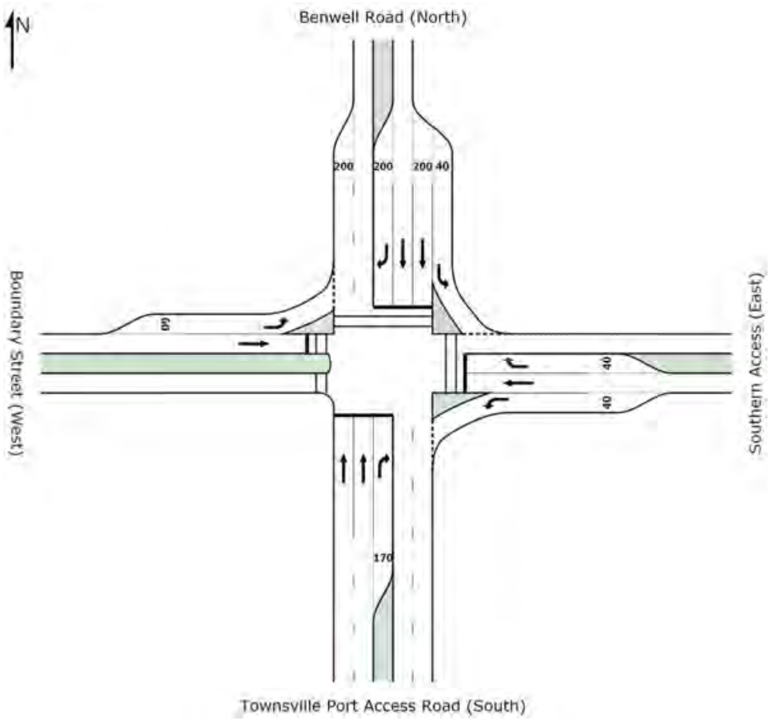
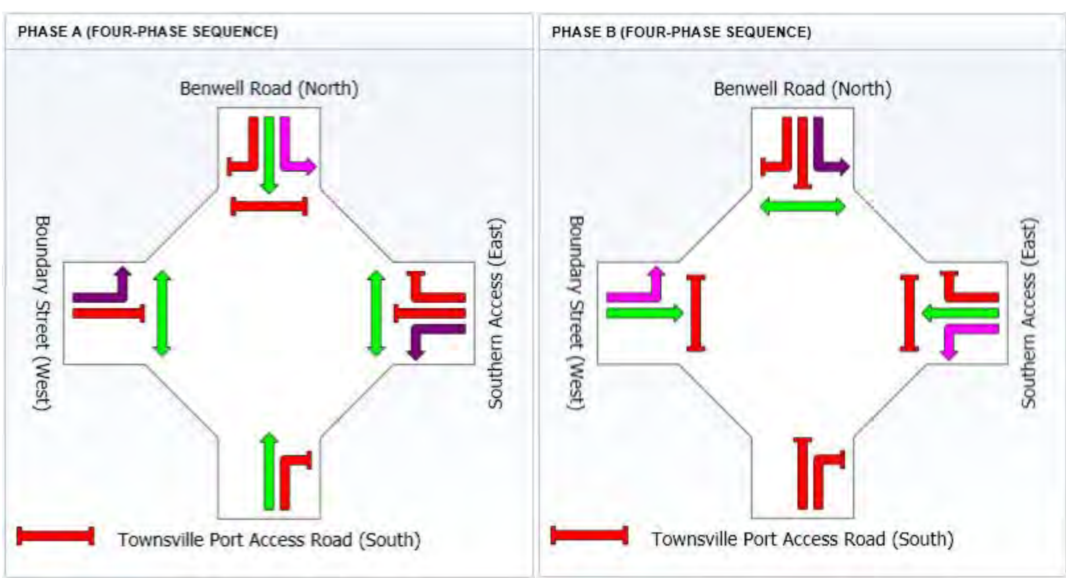


Figure B.14.13 Intersection 3: Indicative Intersection Layout (2035 and beyond)

The signal phase sequence used in this analysis is shown in Figure B.14.14.



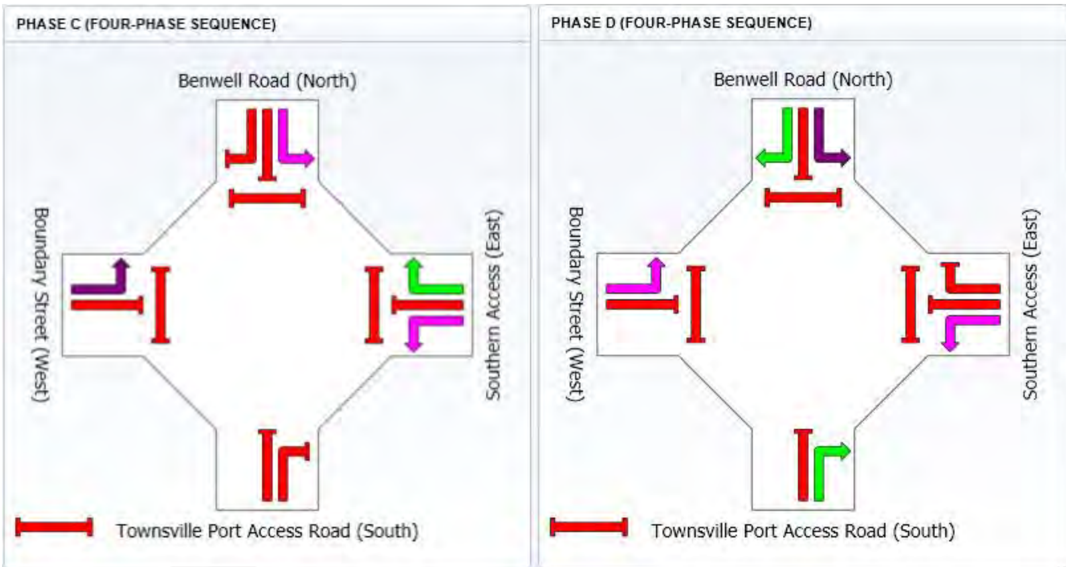


Figure B.14.14 Intersection 3: Four-phase Signal Sequence Modelled in SIDRA

The model was run allowing SIDRA to optimise the cycle times and phase splits based on reducing vehicle delay. The results showed that the intersection would operate acceptably for modelled future years (Table B.14.11). The detailed results from the SIDRA analysis are included in Appendix Q6.

Table B.14.11 Intersection 3: SIDRA Results Summary

Year	Scenario	Morning				Afternoon			
	Without PEP × With PEP ✓	Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS	Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS
2014	×PEP	0.653	107	15	B	0.501	70	12	B
	√PEP	0.688	116	14	B	0.529	76	16	B
2035	×PEP	0.674	138	33	C	0.611	33	20	B
	√PEP	0.738	142	30	C	0.695	59	24	C
2036	×PEP	0.674	138	33	C	0.611	33	20	B
	√PEP	0.674	138	31	C	0.713	40	22	C
2046	×PEP	0.674	138	33	C	0.611	33	20	B
	√PEP	0.674	138	31	C	0.742	42	23	C

B.14.4.1.4 Intersection 4: Boundary Street/Saunders Street

This intersection was modelled for the Townsville Marine Precinct EIS based on the existing intersection layout (as of 2009), which is shown in Figure B.14.15. This previous analysis identified that the intersection will operate above acceptable limits, not only with the Townsville Marine Precinct traffic but even without (i.e. background traffic only).

The previous traffic analysis does not mention how the level rail crossing across the western approach was incorporated into the SIDRA analysis. When a train passes this intersection, by crossing over Boundary Street (West), the only movements with green time during this signal phase are the northbound and southbound movements, which are parallel to the railway line. This phase was not modelled in the Townsville Marine Precinct traffic analysis.

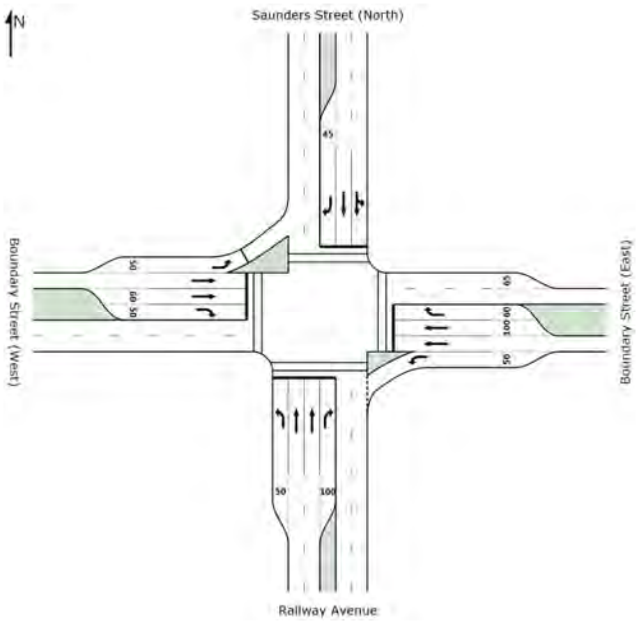


Figure B.14.15 Intersection 4: Indicative Intersection Layout

The signal phase sequence used in the previous traffic analysis was retained in this analysis and is shown in Figure B.14.16.

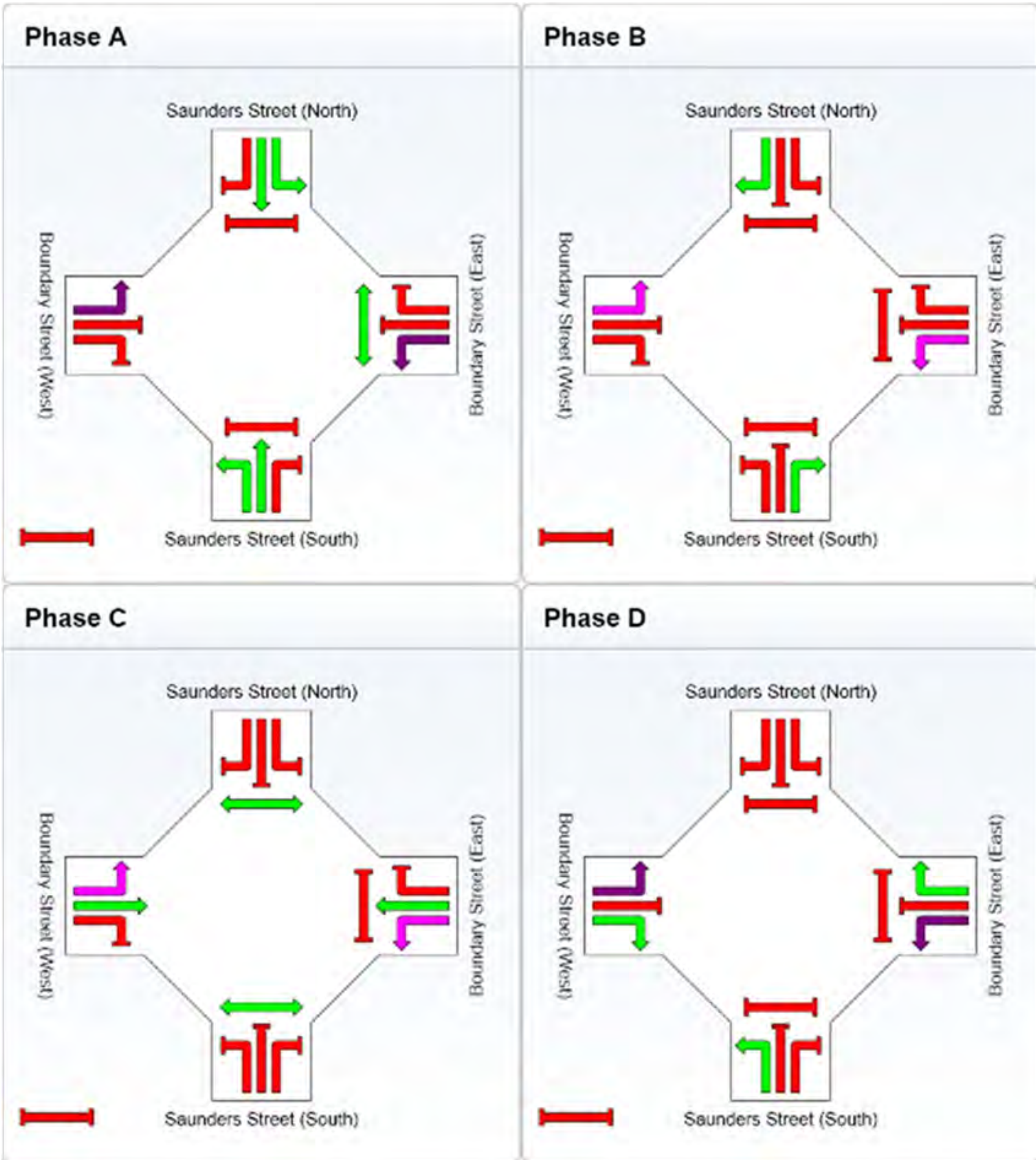


Figure B.14.16 Intersection 4: Four-phase Signal Sequence Modelled in SIDRA

Initially the models were run with the same cycle time used in the previous traffic analysis; 120 seconds during the morning and afternoon peak periods. Subsequently, SIDRA optimised the phase splits. The results showed that the intersection will operate above capacity under tested traffic scenarios (morning and afternoon peaks) and typically there are long delays and queues with the overall LOS E or worse, which indicates the flow at the intersection is unstable and close to breakdown .

Since 2009 the western leg of this intersection (Boundary Street) has been upgraded. The next step was to model the upgraded intersection (Figure B.14.17) and allow SIDRA to optimise the cycle times and phase splits based on reducing vehicle delay. The phase sequence used in the previous traffic analysis was maintained.

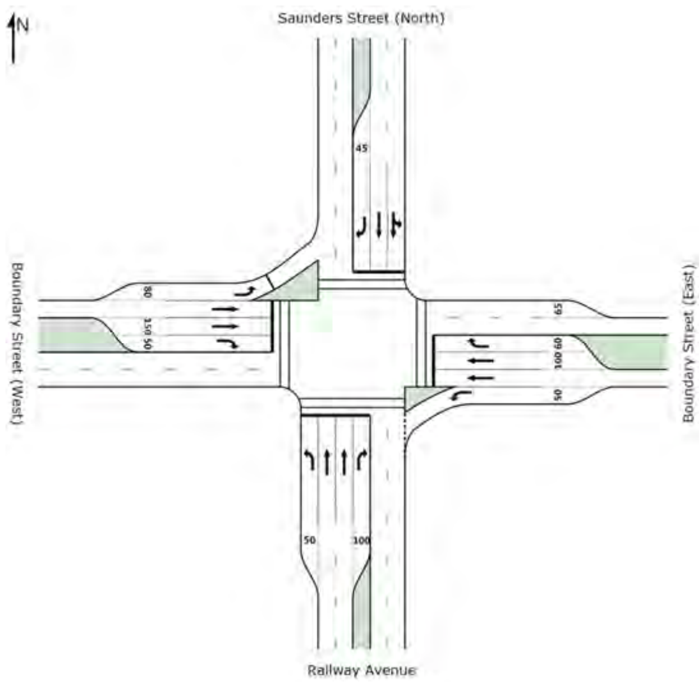


Figure B.14.17 Intersection 4: Indicative Intersection Layout (Upgraded Western Leg)

The results show that even when the signals are optimised the intersection still operates above acceptable limits under all traffic scenarios (Table B.14.12). This indicates that the intersection requires upgrading prior to 2014 to mitigate the impact of background traffic growth. The detailed results from the SIDRA analysis are included in Appendix Q7. Potential mitigation measures are presented in Section B.14.5.

Table B.14.12 Intersection 4: SIDRA Results Summary

Year	Scenario Without PEP × With PEP ✓	Morning				Afternoon			
		Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS	Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS
2014	×PEP	0.786	130	30	C	1.047	592	78	E
	√PEP	0.786	130	30	C	1.047	592	78	E
2035	×PEP	0.974*	250	45	D	1.085	989	101	F
	√PEP	0.974*	250	45	D	1.085	989	103	F
2036	×PEP	0.979*	253	45	D	1.099	1034	106	F
	√PEP	0.979*	253	45	D	1.099	1034	106	F
2046	×PEP	0.973*	279	49	D	1.211	1472	161	F
	√PEP	0.990*	276	52	D	1.238	1459	165	F

* Next highest DOS. Worst DOS is 1.000 due to excess flow in short lane.

B.14.4.1.5 Intersection 7: Bruce Highway/TPAR

The traffic assessment undertaken for the Townsville Marine Precinct EIS did not assess the Bruce Highway/TPAR intersection.

The TTTM for 2016 models this intersection with all movements permitted. In the subsequent modelling years, certain movements are not permitted (both sets of right turn movements from TPAR and left turn movements to TPAR are not allowed), suggesting that the intersection may be upgraded to a grade-separated intersection at some stage in the future. DTMR confirmed that this intersection is likely to be grade-separated in the future. For the purpose of this analysis it has been assumed that the upgrade will occur prior to 2035.

For this assessment this intersection was only analysed in SIDRA for 2014 (i.e. at-grade intersection layout). The indicative intersection layout modelled in SIDRA is shown in Figure B.14.18. A simple two-phase signal sequence was used in the models.

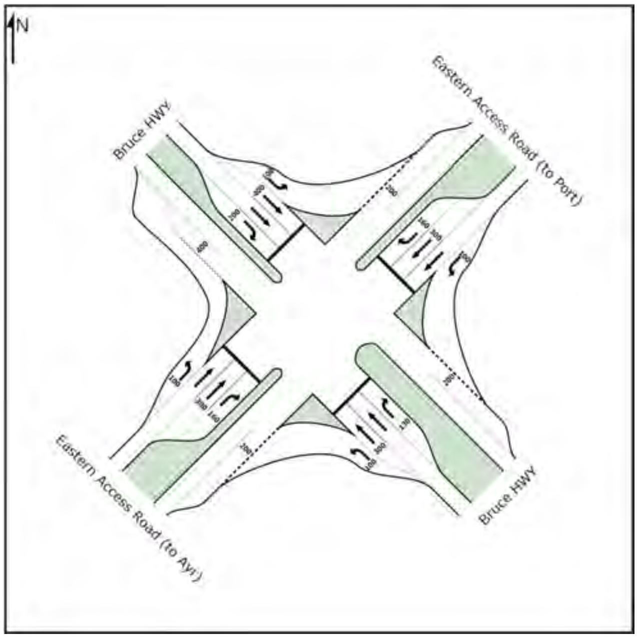


Figure B.14.18 Intersection 7: Intersection in 2014

The SIDRA summary results presented in Table B.14.13 indicate that the intersection will operate just below capacity in 2014 under the wPEP and woPEP traffic scenarios. The detailed results from the SIDRA analysis are included in Appendix Q8.

Table B.14.13 Intersection 7: SIDRA Results Summary

Year	Scenario	Morning				Afternoon			
	Without PEP × With PEP ✓	Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS	Maximum DOS (v/c)	95% Back of Queue (m)	Average Delay (s)	LOS
2014	× PEP	0.796	126	10	A	0.844	133	13	B
	√PEP	0.796	126	10	A	0.844	133	13	B

It is not necessary to model the grade-separated intersection in SIDRA for 2035 and onwards; instead the approach link capacity has been assessed to offer a high level assessment of how this interchange may operate.

The DOS has been calculated for all approaches and all traffic scenarios with the results presented in Table B.14.14. This is the ratio of demand flow (or number of vehicles) to the physical capacity of the link.

Table B.14.14 Intersection 7: Volume/Capacity Ratio

Approach	Morning				Afternoon			
	2035 (woPEP)	2035 (wPEP)	2036 (wPEP)	2046 (wPEP)	2035 (woPEP)	2035 (wPEP)	2036 (wPEP)	2046 (wPEP)
TPAR (North)	0.270	0.277	0.312	0.400	0.720	0.736	0.844	1.127
Bruce Highway (East)	0.583	0.583	0.655	0.827	0.541	0.541	0.595	0.720
TPAR (South)	0.053	0.072	0.069	0.076	0.039	0.046	0.047	0.052
Bruce Highway (West)	0.217	0.217	0.248	0.303	0.336	0.336	0.382	0.475

Table B.14.14 shows that with the PEP the eastern approach of the Bruce Highway will operate close to capacity by 2046. The north approach of the TPAR will operate above capacity by 2046; however, the TPAR is only modelled as two lanes in the TTTM. It is likely to be upgraded to four lanes by 2035 with the increase in traffic demands. It is also expected that once the TPAR is upgraded, with additional link capacity, this approach will operate within acceptable limits.

B.14.4.1.6 Summary of Intersection Analysis

Traffic analysis of key intersections in the Study Area has been undertaken to determine the likely impact the PEP will have on the surrounding road network. Seven intersections were considered in the assessment, with five intersections assessed to determine the impact the PEP on intersection performance. Intersection 5 and 6 were not analysed as the estimated PEP traffic was calculated to be less than 5% of background levels.

The intersection analysis was undertaken using SIDRA Intersection (Sidra Solutions, 2011). The analysis was carried out to determine the intersection performance during the morning and afternoon peak hours for the base case (without PEP traffic) and with PEP traffic. The conditions applied to the PEP scenarios were:

- 2014 – Stage A
- 2035 – Worst case scenario (Stages A to C)
- 2036 – PEP's first fully operational year, 'opening year'
- 2046 – 'opening year' + 10 years

Intersection 1 (Benwell Road/Secondary Marine Precinct Access): the analysis results indicate that this intersection (give way priority-controlled) will operate within acceptable limits under all future year traffic demand scenarios. Based on this analysis, the PEP is likely to have minimal impact on the operation of this intersection. No mitigation measures are required.

Intersection 2 (Benwell Road/Archer Street): the analysis results indicate that this intersection (stop sign priority-controlled) will operate within acceptable limits under all future year traffic demand scenarios. Based on this analysis, the PEP is likely to have minimal impact on the operation of this intersection. No mitigation measures are required.

Intersection 3 (Boundary Street/Benwell Road/Southern Access/TPAR): the analysis results indicate that this signalised intersection will operate within acceptable limits under all future year traffic demand scenarios. Based on this analysis, the PEP is likely to have minimal impact on the operation of this intersection. No mitigation measures are required.

Intersection 4 (Boundary Street/Saunders Street): the analysis undertaken for the Townsville Marine Precinct EIS indicated that this intersection will operate above capacity in future years for the base case (i.e. background traffic only, excluding the Townsville Marine Precinct traffic) as well as any future development in the port or Marine Precinct. The SIDRA analysis undertaken in this report confirms that the existing intersection requires upgrading prior to 2014 to mitigate the impact of background traffic growth.

Intersection 7 (Bruce Highway/TPAR): as confirmed by DTMR, this intersection is likely to be grade-separated in the future. SIDRA analysis of the at-grade intersection under 2014 traffic demand indicated that the intersection will operate just below capacity. The layout modelled is indicative only. Link capacity assessment of the grade-separated interchange indicated that the eastern approach of the Bruce Highway will operate close to capacity by 2046. The north approach of the TPAR will operate above capacity by 2046; however, the TPAR is only modelled as two lanes in the TTTM, but will be upgraded to four lanes by 2035 as part of the planned future upgrade for this corridor. The upgrade will be triggered when the future traffic demands is near its current capacity for a 2-lane road. It is likely that once the TPAR is upgraded this approach will operate within acceptable limits.

B.14.4.2 Pavement Impact Assessment

A preliminary analysis, based on DTMR's *Guidelines for Assessment of Road Impacts of Development* (DTMR, 2006), has been conducted to identify the likely magnitude of pavement impacts on the state controlled roads and council roads due to the predicted additional heavy vehicle movements generated during PEP construction and operation phases.

The preliminary pavement impact assessment examined these pavement impacts as an increase in equivalent standard axles in excess of 5% of the background traffic. Equivalent standard axles is a unit measurement that converts the wheel loads of traffic to an equivalent number of standard loads. This is an effective measuring tool to determine the magnitude of additional pavement impacts caused by a mix of vehicles related to the construction and operational phases of the PEP.

A comparison of the construction and operational traffic generated by the PEP and existing background traffic volumes as measured by annual average daily traffic as well as equivalent standard axles have been considered. It was identified that the worst case scenario, in terms of additional impact due to PEP related traffic, is during the construction phase.

The preliminary assessment indicated that based on the volume of heavy vehicles from both the construction and operational phases of the PEP, the additional equivalent standard axles are expected to be more than the 5% threshold. It is expected that consultation and negotiations will be ongoing with DTMR and TCC on the contributions that the PEP will need to make for roads. The existing and proposed Road Implementation Program and Infrastructure Maintenance Programs for both the DTMR and council will be considered as part of this consultation and negotiation process.

In view of some uncertainty about the transportation of materials during the construction phase and commodities during the operational phase, assumptions have been adopted for the preliminary review of the traffic impact assessment. Once the transport routes and expected volumes of additional PEP related traffic are confirmed, a more detailed assessment will be carried out to assist in determining the annual maintenance contributions.

A suitable agreement between POTL and the government agencies will be considered, which may include (if required due to the additional impact from the PEP) any necessary upgrades and maintenance and rehabilitation in accordance with the existing and proposed Road Implementation Program and Infrastructure Maintenance Programs by DTMR and council.

B.14.5 Mitigation Measures and Residual Impacts

The SIDRA analysis of the five intersections showed that, based on the traffic demand derived for this assessment and using the layouts and signal phasing developed for the assessment of the Townsville Marine Precinct EIS, Intersection 4 (Boundary Street/Saunders Street) will not operate sufficiently under future year traffic demand scenarios.

The previous EIS traffic assessment for Intersection 4 identified that this intersection will operate above capacity not only with but also without the Townsville Marine Precinct traffic in 2027. This intersection requires upgrading prior to 2014 to mitigate background traffic growth.

The indicative level of impact is based on the assumptions adopted for the purpose of the impact assessments. As part of the strategy to mitigate against potential traffic impact from the PEP, a road use management strategy will be developed in consultation with DTMR and TCC to ensure appropriate use of the existing and planned road network i.e. port related traffic to use the TPAR for port access.

Review of the traffic demand derived for this analysis, show that there are significant volumes for both northbound and southbound movements through this intersection. During the afternoon peak hour in 2035 (with PEP traffic) there are approximately 1,500 vehicles per hour travelling southbound through the intersection. There are two through-lanes on this approach. It is envisaged that grade-separation of certain movements may be a potential mitigation measure that can be investigated during the design phase of the PEP.

The Townsville Marine Precinct traffic report identified a number of significant constraints at this intersection. An upgrade of the intersection may require major rail relocations on the western side and property acquisitions on the eastern side.

The potential impacts and mitigation measures, as a consequence of the PEP, are summarised in Table B.14.15. The mitigation measures will form part of the overall Road Use Management Plan.

Table B.14.15 Potential Impacts and Mitigation Measures

Potential Impacts	Mitigation Measures
Construction Phase	

PEP related traffic impact on operation efficiency of key intersections.	▪ Investigate opportunities to improve intersections affected by the construction activities by providing cost effective road network solutions that will alleviate additional traffic impacts from the construction related activities.
	▪ Determine appropriate improvement measures to reduce additional traffic impacts from the construction related activities. These could include :
	  ▪ worker car pooling
	  ▪ staggered start and end times of shifts
	  ▪ provision of offsite 'Park and Ride' facility.

Traffic impact on the state and local road networks.	▪ Determine appropriate transport routes (i.e. high order roads) for construction related activities to reduce impact on state and local road networks and incorporate into construction tenders.
Additional impact on pavements due to the construction activities.	▪ Negotiate with DTMR regarding the need to strengthen the existing pavement thickness to cater for the additional loadings from construction trucks if further modelling confirms initial results.
Operational Phase	

PEP related traffic impact on operation efficiency of key intersections.	▪ Investigate opportunities to improve intersections affected by the additional operational traffic by providing cost effective solutions that will alleviate additional traffic impacts due to PEP operations.
	▪ Mitigate additional traffic impacts from the expanded port operations. These could include :
	  ▪ increased transportation of cargo by rail
	  ▪ transport by road outside peak times.

Additional impact on pavements due to the additional activities from PEP operations.	▪ Negotiate with DTMR regarding the need to strengthen the existing pavement thickness to cater for the additional loadings from construction trucks if further modelling confirms initial results.
PEP related impact on existing rail network.	▪ Work with government to further implementation of the *Mount Isa Rail Infrastructure Master Plan* to address the future rail capacity requirements. ▪ Work closely with QR to identify appropriate trigger points and plan for development of EAC rail.

B.14.6 Cumulative Impacts

The current trade forecasts predict a four-fold increase in annual trade tonnage throughput for the Port of Townsville by 2040. This increase is expected to result from increases in existing trades (i.e. mining, industrial sectors etc.) as well as the new bulk trades. This increase is expected to increase the volume of traffic associated with the expanded port operations.

With the introduction of new bulk trades forming part of the increased throughput, the transport of the commodities to and from the port is expected to split between the new rail and road infrastructure; that is, the EAC (both road corridor and future rail link). The increased level of operations from the expanded port facilities will also increase the volumes of road traffic associated with the additional facilities.

As part of the traffic analysis, the Townsville Marine Precinct has been identified to be in proximity to the PEP with an anticipated opening year of 2017 or beyond. For the worst case traffic impact analysis during the construction phase (i.e. at 2035), it is assumed that the Townsville Marine Precinct development will be completed and in full operation. The cumulative impact of that development has been considered as part of the PEP ‘background’ traffic.

B.14.6.1 Further Investigations and Summary

On completion, the TPAR will link the Flinders and Bruce highways directly to the port. It will provide more direct access to the port from the west and south, as well as reducing heavy vehicle traffic on the local road network and through residential areas of Townsville.

As part of the overall network strategy for the PEP, it is envisaged that the port related traffic would need to be segregated from the general traffic accessing the CBD at the Boundary Street intersection and possibly at the Archer Street intersection. This is in line with DTMR’s intention to limit the volume of non-port related traffic on the TPAR. This option and others will be considered in more detail during the detailed design phase.

Rail will be the main mode of land transportation for cargo handled through the PEP. The likely drivers for the development of the outer harbour are expected to be high tonnage dry bulk commodities e.g. coal, mineral concentrates, fertiliser and magnetite as identified in the trade forecast. These will require the development of rail access on the EAC because of the capacity and efficiency limitations of the existing rail network and implementation of the *Mount Isa Rail Infrastructure Master Plan*.

The development of rail access via the EAC and tenanted sites in the PEP land will require approvals separate to the PEP EIS. POTL, Queensland Rail and other stakeholders will continue the collaborative development of a long-term strategy for the interface between rail and port infrastructure, to optimise network efficiency.

B.14.7 Assessment Summary

This chapter presents the potential and predicted traffic impacts associated with the construction and operational phases of the PEP. This has included an assessment of the risk associated with the impacts identified. The risk assessment has considered:

- magnitude of impact (e.g. consequence): an assessment of the traffic impact from the PEP on the key intersections in the vicinity of the Port of Townsville
- likelihood of impact: the probability of the impact occurring

The risk matrix adopted for this EIS has been applied to this traffic assessment.

Table B.14.16 and Table B.14.17 summarise the potential impacts and risk assessment of the traffic impacts associated with the PEP. They also include the mitigation measures required to reduce the level of risks and to maintain an overall high level of operational efficiency for the road and rail network. The mitigation measures will form part of the overall Road Use Management Plan.

Table B.14.16 Assessment Summary of the Impacts, Risks and Mitigation Measures (Road Transport)

Value /Element	Description of Impact				Summary of Key Mitigation Measures	Residual Risk
	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact	Risk Rating (Before Mitigation)		
Traffic impacts from construction activities						
Performance of key intersections	Operational efficiency	**Moderate** Traffic congestion at Intersection 4: Boundary Street/ Saunders Street	**Likely** Additional construction related vehicles accessing the PEP using this key intersection	**High**	Investigate opportunities for intersection improvements to mitigate against additional traffic impacts from construction related activities	**Low**
Pavement impacts from construction activities						
Increased load intensity	Pavement degradation	**Moderate** Additional traffic loading on pavements from construction activities	**Almost certain**	**High**	Negotiate with DTMR regarding the need for pavement rehabilitation and maintenance to cater for the additional loadings from construction related heavy vehicles	**Low**
Traffic impacts from operational activities						
Performance of key intersections	Operational efficiency	**Moderate** Traffic congestion at some key intersections	**Likely** Additional operational vehicles accessing the PEP using these key intersections	**Medium**	Investigate cost effective solutions to alleviate additional traffic impacts from the expanded port activities	**Low**
Pavement Impacts from operational activities						
Increased load intensity	Pavement degradation	**Moderate** Additional traffic loading on pavements from expanded port activities	**Almost certain**	**High**	Negotiate with DTMR regarding the need for pavement rehabilitation and maintenance to cater for the additional loadings from increased port activities (additional commodities transported by road)	**Low**

Table B.14.17 Assessment Summary of Impacts, Risks and Mitigation Measures (Rail Transport)

Value /Element	Description of Impact				Summary of Key Mitigation Measures	Residual Risk
	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact	Risk Rating (Before Mitigation)		
Rail network impacts from construction activities						
Negligible use of rail transport for PEP construction activities						
Rail infrastructure impacts from construction activities						
Negligible use of rail transport for PEP construction activities						
Traffic impacts from operational activities						
Performance of rail network - Mount Isa Line	Significant increase in demand	**Moderate** The existing capacity of the Mount Isa Line will be exceeded during the early stages of the PEP development	**Almost certain** The PEP trade will comprise mainly bulk cargos transported by rail on the Mount Isa Line	**High**	Work with government to further implementation of the *Mount Isa Rail Infrastructure Master Plan* to address the future rail capacity requirements. [1]	**Low**
Performance of rail network – North Coast Line	Increase in demand locally between Stuart and port	**Low** Only a relatively short section of the line will be affected	**Likely** Over the short section of the line	**Medium**	Work closely with QR to identify appropriate trigger points and plan for the rail access via the EAC.	**Low**
Performance of rail network – town and port track	Operational efficiency and capacity	**Moderate** Conflicting train movements congesting rail and road networks	**Almost certain** If the PEP is developed before rail access is developed via the EAC	**High**	Work closely with QR to identify appropriate trigger points and plan for the development of rail along the EAC if it is not already developed prior to the PEP. This will provide sufficient capacity for the PEP rail requirements and will provide an opportunity to address existing port rail efficiency, capacity and amenity issues.	**Low**
Rail infrastructure impacts from operational activities						
Increased rail traffic	Increased rate of rail infrastructure degradation	**Moderate** Additional rail traffic from PEP operations will result in earlier renewal of infrastructure assets	**Almost certain**	**High**	Work with Queensland Rail to determine progressive rail infrastructure renewal programmes in anticipation of increased rate of degradation. [1]	**Low**

1 Mount Isa Line Development
The key driver for development of the PEP is an increase in bulk trade, which will be transported by rail on the Queensland Rail owned Mount Isa Line. The *Mount Isa Rail Infrastructure Master Plan* addresses future rail capacity on the line as a result from the forecast demand, which would largely result from the same cargo as that handled through the Port of Townsville.

The concurrent and progressive development of rail capacity (and renewal programmes) on the Mount Isa Line to accommodate the growth in rail traffic is essential for the PEP development. POTL, Queensland Rail and relevant stakeholders will need to jointly progress the integrated development of both port and rail infrastructure with reciprocal commitments in place prior to each stage of development. Approvals for the development of rail outside the port expansion area will require approvals separate to the PEP EIS.

Port Expansion Project EIS

Part B

Section B15 – Indigenous Cultural Heritage

AECOM BMT WBM

B.15 Indigenous Cultural Heritage

B.15.1 Relevance of the Project to Cultural Heritage Values

Indigenous cultural heritage values are interwoven with Aboriginal and Torres Strait Islander people's ongoing connection to and use of the landscape and country to connect with their past and retell their stories. It is defined and managed by Aboriginal parties who are culturally responsible for a place's heritage values.

This chapter addresses Section 5.11 of the *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement* (ToR) and specifically describes:

- the existing Indigenous cultural heritage values that may be affected by the Project
- the environmental values of the cultural landscapes of the Project Area in terms of the physical, ecological and cultural integrity
- the potential impacts to these values and proposed mitigation measures in accordance with legislative requirements and the Cultural Heritage Management Plan (CHMP).

Under s. 87, Part 7 of the *Aboriginal Cultural Heritage Act 2003* (Qld), a CHMP is needed for projects requiring an Environmental Impact Statement.

Section 5.11.3 of the ToR requires that the areas addressed by application for native title claims be identified and the requirements to deal with these bodies be addressed as part of the EIS. Discussion on native title is provided in Section B.15.2.1.6.

B.15.2 Assessment Framework and Statutory Policies

Cultural heritage, whether it be Indigenous or historic, plays an important role in any community and the following provides a discussion on the legislative context under which this Aboriginal cultural heritage assessment has been considered.

B.15.2.1 Legislation and Policies

B.15.2.1.1 State of Queensland

All Aboriginal cultural heritage items, places, areas or archaeological sites in Queensland are protected by the *Aboriginal Cultural Heritage Act 2003*. Section 23 of the Act states 'A person who carries out an activity must take all reasonable and practical measures to ensure the activity does not harm Aboriginal cultural heritage' (the 'cultural heritage duty of care').

The duty of care guidelines, gazetted under s. 28 of the Act, identify reasonable and practicable measures for ensuring activities are managed to avoid or reduce harm to Aboriginal cultural heritage. The duty of care guidelines require a land user to make an assessment of their land use activity and the likelihood of it causing harm to Aboriginal cultural heritage.

B.15.2.1.2 Commonwealth

Aboriginal areas or sites are protected by the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*. This legislation is mostly activated when state legislation proves to be inadequate in relation to the protection of Aboriginal cultural heritage. In these instances, an application can be made to the minister orally or in writing to seek the protection or preservation of a particular area or object.

Other Commonwealth legislation that considers heritage aspects includes:

- *Environment and Heritage Legislation Amendment Act (No. 1) 2003*

  This Act amends the *Environment Protection and Biodiversity Conservation Act 1999* to include the protection and conservation of national heritage. It also includes provisions to identify places for inclusion in the National Heritage List and Commonwealth Heritage List and to enhance the protection, conservation and preservation of those places.

- *Australian Heritage Council Act 2003*

  This Act establishes a new heritage advisory body to the applicable minister. The Australian Heritage Council provides advice to the minister on conserving and protecting Australian heritage including heritage being considered for inclusion in the National Heritage List or the Commonwealth Heritage List.

- *Great Barrier Reef Marine Park Act 1975*

  The GBRMP Act establishes a framework for the establishment, control, management and development of the GBRMP. The Act is administered by the GBRMPA. Section 38BA of the GBRMP Act prohibits the carrying out of an activity that requires permission without first having obtained the permission. Section 2A(1) of the GBRMP Act states "*The main objective of this Act is to provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region'*.

B.15.2.1.3 Great Barrier Reef Marine Park Heritage Strategy

The Great Barrier Reef Marine Park Heritage Strategy has been developed in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* to address matters prescribed by the *Environment Protection and Biodiversity Conservation Regulations 2000* and is consistent with the Commonwealth heritage management principles specified in Schedule 7B of the regulations. The Great Barrier Reef Marine Park Authority is responsible for identifying, protecting and conserving the heritage values found in the Great Barrier Reef Marine Park. The authority also strives to ensure the world heritage values of the Great Barrier Reef Marine Park are protected.

For identifying and assessing places for Indigenous values in the Great Barrier Reef Marine Park the authority follows the recommended procedures set out in '*Ask First: A guide to respecting Indigenous heritage places and values'* (AHC, 2002a). This publication, written by the Australian Heritage Commission focuses on allowing the relevant Indigenous people to determine the significance of places in accordance with their culture before moving to achieving agreements between parties on how places and heritage values should be managed. As such, it complements the Australian Natural Heritage Charter and the Burra Charter.

B.15.2.1.4 Australian National Heritage Charter

The Australian National Heritage Charter is a guideline for best practice conservation principles for Australia, based on the consensus of a broad range of experts. It aims to assist everyone with an interest in natural places to establish their natural heritage values and manage them (AHC, 2002b). The charter relates closely with the general structures and logic of *The Burra Charter* (Australia ICOMOS, 1999a). The similarity between these charters enables them to be used together for places that have both natural and cultural values. The charter uses the definitions contained in Articles 10 and 11 of *The Burra Charter* for defining the cultural significance of place.

B.15.2.1.5 Burra Charter

The Burra Charter (Australia ICOMOS, 1999a) sets the standard of practice in Australia for places of cultural heritage significance. It defines heritage significance as 'aesthetic, historic, scientific, social or spiritual value for past, present or future generations' (Australia ICOMOS, 1999a). Heritage significance is 'embodied in the place itself, its fabric, setting, use, associations, meaning, records, related places and related objects' (Australia ICOMOS, 1999a).

Cultural heritage significance is not static and can change over time as a result of continuing history or use of a place, or if new information comes to light (Australia ICOMOS, 1999a). Identifying and assessing cultural heritage significance helps to estimate the value of places to improve our understanding of the past, to enrich the present and provide for future generations (Australia ICOMOS, 1999a).

The Burra Charter has been widely accepted and adopted as the best standard for heritage conservation practice in Australia and provides guidance for the conservation and management of places of cultural significance.

B.15.2.1.6 Native Title Act

The *Native Title Act 1993* (Cth) overturned the legal doctrine that Australia was *terra nullius* – a land belonging to no-one – and recognised the original and continuing ownership of the land by Aboriginal and Torres Strait Islander peoples. It set up a structure by which Indigenous claims of continuing native title might be assessed, and established the National Native Title Tribunal (NNTT) to act as facilitator and mediator in native title applications, and to maintain registers of claims and determinations.

In Queensland, the Commonwealth Act is supported by the *Native Title (Queensland) Act 1993*, which recognises Indigenous people's ongoing affiliations with the land, and seeks to ensure that Queensland law is consistent with the Commonwealth legislation.

B.15.2.1.7 Convention Concerning the Protection of the World Cultural and Natural Heritage 1972 (World Heritage Convention)

States, including Autralia, that are parties to the convention agree to identify, protect, conserve, present and rehabilitate world heritage properties. They agree, amongst other things, as far as possible to the extent that values relate to the property, to:

- 'adopt a general policy that aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of that heritage into comprehensive planning programs'
- undertake 'appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage'.

B.15.2.2 Assessment Methodology

Recognising the importance of Aboriginal cultural heritage in the context of the port's future development, Port of Townsville Limited (POTL) commissioned an Aboriginal cultural heritage study and report during the assessment phase of the Townsville Marine Precinct that also addressed the PEP. This study, carried out by Northern Archaeology and Segue (2009), involved desktop research, consultation with the Aboriginal parties, a site visit, and an assessment of the potential adverse impacts of the Project on Aboriginal cultural heritage.

For this EIS, a review of Northern Archaeology and Segue's Aboriginal cultural heritage report (Bird & Heijm, 2009) was undertaken to ensure its relevance, currency, and applicability to the PEP. This review considered the study's methodology, research, survey findings, consultation, and recommendations and also compared the assessment area against the current Project Area. Further consultation has been undertaken with Traditional Owners to provide updates about Project planning and progress.

B.15.3 Existing Values, Uses and Characteristics

B.15.3.1 Cultural Heritage Study

An Aboriginal cultural heritage investigation of future development at the port was undertaken by Michele Bird (Northern Archaeology Consultancies Pty Ltd) and Nicolaas Heijm (Segue Pty Ltd) (2009) on behalf of POTL (Appendix R1). This work was conducted in consultation and cooperation with the endorsed Aboriginal parties for the Project Area (i.e. the Bindall and Wulgurukaba Traditional Owners).

The investigation involved assessing the Aboriginal significance of the Ross River, Ross Creek and Cleveland Bay areas for consideration in the PEP and Townsville Marine Precinct Project.

Identification of Native Title Claimants and Aboriginal Parties

Northern Archaeology and Segue found that there were no native title claims in the area, and consequently no 'native title party', 'Aboriginal party' or 'cultural heritage body' under the *Aboriginal Cultural Heritage Act 2003* for the port area at the time of their cultural heritage assessment. Searches of the NNTT and the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (DATSIMA) registers reveals that this remains the case. In accordance with the Act, Northern Archaeology and Segue posted a public notice of the planned development, and subsequently identified 18 endorsed Aboriginal parties for the area. These endorsed Aboriginal parties include representatives of the main Aboriginal stakeholders and/or interest groups for Townsville (Bird & Heijm, 2009).

Methodology

The cultural heritage study involved a combination of desktop assessment and a site survey to assess levels of cultural heritage significance in the Project Area. As part of the desktop component, databases and registers, ethnographic information, historical data, and previous archaeological research reports were searched and reviewed to identify places of potential cultural heritage significance in the Project Area. A search of the Aboriginal and Torres Strait Islander Cultural Heritage Database and Register was conducted in October 2011, which confirmed that there have been no new Aboriginal cultural heritage values identified in the Project Area.

As the majority of the Project Area comprises sub-tidal areas, it was agreed that there was no requirement for a cultural heritage survey. A site survey was conducted on 24 July 2008 that inspected the area around Benwell Road. During this survey, it was confirmed that the heavily modified nature of the area meant there was no need for further cultural heritage surveys. The report notes that further field inspections are not warranted.

Findings and Recommendations

The investigation found that the broader Study Area had significant Aboriginal cultural heritage values, including both tangible and intangible elements of Aboriginal cultural significance. The Traditional Owners expressed the view that both the land and sea country in the Project Area remained significant components of the Aboriginal cultural landscape of the greater Townsville region. The areas of Ross River and Ross Creek were identified as integral components of the local Aboriginal creation story that explains the creation of Halifax Bay and Cleveland Bay coastlines. The area of Benwell Road Beach was also noted as an important place that many local Aboriginal people still use for the purpose of fishing, yabbying and collecting shellfish.

In contrast to the marine areas of the Study Area, the land areas adjacent to, and surrounding the Cleveland Bay coastline contain tangible archaeological evidence for the Aboriginal use and occupation of this landscape. However, the study concludes that it is highly unlikely that the PEP would have any major detrimental impacts to the prehistoric or historic Aboriginal record of Cleveland Bay as the entire area has already been subjected to large amounts of modification and disturbance.

The cultural heritage study made a number of recommendations to POTL which are being enacted.

B.15.4 Assessment of Potential Impacts

Construction works generally have the potential to directly or indirectly impact on the Aboriginal cultural heritage values in the Project Area. Direct impacts include actions that would directly and adversely affect an archaeological site, either through the destruction of an archaeological site or part thereof. An indirect impact is considered to be an action that has the potential to cause a direct impact on an archaeological site unless due care and consideration for the site is achieved.

The development area of the PEP is completely on sub-tidal land and the adjoining port land has been highly modified over decades through previous dredging and reclamation activities. As a result, the risk of disturbing or destroying items of Aboriginal cultural significance on the land is considered low.

In relation to the marine environment, the PEP will require deepening of the sea channel into both the Great Barrier Reef World Heritage Area and the Great Barrier Reef Marine Park. Unlike the main navigation channels, this sea channel deepening is not covered by the existing CHMP. There is a possibility that this area may contain cultural significance as prior consultation with the Aboriginal parties has highlighted certain intangible Aboriginal heritage values associated with the marine environment. To be fully compliant, the cultural significance of the channel deepening should be determined by the Aboriginal Party before agreement can be made on how places and heritage values would be managed. Further consultation will be undertaken with the endorsed parties to ascertain the significance of any associated cultural values for the channel deepening.

Marine species that are considered of cultural heritage significance due to their traditional use values include dugong and turtle. There will be negligible impact resultant from the Project construction and operation on these species as discussed in Chapter B6 Marine Ecology. Further consultation will be undertaken with the endorsed parties to ascertain the significance of any associated cultural values for the marine environment.

Intangible cultural heritage values have also been identified at Cleveland Bay, Ross Creek and Ross River, which are important story places, as well as at Benwell Road Beach, which is a teaching and recreation place for the present-day Aboriginal community. The endorsed parties have expressed concern that development may impact these areas, but further consultation will be required to ascertain their significance and appropriate management.

Recognition of the Aboriginal cultural heritage values of the broader area has been discussed through consultation with representatives of the Aboriginal parties and specific measures have been agreed to mitigate potential indirect impacts. These are embodied in the CHMP registered with DATSIMA.

In addition to implementing measures in accordance with the CHMP, POTL is continuing to consult with the Traditional Owners regarding progress on the PEP, and is in the process of undertaking further CHMP discussions for PEP and other port projects.

B.15.5 Mitigation Measures and Residual Impacts

POTL has adopted a whole-of-port approach to managing its Aboriginal cultural heritage requirements for port developments so ongoing consultation has combined assessment of current and potential future projects. Further consultation meetings are programmed for 2012.

These combined port development effects are not known or have not raised matters assessed as being significant. Notwithstanding, management of risks to cultural values are addressed in the endorsed CHMP and, should matters be identified, will be addressed subsequently.

A signed CHMP covering the PEP was registered by the Chief Executive of the Department of Environment and Resource Management (now DATSIMA) under Part 7 of the Act on 23 December 2009. Through execution of this CHMP, POTL's duty of care under the Act is also satisfied.

The CHMP ensures that appropriate implementation of the recommendations for the protection and management of Aboriginal cultural heritage are a part of future port developments. The plan also recognises ongoing consultation with the Aboriginal parties to ensure that they are kept informed of Project developments and progress. A key consideration of the CHMP is that the endorsed parties to the agreement remain the Aboriginal parties for the duration of the Project.

As a part of the EIS process, POTL provided an update on the progress of the PEP EIS to representatives of the Aboriginal parties on 10 November 2011 and it is proposed that further meetings and management procedures will take place in accordance with the CHMP.

The cultural heritage report for the Project recommended the following mitigation measures:

1. If any Aboriginal cultural heritage sites, materials or values are discovered during development operations work and other activities are to cease pending an inspection by a representative from the Aboriginal parties.
2. If human skeletal material is discovered during development works operations are to cease immediately within 100 m of the remains. The Queensland Police, Cultural Heritage Coordination Unit (DATSIMA) and an Aboriginal representative are to be contacted immediately to advise on established policy and procedures for dealing with human remains.
3. Personnel and contractors involved in the development project are to undertake a cultural heritage induction prior to commencement of development operations.

It is anticipated that with these mitigation measures in place, there is only a low risk that Aboriginal cultural heritage in the development area will be harmed (Table B.15.1).

B.15.6 Assessment Summary

An Aboriginal cultural heritage assessment was undertaken in consultation with representatives of the Aboriginal parties, which identified the significant Aboriginal cultural heritage values of the Project Area and the surrounding Study Area (Bird & Heijm, 2009). It is recognised that although the Study Area has been substantially modified, it still plays a role in understanding the Aboriginal cultural landscape and values of the greater Townsville region.

Through the consultative process with representatives of the Aboriginal parties, a CHMP was developed and agreed that identifies the Aboriginal cultural heritage values and specifies the mitigation measures to manage potential impacts for the PEP. This CHMP has been registered with DATSIMA and its implementation fulfils the requirement for a CHMP under the Queensland *Aboriginal Cultural Heritage Act 2003* and POTL's duty of care under the Act.

Table B.15.1 Impact Assessment Summary – Indigenous Cultural Heritage

Value / Element	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact	Risk Rating	Mitigation Measures	Residual Risk
Impacts on Aboriginal cultural heritage values	Disturbance or destruction of cultural items in the marine environment or onland	Moderate	Unlikely	Low	Implementation of the CHMP and ongoing consultation with representatives of the Aboriginal parties in accordance with the CHMP	Low
Impacts on cultural and spiritual values in the Great Barrier Reef Marine Park	Disturbance of cultural heritage places in the marine environment	Moderate	Possible	Medium	Implementation of the CHMP and ongoing consultation with representatives of the Aboriginal parties in accordance with the CHMP	Low

Port Expansion Project EIS

Part B

Section B16 – Non-Indigenous Heritage

AECOM BMT WBM

B.16 Non-Indigenous Cultural Heritage

B.16.1 Relevance of the Project to Non-indigenous Cultural Heritage

This chapter describes the contextual history and non-Indigenous (historic) cultural heritage values surrounding the Port of Townsville, assesses the potential impacts the Project may have on these values in the context of historic cultural legislative requirements and recommends appropriate mitigation measures.

The findings of the thematic history, register searches and site survey of this section has been combined to assess the potential impacts and/or enhancements of the Project on the area's historic cultural heritage values and to identify measures that may be used to mitigate any impacts.

Indigenous cultural heritage is addressed separately in Chapter 16.

B.16.2 Assessment Framework and Statutory Policies

B.16.2.1 Legislation and Statutory Policies

This section examines the set of Commonwealth and State legislation and policies that have requirements in relation to cultural heritage matters.

B.16.2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* is administered by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). This Act provides the legislative framework for protecting matters of national environmental significance, which includes places listed on the World Heritage List, National Heritage List, and Commonwealth Heritage List. Item on any of these lists are subject to the provisions of the Act.

B.16.2.1.2 Australian Heritage Council Act 2003

The *Australian Heritage Council Act 2003* established a new heritage advisory body to the Minister for DSEWPC. The Australian Heritage Council provides advice to the Minister on conserving and protecting Australian heritage, including heritage being considered for inclusion in the National Heritage List or the Commonwealth Heritage List.

In 2004, responsibility for maintaining the Register of the National Estate shifted to the Australian Heritage Council, under the *Australian Heritage Council Act 2003*. In 2006 the *Environment Protection and Biodiversity Act 1999* and the *Australian Heritage Council Act 2003* were amended to freeze the Register of the National Estate and to provide for a five-year phasing out of statutory references to the Register of the National Estate, resulting in no new places of heritage significance being added to the list since that date. The Register of the National Estate is maintained on a non-statutory basis as a publicly available archive and educational resource.

B.16.2.1.3 Great Barrier Reef Marine Park Act 1975

The GBRMP Act establishes a framework for the establishment, control, management and development of the GBRMP. The Act is administered by the GBRMPA.

Section 38BA of the GBRMP Act prohibits the carrying out of an activity that requires permission without first having obtained the permission. Section 2A(1) of the GBRMP Act states "*The main objective of this Act is to provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region'*. The Port of Townsville and the port limits are exempt from the Great Barrier Reef Region under section 14 of the *Seas and Submerged Land Act 1973*. Section 2A(1) of the GBRMP Act applies only to the elements of the project which are to occur outside the port limits. The Great Barrier Reef Marine Park Zoning Plan (GBRMP Zoning Plan) (GBRMPA, 2003) makes it a requirement to obtain permission for the proposed lengthening of the main Sea Channel to the Port where the proposed channel occurs in either the General Use or Habitat Protection zones.

Part 2A of the GBRMP Regulations specifies the general procedure for an application for permission. A referral under the EPBC Act of an activity that is proposed in the GBRMP is an application for permission under the GBRMP Act, where it undergoes an assessment pursuant to the EPBC Act.

B.16.2.1.4 State Legislation

The *Queensland Heritage Act 1992* is administered by the Department of Environment and Heritage Protection and provides for the conservation of Queensland's cultural heritage by protecting places and areas listed on the Queensland Heritage Register. The *Queensland Heritage Act 1992* underwent revisions and amendments in 2003 and again in early 2008.

The Queensland Heritage Register is a list of places that are important for their rarity, representativeness or aesthetic, architectural, archaeological, social and historical contributions to the development of Queensland.

B.16.2.1.5 Local Legislation

The Environmental Impact Statement (EIS) Study Area includes the area surrounding the Port of Townsville, within the Townsville City Council (TCC) area. TCC was created through the amalgamation of the Townsville City and Thuringowa City councils and operates under the *Townsville City Plan 2005*; an interim planning arrangement. Part 3, Subsection H of the plan provides for the recognition and protection of places of local heritage significance (TCC, 2005a).

Heritage provisions of the *Townsville City Plan 2005* are relevant in the context of identifying significant heritage sites located in the TCC area (TCC, 2005a).

B.16.2.2 Assessment Methodology

The methodology for the historic cultural heritage study is based on:

- developing the thematic history of the Port of Townsville and surrounding area (Study Area) to provide a framework that will guide identifying potential impacts on significant heritage places
- compiling an inventory of places of heritage significance
- undertaking a site survey of the Study Area
- assessing the potential impacts to cultural heritage values and describing the measures that may be implemented to maintain and mitigate any risk of impact to heritage places.

Reference is also made to the guidelines and principles of Commonwealth, state, and local authorities, including:

- The *Burra Charter*, published by the International Council on Monuments and Sites (ICOMOS) Australia ((Australia ICOMOS, 1999a);
- Great Barrier Reef Marine Park Authority *Heritage Strategy* (GBRMPA, 2005)
- *Australian Historic Themes*, published by the Australian Heritage Commission (AHC, 2000)
- *Using the Criteria: A Methodology*, published by the Cultural Heritage Branch of the former Environmental Protection Agency (now Department of Environment and Heritage Protection) (Bennett (ed.), 2006).

The following were also considered in the historic cultural heritage study:

- Commonwealth, state and local statutory frameworks and local legislation
- criteria for entry on the World Heritage List, National Heritage List, Commonwealth Heritage List, and the Register of the National Estate
- criteria for entry on the Queensland Heritage Register
- criteria for entry on the *Townsville City Plan 2005*.

B.16.2.2.1 Thematic History

Archival and library research of relevant documents and written histories were reviewed to complete a thematic history of the Study Area. The thematic approach adopted is consistent with the thematic framework recommended by the Australian Heritage Council in its publication *Australian Historic Themes*. It provides a broad framework through which to interpret the heritage values of the Study Area and assists in the interpretation of specific places of heritage significance.

Information sources consulted during preparation of the thematic history include:

- previous environmental studies of the Port of Townsville, provided by Port of Townsville Limited (POTL)
- previous environmental studies held by the John Oxley Library, Brisbane
- reports detailing the heritage values of areas adjacent to the Port of Townsville
- Australian Heritage Database
- Queensland Heritage Register
- TCC's Local Heritage Database
- Townville CBD Heritage Study
- archival and library research on historic documents related to the Port of Townsville
- review of a number of written histories of the Port of Townsville.

B.16.2.2.2 Register Search and Site Survey

A search of the relevant Commonwealth, state and local heritage registers was undertaken to identify places of known heritage significance in the Study Area.

A site survey of the Project and Study areas was undertaken by AECOM on 6 July 2011 to confirm the location of listed places and identify other potential places of heritage significance.

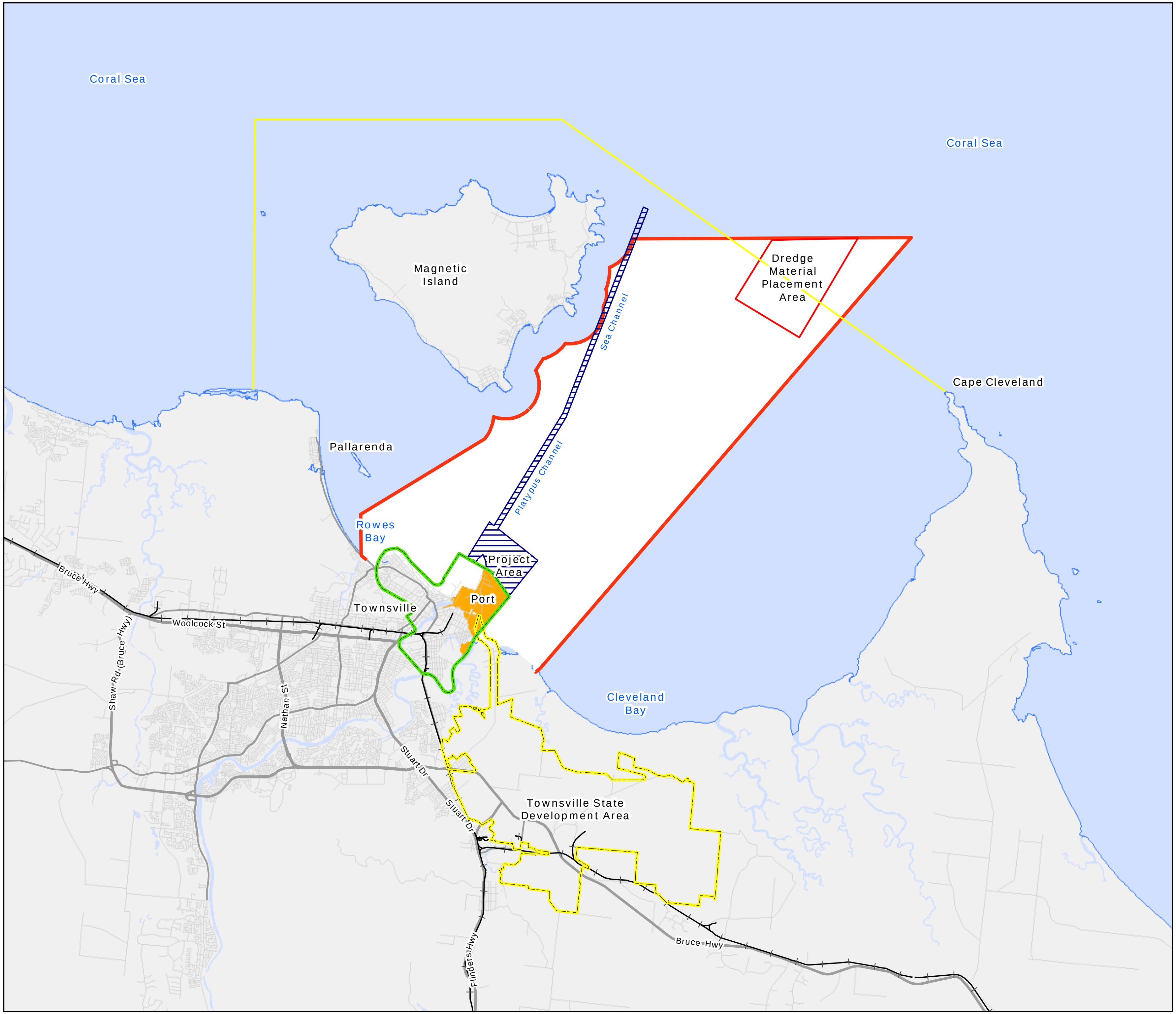
B.16.2.2.3 Study Area

The Study Area is shown on Figure B.16.1. The Study Area comprises the Project Area, the existing Port of Townsville area and the nearby portion of the suburb of South Townsville as part of broader considerations. This broad approach was chosen to ensure that the study includes a robust and comprehensive consideration of potential heritage issues associated with the Project. The area of investigation allows for the consideration of not only the potential direct impacts during the construction and operational phases of the Project, but also on the cultural heritage values of areas adjoining the Project Area, including the heritage values of the Great Barrier Reef World Heritage Area.

PORT EXPANSION PROJECT EIS

Non-Indigenous Culture Heritage Study Area

Figure B.16.1



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary
- Non-Indigenous Culture Heritage Study Area

N

Scale:1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_091

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012

B.16.3 Existing Values, Uses and Characteristics

B.16.3.1 Thematic History

The thematic history provides a broad framework through which to interpret the Project Area's existing and potential heritage values, and assist the interpretation of specific places of heritage significance. It is not intended to be an exhaustive historical treatment of the Study Area.

The thematic history identified the following Australian Heritage Council themes as important to the history of the Study Area:

- Selecting Township Sites (Theme 4.1.1)
- Administering Australia (Theme 7.6)
- Using Natural Resources (Theme 3.4)
- Developing Primary Production (Theme 3.5)
- Moving Goods and People (Theme 3.8)
- Defending the Nation (Theme 7.7)
- Enjoying the Natural Environment (Theme 8.1.4)
- Making Suburbs (Theme 4.1.2).

These key themes provide a framework for interpreting, assessing, and managing the Study Area's key heritage values.

B.16.3.1.1 Selecting a Site for Port and Township

The Port of Townsville has been highly significant to the history and development of the city of Townsville and the wider North Queensland region. Established in 1864 to service the newly settled rural hinterland, the town that developed around the harbour was to become the largest urban centre in North Queensland and a de facto northern capital city (Blake, 1999).

As the most important entry point in the North Queensland region, the Port of Townsville has continued to service the evolving economic, industrial and communal development of North Queensland. Additionally, the port's own evolution has reflected the vacillations of rural production, extractive mineral industry, manufacturing, governmental changes, and social and urban development in and around Townsville and its hinterland.

By the early 1860s pastoral settlement had reached the area around Cleveland Bay; with John Melton Black and Robert Towns' Woodstock station on the plains south of Mount Stuart, and Dotswood, Inkerman, Jarvisfield and Fanning River to the south and west (Bell, 2003a). Overland transport imposed major costs on the early pastoralist in this area of North Queensland as the closest ports where located at Wickham or Cardwell. Black realised that it would give him a strong economic advantage if he could establish a port closer to his properties (Bell, 2003a). In 1864, buoyed by the newly founded Queensland Colonial Government's efforts to encourage further northern settlement, Black sent his property managers, Mark Reid and Andrew Ball, to search for a suitable place where ships could load and unload goods in the sheltered waters of Cleveland Bay. Reid and Ball located a narrow river mouth where small ships could tie up alongside firm level ground and named the river after their colleague William Ross.

This site's discovery was to play a crucial strategic part in the development of North Queensland for the next century and importantly in the founding and later development of Townsville (Bell, 2003a). Although its shallow waters and the existence of a number of existing ports along the northern Queensland coast seemed to prohibit the founding of a port in Cleveland Bay, the demands of settlers north of the Burdekin River for an accessible port saw the founding of what is now the settlement of Townsville in 1864 (Donnelly, 1959). Despite the seemingly unfavourable location, a jetty was built on Ross Island between Ross Creek and Ross River, and vessels would anchor in the lee of Magnetic Island and discharge goods and passengers via lighters (Undefined, 1992).

Black arrived in the region on 5 November 1864 to establish the port and he remained a resident until 1876 (Taylor, 1980). When the port was gazetted in 1865, local people had wanted to call it Blacktown, but Black modestly declined, and suggested the name of Townsville after his more prominent business partner (Bell, 2003a). Ironically, despite having only visited the place once, Robert Towns is recalled as one of the fathers of Townsville (Carver, 1993).

Figure B.16.2 View of Townsville Harbour showing the Breakwater, 1901 (Unidentified 1901)

Importantly the location of the original port was seminal for the site of present day Townsville. Black and Towns actively recruited labour to the area to assist with the port's construction, which led to the establishment of a small settlement around the port. The continued growth of North Queensland as a pastoral and agricultural province combined with the port's growth attracted traders, merchants, and other settlers to the area and swelled the burgeoning settlement.

Thom Blake's study on the heritage of the city's CBD noted that the small original settlement attached to the port has shaped the development of Townsville and its influence can still be discerned in the broader urban landscape and plan of the city (Blake, 1999).

B.16.3.1.2 Administering Australia

The population of Townsville steadily increased with the growth of the town and its port. By the end of 1865 the population exceeded 400 people, which necessitated a properly constituted form of government to control and administer local affairs (Taylor, 1980). On 14 February 1866, the Governor declared by proclamation the town of 'Townsville' to be a municipality. This was followed by a general election in March 1886 where John Black was chosen as the city's first mayor in recognition of his tireless efforts to establish the city (Taylor, 1980). At various times, Black served as a shipping agent, surveyor, newspaper editor, and storekeeper (Carver, 1993).

Australia's reliance on maritime trade and communication meant that Townsville was to play an important role in customs and immigration in Australia.

In 1865, soon after its founding, the popularity of Cleveland Bay for arriving vessels and as the last stop before leaving Australian waters for overseas saw it gazetted as an official port of Entry and Clearance (Davenport, 1986). This made the port an important link in trade and migration. As a result, the fledgling Queensland Colonial Government took responsibility for the port's administration and maintenance, and James Gordon was appointed Harbour Master and Sub-Collector of Customs (Taylor, 1980).

The operation of the port continued to reflect the machinations of colonial and later Commonwealth government, in relation to the administration of ports and harbours (and by extension trade and immigration), throughout Australia. After agitation from a range of interests throughout the state, but most pertinently Townsville businessman and later Queensland Premier Robert Philp, the *Harbour Boards Act 1892* (Qld) was passed. This created a number of independent Harbour Boards throughout the state. The first that came into effect on 1 January 1896 was the Townsville Harbour Board (Taylor, 1980) (Figure B.16.3).

Figure B.16.3 Members of the Townsville Harbour Board 1903 (Unidentified 1903)

Townsville's importance as an administrative entry point continued after the federation of Australia. In 1902 a new Customs House was completed on Wickham Street (Taylor, 1980). Although this building was initiated by the Queensland government, the Australian Customs service took over responsibility for the administration of customs following 1901 and eventually the building was transferred to the Commonwealth in 1908 (Taylor, 1980).

Even with changes in technology, the Port of Townsville remained an important entry point. In 1938, improvements to the port's facilities and its existing customs infrastructure saw it become a nominated point of call for Empire flying boats (Davenport, 1986). This administrative role continued throughout the twentieth century and today the port hosts both Australian Customs and Border Protection and Australian Quarantine Inspection Services.

B.16.3.1.3 Using Natural Resources

Although the port's first use was the export of agricultural products, the importance of North Queensland's vast mineral resources soon dominated its growth. The discovery of gold at nearby Cape River in 1867 and Ravenswood in 1869 saw the rapid development of the port as prospectors sought to convert their discoveries to wealth (Taylor, 1980).

While Townsville had grown to be a major port in the region, this status was further solidified by the decision to locate the terminus of what would eventually become the Great Northern Railway at Townsville in 1878 (Blake, 1999). This railway line eventually stretched to Mount Isa, making the port the major export point for the majority of mineral discoveries in North Queensland.

While a number of regional mining centres contributed to the tonnages shipped across the Port of Townsville's wharves, it was the development of Mount Isa as the hub of a major mineral province that proved most beneficial to the port's operations during the twentieth century.

The commencement of mining, milling and smelting operations at Mount Isa in 1931 saw a large increase in the amount of minerals being exported through the port and in the later part of the 1930s a second crane was installed at the port specifically to handle the increase in exports from Mount Isa (Pullman, 2000).

Understanding the importance of mineral exports, the Harbour Board made a number of improvements to further facilitate the export of minerals following World War II. As a result, in 1964 the port exported 200,316 t of minerals including refined copper (63,565 t), zinc concentrate (73,154 t) and silver lead (57,575 t) (OAPS, 1964).

By 1982 this had increased to 900,000 t of mining industry products exported over the docks at Townsville, which comprised over half of the port's yearly export total (TCC, 1982).

POTL's *2009/2010 Annual Report* (POTL, 2010) provided evidence of this continued growth, as it showed mineral exports comprised approximately 58% of the port's total exports (i.e. 5,961,578 t).

B.16.3.1.4 Developing Primary Production

From its initial founding, the Port of Townsville has supported the North Queensland pastoral industry (Blake, 1999). Virtually all pastoralists in the region came to rely on and use the port soon after its founding (Carver, 1993). This continued role was to prove integral to the growth of much of North Queensland's agricultural and pastoral industry. At first, the most viable option for pastoralists who settled the region was to dispatch their cattle and sheep to the boiling down works that Towns established at Ross River; where the carcasses were treated and the resulting tallow was sent to market (May, 1990). At this time the export of meat to southern domestic and overseas markets was restricted by the lack of reliable refrigeration technology (Hermann, 2002).

The beef industry boomed with the development of refrigeration, which allowed carcasses to be exported to larger markets, primarily in Britain, but also throughout the world. Capitalising on this technological development, the Queensland Meat Export Company built a new meat works in 1890, on the south bank of Ross River, which gave a major boost to the area's pastoral industry (Figure B.16.4).

Figure B.16.4 Stevedores loading frozen meat at Townsville Port c. 1901 (Unidentified 1901)

According to the historian of North Queensland, Dawn May, this development had 'tremendous economic, social, and political consequences' for Townsville, its hinterland, and the wider state as it granted North Queensland pastoralists the ability to access wider markets (May, 1990). By 1913 the meat works was described as 'the most up to date in the world' (May, 1990) and the following 20 years were the heyday of the North Queensland beef cattle industry, with Ross River the focus of its export activity (Bell, 2003b).

Townsville's first major agricultural venture was the cultivation of cotton. Robert Towns had tried similar ventures at his properties in south-east Queensland. The earliest ventures in this form of agriculture in Townsville were at what is now known as Railway Estate. Despite some early successes, the ending of the American Civil War in 1865 meant the end of the cotton industry in Queensland.

From 1879 to 1880 a rush set in for Queensland's sugar land. The production of raw sugar in 1870 amounted to 2,854 t, and by 1880 had escalated by 550% to 15,681 t (Taylor, 1980). Although mineral exports eventually surpassed agriculture as the port's most voluminous export product, rural produce continued to play a vital role in the port's growth and operations.

Simultaneously, improvements to the port's facilities allowed rural producers to maintain a competitive advantage in international markets through the use of up to date technology.

The Harbour Board began construction of a bulk sugar terminal in 1957. It was completed in 1959 at a cost of £1, 600,000 and was only the fourth such facility in Australia. The first load of bulk sugar left Townsville on a Dutch bulk carrier on 24 August 1959 (OAPS, 1964). By 1964 the port exported over 270,000 t of sugar in raw and molasses form and 39,654 t of frozen and processed meat from the North Queensland region (OAPS, 1964). Since 1973 there has been a focus on providing bulk handling services to increase the efficiency of the port's operations and ensure a competitive advantage for the region's agricultural activities (Taylor, 1980).

B.16.3.1.5 Moving Goods and People

Alongside the considerable movement of both mineral and agricultural products, the Port of Townsville has played an important role in the movement of passengers both domestically and internationally. Initially the port was an important part of the coastal trade routes along the North Queensland coast for various coastal services that maintained regular passenger routes (Taylor, 1980). Passengers who came to Townsville via sea were originally bought ashore by lighter and disembarked at the jetty on Ross Island (Outlet for the Wealth of the Mighty North, n.d.). Later improvement to the port's facilities saw passengers able to disembark on the port's wharves. To adapt to changes in passenger technology a separate section of the harbour was excavated to create a mooring for the newly introduced flying boats that began to land at Townsville in 1938 (Davenport, 1986) (Figure B.16.5).

At this time Townsville was also the final port of call for passenger ships leaving Australia via the east coast for Europe and customs facilities and immigration facilities were maintained at the port (EPA, 2009). The port continued as a terminal for passenger vessels throughout the twentieth century and up to present day. A dedicated passenger terminal is currently being constructed on Berth 10 at the time of this report.

Figure B.16.5 Flying boat, Challenger on her Moorings in the Townsville Harbour (Unidentified 1938)

The increased shipping traffic attracted by the railway was the impetus for the commencement of harbour works in the form of breakwaters, dredged basins and land reclamation, which have continued to the present day. By the 1890s, the anchorage in Black's muddy creek was a distant memory, and international steamships were berthing at deepwater wharves in Townsville's growing harbour (Bell, 2003a) (Figure B.16.6).

Figure B.16.6 Steamboats and Steamships Moored at Townsville, 1900 (Unknown 1902)

B.16.3.1.6 Defending the Nation

As one of the most important northern ports on the Australian eastern seaboard, defence of the harbour, and Townsville more generally, has been an important part of the Port of Townsville's history. Fear of Russian or French invasion from the 1860s onwards meant the defence of important coastal ports, such as Townsville, was vital to the new Queensland Colonial Government (Blake, 1999). To secure the town and the port, early fortifications were built at Kissing Point and other strategic locations along the coast. The port did not host any defensive installations at this time (David Russell Lawrence, 1989) (Figure B.16.7).

Figure B.16.7 members of the Townsville Garrison Artillery standing next to cannon at Kissing Point, Townsville, 1882 (Unidentified 2004)

This changed during the two major military conflicts of the twentieth century. During World War I, the port was manned by military personnel to guard this strategic piece of infrastructure in case of attack and as means to provide a defensive force in case of invasion (Taylor, 1980). The port was also the embarkation site in 1914 for 1,000 soldiers of the Australian Naval and Military Expeditionary Force, who took part in a secret operation to capture German New Guinea and destroy communication stations (MacKenzie, 1941). This force left Townsville on board the HMAS Kanowna (Figure B.16.8).

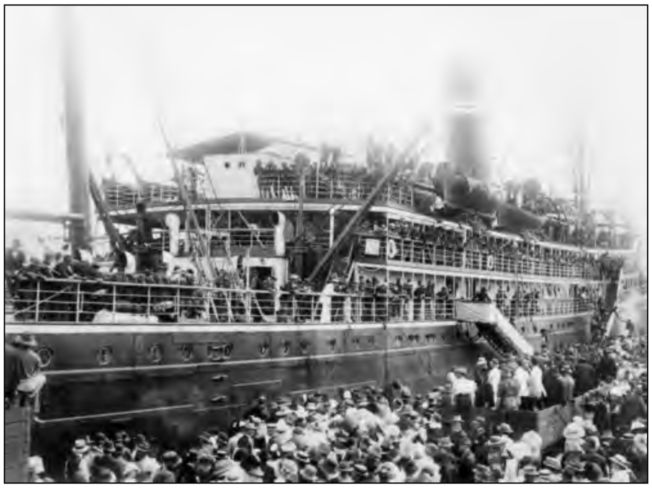


Figure B.16.8 HMAS Kanowna Drawing Away from the Wharf (Unidentified 1914)

While Townsville experienced an influx of military ships and personal during World War I, this was dwarfed by the level of military personal and equipment that would pass through Townsville during World War II. The conflict had a significant impact on Townsville, both in material remains and social attitudes. Military historian, Darryl McIntyre, believes that ‘the social changes created as a result of wartime conditions were enormous’. As an important northern port and potential staging point for a planned future counter-attack on the Japanese army in the Pacific, the city of Townsville became the centre of a military complex larger than anything Australia had seen before (Bell, 2003a). The population grew from 25,000 people to over 100,000 in just one year with the influx of American service personnel into Townsville in 1942 (Garrett, Stein, Bigourdan, & Jeffery, 2006).

Townsville's strategic potential, first recognised in colonial times, became evident during World War II when the city was transformed into a major staging post for allied operations in the Pacific. As a result, World War II had a significant effect on the Townsville area. Cleveland Bay was a central harbour serving as an assembly point for shipping during World War II (Figure B.16.9).

Figure B.16.9 An aerial port quarter view of the Corvette HMAS Kapunda (Unidentified 1943)

As up to 40 ships could be found in the bay each day awaiting convoy to the South Pacific, the port became a major target for aerial and naval attack during the war and was bombed by Japanese planes on at least three occasions. A number of material changes were subsequently made to the port including the painting of buildings and other structures in appropriate camouflage colour schemes and the construction of defensive infrastructure such as gun emplacements, air raid shelters and six new landing grounds in the immediate surrounding district (Garrett, Stein, Bigourdan, & Jeffery, 2006).

Defensive forts were also built on Magnetic Island to scan the new harbour, and there was discussion of tunnelling into Castle Hill, the city's most prominent natural feature, to create an air raid shelter; although costs proved prohibitive (McIntyre, 1992).

The port made valuable contributions to the Allied war effort during World War II and it was decided by the Harbour Board that for the duration of the war it would make the port and its facilities available to the military without charge and allowed military installations and buildings to be constructed in the port. Additionally, as a organisation with a large workforce and considerable plant equipment, the Board undertook a number of construction activities away from the port on behalf of the allied military effort (Taylor, 1980). Most of the infrastructure relating to World War II has since been removed and there is little remaining evidence visible today in the port.

B.16.3.1.7 Enjoying the Natural Environment

Alongside the port's historical agricultural, industrial, and military uses, the environment and facilities provided by the Townsville harbour have played a significant role in recreational boating. The earliest recreational activities took place at Ross Creek in 1887 when Harry Butler established accommodation for holiday makers at Magnetic Island and provided a regular boat service from the mainland. Robert Hayes followed in 1889, building a two-storey hotel there and also inaugurating a ferry service.

In their early years these services were operated from existing wharves and temporary landings. In 1909 both services were granted creek frontage sites in Ross Creek on which to erect pontoon landings and depots (Taylor, 1980). During the 1960s, a small boat landing was constructed in the harbour swing basin to accommodate commercial and recreational craft (Taylor, 1980). This was followed by a second boat ramp constructed during the 1980s that increased the capacity for recreational craft. As a result, the port has had a tremendous social value to the Townsville community through the provision of recreational boating and fishing facilities (Taylor, 1980) (Figure B.16.10).

Figure B.16.10 Early Image of Yachts on Ross Creek (Unidentified nd)

B.16.3.1.8 South Townsville

Also known as Ross Island, the community that developed in the suburb of the current day South Townsville has been closely associated with the development of the Port of Townsville. As one of the oldest locales in the city, the suburb's evolution has reflected the changes not only in settlement patterns and land uses in Townsville, but also the alterations to operations at the port itself. As a result of its past, the suburb's history has been dominated by its use as a residence for employees of the port and closely related industries.

When John Black arrived in Townsville, Ross Island was reportedly described as a 'bush-covered island' bounded by Cleveland Bay, Ross Creek, and Ross River (Woods Bagot & Gibson-Wilde, 1993a). Although the construction of the first jetty that signalled the beginning of the Port of Townsville was on Ross Island, passengers and goods were unloaded at the jetty and then ferried back across Ross Creek to the fledgling Townsville settlement. It was not until 1868 that the first official settlement on Ross Island began, when the Burdekin and Flinders Hospital was built on land now occupied by the port (Woods Bagot & Gibson-Wilde, 1993b) (Figure B.16.11). Despite South Townsville being an integral part of the port operations it was not officially part of the Municipality of Townsville when it was proclaimed and the area remained isolated by a lack of transport over Ross Creek (Taylor, 1980; Woods Bagot & Gibson-Wilde, 1993b) (Figure B.16.12).

Figure B.16.11 A view of Townsville c. 1870 (Daintree 1870)

The mouth of Ross Creek and Ross Island in the background shows the original topography and geography of the current South Townsville

Figure B.16.12 1946 Flood (Unidentified 1946)

South Townsville topography has meant it has been susceptible to flooding and inundations.

Immigration barracks were established at Ross Island in 1876 and around the same time a tent town of over 400 workers evolved to house the families of those men who had been employed to work on harbour improvements (Woods Bagot & Gibson-Wilde, 1993b). This set the tone for the dominant period of the suburb’s development. Historian of South Townsville, Dorothy Gibson-Wilde, has described South Townsville’s dominant historical use as a dormitory suburb for the port and associated industries that thrived in close vicinity (Woods Bagot & Gibson-Wilde, 1993b).

The growth of the Port of Townsville from the 1890s onward meant that South Townsville became the most populated suburb of Townsville until the beginning of the World War II (Woods Bagot & Gibson-Wilde, 1993b). Due to the occupations of many residents of the suburb, it also developed a strong, and at times radical, working class political culture and an urban character typified by closely located workers cottages that remain evident in some sections of the suburb today (Woods Bagot & Gibson-Wilde, 1993b).

During the post-World War II years, new land use patterns began to affect the suburb. The town plan of 1967 further opened the suburb to industrial land uses and this began to encroach on former residential uses and on the suburb’s historic residential character (mostly around Perkins and Palmer Streets)

(Woods Bagot & Gibson-Wilde, 1993b). As a result, population patterns became more transitory as older owner-occupier residents who had lived in the suburb to be close to their employment at the port and/or related industries were eventually replaced by short-term rental occupiers. These transitory residents were later replaced as interest in heritage preservation saw the retention of many of the workers cottages in the suburbs, which were then filled with white-collar workers wishing to be close to the Townsville CBD (Woods Bagot & Gibson-Wilde, 1993b).

B.16.3.2 Register Searches

B.16.3.2.1 Australian Heritage Database

The Australian Heritage Database includes the following registers:

- World Heritage List
- National Heritage List
- Commonwealth Heritage List
- Register of the National Estate
- List of Overseas Places of Historic Significance to Australia
- Places under consideration, or that may have been considered for, any one of these lists.

A search of the Australian Heritage Database (4 July 2011) revealed one place in the Study Area listed on a number of the above registers. These listings pertain to the Great Barrier Reef and are listed based on recognition of the region's outstanding natural universal value. Further details of these listings are provided in Table B.16.1.

Table B.16.1 Great Barrier Reef Listings on the Australian Heritage Database

List	Class	Legal Status	Place ID
World Heritage List	Natural	Declared property (30/10/1981)	105060
National Heritage List	Natural	Listed place (21/05/2007)	105709
Register of the National Estate	Natural	Registered (14/05/1991)	8320
Commonwealth Heritage List	Natural	Indicative place	105573

The significance of the Reef is associated with its natural beauty, ecological diversity, and aesthetic importance. As such, the potential impacts on the Reef's heritage values will be addressed as part of other relevant assessment of factors in this EIS, as shown in Table B.16.2.

Table B.16.2 Great Barrier Reef Values and EIS Chapters

Great Barrier Reef Outstanding Universal Values	Chapter
Natural Beauty	Scenic Amenity
Aesthetic importance	Scenic Amenity
Ecological diversity	Marine Ecology

The listed Outstanding Natural Universal Value of the Great Barrier Reef World Heritage Area do not relate to non-Indigenous cultural heritage for the Study Area. It is unlikely that any direct associative values exist, as per the Burra Charter, between non-Indigenous cultural heritage in the Study Area and the Great Barrier Reef World Heritage Area.

B.16.3.2.2 Queensland Heritage Register

A place may be entered in the Queensland Heritage Register if it is of cultural heritage significance and satisfies one or more of the following significance criteria:

- A: the place is important in demonstrating the evolution or pattern of Queensland's history

- B: the place demonstrates rare, uncommon or endangered aspects of Queensland's cultural heritage
- C: the place has potential to yield information that will contribute to an understanding of Queensland's history
- D: the place is important in demonstrating the principal characteristics of a particular class of cultural places
- E: the place is important in exhibiting particular aesthetic characteristics valued by the community or a particular cultural group
- F: the place is important in demonstrating a high degree of creative or technical achievement at a particular period
- G: the place has a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons
- H: the place has a special association with the life or work of a particular person, group or organisation of importance in Queensland's history.

A search of the Queensland Heritage Register on 4 July 2011 revealed two heritage listed places on the register for South Townsville. Neither site is located in the Project Area, but are at a linear distance of approximately 2 km and 2.5 km, respectively, from the southern extent of the PEP boundary.

Table B.16.3 lists the two places nominated on the Queensland Heritage Register and identifies their significant heritage elements.

Table B.16.3 Places Listed on the Queensland Heritage Register

Place	Register ID Number	Address	Significance Criteria
St John's Anglican Church Precinct	600880	30-34 Macrossan Street, South Townsville	A, D, E and H
Victoria Park Hotel	600882	266 Boundary Street, Townsville	A, B, D, G and H

An analysis of these places' heritage listings determined that their significance, as recorded on the Queensland Heritage Register, is embodied in one or both of the following heritage elements as defined in the *Burra Charter*:

- Fabric: all of the physical material of the place including components, fixtures, contents and objects (Australia ICOMOS, 1999c).
- Association: the special connections that exist between a people and a place (Australia ICOMOS, 1999d).

B.16.3.2.3 Queensland Heritage Database

The Queensland Heritage Database is maintained by the Department of Environment and Heritage Protection. This database is a non-statutory list of places of reported with potential heritage significance that contains information that may be of use when considering an area's heritage values as part of an assessment. A search of this database confirmed no places recorded in the Project or Study areas.

B.16.3.2.4 Townsville City Council Heritage Database

Most of Townsville's heritage properties were identified in an *Urban Conservation Study* (Woods Bagot & Gibson-Wilde, 1993b). Property owners and the community were encouraged to nominate places of potential cultural heritage significance and an assessment was undertaken to determine which sites were culturally significant. TCC's Local Heritage Database is based on the outcomes of that assessment.

There are no established criteria for entry onto the Local Heritage Database. There are statements of significance provided for properties that assist in assessment of the elements that contribute to each place's heritage significance.

A search of this database confirmed that there are no places in the Project Area of local heritage significance. Fifty places are listed in the Study Area; located in the suburb of South Townsville (Table B.16.4). Two of these places, the Victoria Park Hotel and St John's Anglican Church Precinct, also appear on the Queensland Heritage Register, as previously discussed.

An analysis of these places' heritage listings determined that their significance is embodied in one or all of the three following heritage elements as defined in the *Burra Charter*:

- Fabric: all of the physical material of the place including components, fixtures, contents and objects (Australia ICOMOS, 1999c).
- Setting: the area around a place, which may include the visual catchment (Australia ICOMOS, 1999b).
- Association: the special connections that exist between a people and a place (Australia ICOMOS, 1999d).

Table B.16.4 lists each of the places nominated on the register and identifies their significant heritage elements.

B.16.3.2.5 Australian National Shipwreck Database

A search of the Australian National Shipwreck database confirmed that there are 12 historic shipwrecks recorded in Cleveland Bay (Table B.16.5). Based on available information and a search of the Queensland Heritage Database, none of these sites are located in the Project Area or immediately adjoining areas.

B.16.3.2.6 Historic Aeroplane Wrecks

The *Listing of Aircraft Wreckage in North Queensland* compiled by Keith Rundle (2005) of the Royal Australian Air Force recorded that there were over 161 known aircraft crashes in the Townsville area during World War II. A further study undertaken by members of the James Cook University Archaeological Department in 2006 (?JCU, 20060 recorded that there are presently 122 known aircraft crash sites located in Townsville waters with a large majority in Cleveland Bay. None of these sites are known to be in the Project Area. While these aeroplane wrecks have been identified as important archaeological sites that retain a heritage value, they are not currently protected under any state or Commonwealth legislation.

A review of the results of the multi-beam and side scan seismic sonar results undertaken as part of the PEP did not reveal any anomalies that may indicate the presence of exposed shipwrecks or crashed planes.

B.16.3.3 Site Survey

On 6 July 2011, a site survey was conducted at each of the places of heritage significance in the Study Area to verify the location and condition of these sites to determine whether the PEP may have an impact on a listed place. The survey was limited to only external inspections of the places and no internal inspections were conducted.

All places were assessed to be in a condition commensurate with that recorded in their respective heritage citations and were in the locations identified by the register searches.

Figure B.16.13 shows the location of identified places. During the survey, a visual assessment of the proximity of each place to the Project Area was undertaken. This included an assessment of any lines of sight that may be affected.

A key task completed during this survey was to ascertain if there were any other places of potential heritage significance in or close to the Project Area. The site survey was limited to land-based areas and, since the site of the PEP is situated in the sub-tidal waters seaward of the existing northern breakwater, no historic visual survey was conducted of this area.

The results of the archival research undertaken as part of this study did not reveal any evidence that would suggest a high probability for the discovery of items of non-Indigenous cultural significance during the reclamation works for the PEP.

B.16.3.4 Summary of the Existing Heritage Environment

Searches of the relevant Commonwealth, state and local heritage registers confirmed that there are 50 places of heritage significance in the Study Area. Two of these places are listed on the Queensland Heritage Register, and a further 48 sites are nominated on the TCC's Local Heritage Database. All of these sites are located to the south of Archer Street, and are at least 1.8 km from the southern extent of the PEP boundary.

Both the Victoria Park Hotel and St John's Anglican Church Precinct are listed on both registers. There are currently no places in the Study Area that appear on any Commonwealth registers.

PORT EXPANSION PROJECT EIS

Location of Registered Historic Sites in South Townsville

Figure B.16.13

Legend

- The Strand
- Railway Line
- Townsville Port Access Road
- Project Area
- Townsville State Development Area
- Non-Indigenous Culture Heritage Study Area
- Heritage Sites
- Existing Port Land

Scale: 1:20,000 (when printed at A4)

0 100 200 400 600 800

Metres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_016

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery - Port of Townsville 2011.
Strategic/Proposed Port Land - Port of Townsville Land Use Plan

Table B.16.4 Places in the Study Area Listed on the Townsville City Council Heritage Register

Property ID Number	Name and Address	Suburb	Significance
82350	265 Boundary Street	South Townsville	Fabric: A very good example of a fibrous cement residential building of the 1950s and 1960s.
			Fabric: Evolution or pattern of Queensland history.
			Fabric: Rare, uncommon or endangered aspects of Queensland's cultural heritage.
			Fabric: Demonstrates principal characteristics of particular class of cultural places.
			Association: Strong or special association with a cultural group.
			Association: Association with a particular person, group or organisation.
76050	1 Hubert Street	South Townsville	Fabric: A good example of a rare style of verandah roof.
76170	25 Hubert Street	South Townsville	Fabric: A good example of an older style two-storey multi-residential dwelling.
76610	St. Patrick's Church 32 Hubert Street	South Townsville	Association: Association with J P O'Donoghue.
			Association: Association with the Sisters of Mercy.
			Fabric: A rare example of large public building that has been relocated.
			Fabric: Explains the evolution of the Parish of St Patrick's Townsville.
82110	Souths Football Clubhouse 65 Morey Street	South Townsville	Fabric: Site of first ship-to-shore radio broadcast in North Queensland.
			Fabric: An early example of a reinforced concrete radio broadcast centre.
			Fabric: Potential to illustrate a technique of broadcasting no longer used.
			Association: Important as a communication centre during World War II.
81900	64 Allen Street	South Townsville	Fabric: An excellent example of a c. 1930 multiple gabled residence.
			Setting: Occupies and contributes to the heritage values of Nelson Street.
81960	77 Allen Street	South Townsville	Fabric: A good example of the custom of recycling an old timber building.
81490	2 Archer Street	South Townsville	Fabric: An example of the recycling of a building removed from the goldfields to Townsville.
81510	8 Archer Street	South Townsville	Fabric: A good example of an early asymmetric house. An example of a recycled house from Charters Towers.
81520	24 Archer Street	South Townsville	Fabric: Illustrates the introduction of new building technology to North Queensland. It is the only known example of an early prefabricated concrete house in Townsville (perhaps in North Queensland) and has the capability of revealing aspects of a rare building technique.
79240	57 Perkins Street	South Townsville	Fabric: The best example in the study of the methods by which workers' dwellings were extended.
79380	89-91 Perkins Street	South Townsville	Fabric: Probably the best example of a Style Moderne brick house in the Townsville region and the best brick

Property ID Number	Name and Address	Suburb	Significance
			house in South Townsville.
79440	99A Perkins Street	South Townsville	Fabric: A very good example of 1940s to 1950s house illustrating the continuation of Californian bungalow influence from the 1920s.
79460	103 Perkins Street	South Townsville	Fabric: This house is said to from1890 and to have come from Charters Towers.
79520	115-147 Perkins Street	South Townsville	Fabric: For its association with New Zealand Loan and Mercantile Agency Company Limited, a major service firm for the North Queensland pastoralists.
77770	South Townsville School	South Townsville	Fabric: Significant trees predate 1941, banyans and mango trees.
78190	107 Tully Street	South Townsville	Fabric: A very good example of house and matching fence, late 1930s to 1950s.
78600	Victoria Park	South Townsville	No statement of significance recorded in listing.
77120	40 Bell Street	South Townsville	Fabric: An excellent example of worker's dwelling with surrounding verandahs. An excellent example of use of chamfer boards, casements and louvers to infill verandahs.
77190	26 Bell Street	South Townsville	Fabric: A good example of early worker's dwelling.
77330	3 Bell Street	South Townsville	Fabric: A good example of worker's dwelling c. 1900.
77340	5 Bell Street	South Townsville	Fabric: A good and well preserved example of a worker's dwelling of the early 20th century in a suburb characterised as predominantly a dormitory suburb for workers in nearby industries.
			Association: For its association with the Ogden family, well known in South Townsville from the 1880s to the 1960s.
			Fabric: A good example of verandah infill.
77350	7 Bell Street	South Townsville	Fabric: A very good example of a worker's dwelling c. 1900.
77360	9 Bell Street	South Townsville	Fabric: A good example of a worker's dwelling c. 1900 or earlier.
77380	13 Bell Street	South Townsville	Fabric: A very good example of this style of dwelling.
77440	25 Bell Street	South Townsville	Fabric: A very good example of two-storey local store with living quarters above. It would appear that few such buildings were erected in Townsville in the late 1940s.
77460	29 Bell Street	South Townsville	Fabric: A very good example of a larger dwelling with verandahs surrounding the core of the house, uncommon in South Townsville.
77500	35 Bell Street	South Townsville	Fabric: One of the best examples remaining in Townsville of a low-set worker's dwelling on timber piers with pyramid roof and ventilator, and with only one side verandah. An excellent example of the use of timber louvers for verandah infill, a use which was once common but is now comparatively rare.
			Association: For its association with the Butler family, good representatives of the workers of South Townsville, for nearly a century.
77530	41 Bell Street	South	Fabric: A very good example of high set worker's

Property ID Number	Name and Address	Suburb	Significance
		Townsville	dwelling illustrating the use of timber louvers for verandah infill, a use once common but now comparatively rare.
98660	22 Campbell Street	South Townsville	No statement of significance recorded in listing.
98670	20 Campbell Street	South Townsville	Fabric: An unusual and intact example of late Californian bungalow style, with unique decorative features. Contribution to streetscape.
98710	8 Campbell Street	South Townsville	Fabric: A very well preserved early example of asymmetric dwelling. Contribution to streetscape.
76270	42 Nelson Street	South Townsville	Fabric: A very good example of two-storey house in the 1950s and 1960s, of which few were built.
			Association: Association with the history of the Catholic Church in South Townsville.
76280	40 Nelson Street	South Townsville	Fabric: A very good example of a style of house rare in Townsville.
			Association: Association with Thomas E Robertson and the firm Inglis Smith and Company.
76320	32 Nelson Street	South Townsville	Fabric: For the introduction of a new style of dwelling to the Townsville region. Containing probably the first private roof-top swimming pool in Townsville. A unique example of concrete house in a city in which concrete houses are rare.
76370	20 Nelson Street	South Townsville	Fabric: A very good example of a 1890s worker's dwelling with subsequent alterations which can be dated with reasonable accuracy. As an example of the style of worker's dwelling built by Page and Sherlaw, contractors well known in North Queensland.
			Association: Association with the Marnock family, a typical working class family for nearly a century.
76420	10 Nelson Street	South Townsville	No statement of significance recorded in listing.
76450	1 Nelson Street	South Townsville	Fabric: A good example of triple-gable style with bay windows.
76460	3 Nelson Street	South Townsville	Fabric: A very good example of a worker's dwelling without a central front door, but with two French doors as entry points. A very good example of Art Deco entrance and unusual and innovative verandah infill.
76520	15 Nelson Street	South Townsville	Fabric: A very good and largely intact example of an early worker's dwelling.
76530	17 Nelson Street	South Townsville	Fabric: Example of a prefabricated house c. 1910. Association with William Hollins, a well known small businessman in South Townsville.
76570	27 Nelson Street	South Townsville	Fabric: A very fine and largely intact example of a worker's dwelling c. 1920.
76660	51 Nelson Street	South Townsville	Fabric: A very good example of asymmetric house dated 1935. The only example of its kind in the Study Area.
81710	9 Cannan Street	South Townsville	Fabric: A good example of pyramid-roofed worker's dwelling with much detail intact.
81720	3 Cannan Street	South Townsville	Fabric: A very good example of a hand-built concrete house, rare in Townsville. A good example of the continuing influence of style of the 1930s into the 1950s.
77940	Commonwealth Hotel	South	Fabric: The Commonwealth Hotel is a fine example of a

Property ID Number	Name and Address	Suburb	Significance
		Townsville	hotel built to cater to the needs of workers in South Townsville, a suburb largely a dormitory for workers in heavy industries in surrounding areas. An unusual example of one of a pair of hotels erected at the same time in a few blocks of one another, both possibly designed by the architects Tunbridge, Tunbridge and Lynch.
77960	24 Macrossan Street	South Townsville	Fabric: A very good example of larger worker's dwelling.
77990	St John's Church 30-34 Macrossan Street	South Townsville	Fabric: (Church) An excellent example of a timber and iron church of Federation period. An example of the innovative architecture of Charles Dalton Lynch, a major Townsville architect of the early 20th century. The building illustrates well Lynch's response to design for tropical conditions.
			Association: (Church hall) As an adjunct to St John's Church.
			Fabric: (Rectory) A good (though not intact) example of an asymmetric house c. 1910.
			Association: Association with Anglican Church history in South Townsville.
75240	7 Martin Street	South Townsville	Fabric: The only example in South Townsville and a very good and largely intact example of c. 1950 fibrous cement sheeted house.

Table B.16.5 Australian National Shipwreck Database

ID	Vessel Name	Vessel Type	Year Wrecked	Wreck Location
2350	Coquette	Sailing vessel	1903	Townsville Harbour
2371	Dairy Maid	Single screw steamer	1895	Townsville Harbour/ Cleveland Bay
2387	Derwent	Twin screw steamer	1925	Townsville Harbour
2451	Ellen	Unknown	1896	Townsville Harbour
2473	Ethyl Jackson	Unknown	1913	Ross Creek Townsville Harbour
2531	Franklin	Single screw steamer	1893	Townsville Harbour
2589	Heather Belle	Single screw steamer	1896	Townsville Harbour
2644	Island Gypsy	Unknown	1970	Between Townsville and Happy Bay
2754	Lark	Sailing vessel	1896	Townsville Harbour
2818	Maria	Sailing vessel	1893	Between Townsville and Bundaberg
3056	Rialto	Sailing vessel	1920	Between Townsville and Bay Rock
3150	Star of Hope	Unknown	1904	Townsville Harbour

B.16.4 Assessment of Potential Impacts

B.16.4.1 Direct Potential Impacts

Direct impacts would occur if a heritage place or site was located directly in the construction area and/or would be physically impacted by construction. No places or items of non-Indigenous heritage significance have been identified in the Project Area (Figure B.16.13**Error! Reference source not found.**). There are no anticipated direct impacts to cultural heritage arising from PEP works.

B.16.4.2 Shipwrecks and Aeroplane Crash Sites

Although there are no recorded shipwrecks or known aeroplane crash sites in the Project Area there is the potential for unrecorded wreck and plane sites or for submerged heritage to be present. It is recommended that if any potential items of heritage value are discovered as part of the dredging and reclamation process, the Department of Environment and Heritage Protection be notified immediately in accordance with s. 89 of the *Queensland Heritage Act 1992*.

B.16.4.3 Indirect Potential Impacts

Possible indirect impacts may affect the contributory nature of the environmental setting of places and the contribution that this setting makes to their heritage significance. These potential indirect impacts may include:

- impact on its settings through inappropriate siting or design
- intermittent additional environmental effects such as noise, dust or light emissions
- potential damage to the physical fabric of historic buildings or historic landscapes
- changes to the visual amenity of the place.

As this study has identified, there are a number of places of heritage significance located in the Study Area, in the suburb of South Townsville. As each of the sites lies outside the planned development areas and transit corridors (Figure B.16.13**Error! Reference source not found.**), and outside of the construction buffer zones suggested in Chapter 12, it is not anticipated that they will be indirectly impacted by the development.

B.16.5 Mitigation Measures and Residual Impacts

The non-Indigenous cultural heritage assessment shows that the Project Area has no known existing heritage values and there is a low potential for the discovery of any other sites, places, or items of heritage significance during the construction or operational phases of the Project. This is primarily because the Project is located on sub-tidal land to be reclaimed for the purposes of constructing the new outer harbour.

The non-Indigenous cultural heritage study extended its consideration to areas adjacent to the Project Area to determine if there is a potential for any direct or indirect impacts to heritage values in South Townsville. This analysis identified 50 places of heritage significance on the local heritage register and/or Queensland Heritage Register, which embody three heritage elements: fabric, setting or association. It was determined that none of these places would be subject to any direct impact due to the nature of the Project and the distance of these places from the Project Area.

Separate assessments of potential traffic, visual amenity, noise, dust, and vibration impacts in the South Townsville transport corridors may require the implementation of other mitigation measures. These measures have the potential to further assist in the conservation of South Townsville's heritage values and are addressed separately in the respective chapters.

Should any items of potential cultural heritage significance be discovered as part of the dredging and reclamation activities, Department of Environment and Heritage Protection will be notified immediately in accordance with s. 89 of the *Queensland Heritage Act 1992*.

The majority of heavy vehicles to be used for construction and operations for the PEP will use the new Townsville Port Access Road and bridge. This new infrastructure will reduce the volume of heavy traffic along Boundary Street and diminish the cumulative impacts on listed heritage sites located in the nearby suburb of South Townsville.

Given that the closest listed heritage places is located 1.8 km from the southern boundary of the Project Area there will be no negative impacts on the listed heritage places identified in this report.

B.16.6 Assessment Summary

The non-Indigenous cultural heritage study describes the existing heritage values of the site of the PEP and its immediately adjacent areas, and provides mitigation measures to reduce the potential for adverse impact on existing historic heritage values. The study found that the Port of Townsville and the adjacent suburb of South Townsville have a complex and interrelated history. In the case of South Townsville, this history is represented in a number of places and sites of cultural heritage significance that appear on the Queensland Heritage Register and the TCC Local Heritage Database.

As the project is to be constructed entirely on reclaimed sub-tidal land, it is highly unlikely that any places or sites of heritage significance will be directly affected during the construction or operational phases of the Project. Should there be any items of potential heritage significance discovered during dredging activities, work around the object should cease and Department of Environment and Heritage Protection will be notified immediately in accordance with s. 89 of the *Queensland Heritage Act 1992*.

Table B.16.6 summarises non-Indigenous cultural heritage impact assessment for the PEP.

Table B.16.6 Impact Assessment Summary – Non-Indigenous Cultural Heritage Study Area

Element	Primary Impacting Process	Magnitude of Impact	Likelihood of Impact	Risk Rating (Before Mitigation)	Summary of Key Mitigation Measures	Residual Risk
Fabric	Environmental factors (such as noise, air, light, vibration) may affect the integrity of heritage built fabric.	Low	No direct or indirect impacts.	Negligible	Nil	Direct: Negligible Indirect: unknown, but unlikely
Association	Direct or indirect impacts that would affect the community's enjoyment or use of these places or restrict the opportunity for the interpretation, commemoration and celebration of the community's links with the places.	Low	Highly Unlikely. It is highly unlikely that there would be direct or indirect impacts to any identified heritage site that will restrict the interpretation, commemoration, or enjoyment of these places by the public.	Negligible	Nil	Negligible
Setting	Direct or indirect impacts that would compromise the visual settings that contributes to the place's cultural heritage significance.	Low	Highly Unlikely There is only one place in the Study Area that is listed for its setting (64 Allen Street, South Townsville). The Project will not result in the introduction of new visual elements to the setting of this place and its cultural heritage will not be adversely impacted.	Negligible	Nil	Negligible

Port Expansion Project EIS

Part B

Section B17 – Scenic Amenity

AECOM BMT WBM

B.17 Scenic Amenity

The purpose of this chapter is to describe the landscape and visual values that contribute to the scenic amenity in and around the port and to assess likely current views and the potential for these views to be affected by Port Expansion Project (the Project, PEP) shown on Figure B.17.1.

B.17.1 Relevance of the Project to Scenic Amenity

The following define the outputs of this assessment:

- *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement* (ToR) (CG, 2012) (Appendix A).
- Guidelines for an environmental impact statement for the Port of Townsville Port Expansion Project, Queensland (EPBC 2011/5979/GBRMPA G34429.1)(Guidelines) (DSEWPC, 2012) (Appendix A).

Key components of the Project anticipated during the construction and operational phases that are relevant to scenic amenity impact assessment include:

- The construction of a deep water outer harbour formed by the construction of a breakwater approximately 1 km seaward of the existing northern breakwater, and deepening of the harbour basin.
- The construction of up to six additional vessel berths inside the outer harbour (Berths 14 to 19), including wharf structures to provide for the berthing and mooring of ships.
- The creation of approximately 100 ha of reclaimed land backing the berths to provide for cargo storage and handling infrastructure, including rail infrastructure. This land is to be created from material reclaimed from the outer harbour dredging and include internal bunds to facilitate effective land reclamation.
- Construction of internal roads and rail infrastructure in the Project Area that connects through the existing port to the transportation infrastructure located in the Eastern Access Corridor (EAC). Access into the port will be through the existing entry access. The completion of the Townsville Port Access Road (currently under construction) will provide the main route for heavy vehicles to the port. There is provision for a new rail line to be constructed in the EAC in the future. Approval of the rail infrastructure will be subject to separate development approvals.
- Installation of services infrastructure (for example, stormwater, water supply, power, waste water, and telecommunications).
- The deepening of the existing approach shipping channels (Platypus and Sea channels), which will create a minor extension of the Sea Channel seawards.
- Widening of the Platypus Channel near the outer harbour entrance.
- Installation of aids to navigation for the shipping channels and outer harbour basin.
- Construction of a western breakwater to protect the outer harbour, which may or may not be required depending on the results of further hydrodynamic and engineering studies undertaken as part of the detailed design.

B.17.1.1 Project Timing and Staging

It is not possible to predict exactly when the new berths and associated infrastructure will be developed. Construction of the main components of the development is anticipated to be spread over four construction stages, with the following aspects relevant to scenic amenity.

- Stage A: Berths 14 and 15 (2014/15 and 2015/16):
  - dredging works associated with the reclamation area, bund and breakwater structures, Berths 14 and 15 manoeuvring basin, the Platypus and Sea channels, including placement of dredged material in bunded areas as reclamation fill and excess dredged material deposited at the existing offshore Dredge Material Placement Area

   - bunded outer harbour reclamation area (entire outer harbour reclamation footprint) with revetment and breakwater protection
   - development of two new berths (Berths 14 and 15)
   - development of the first rail loop and wagon unloading/loading infrastructure.
- Stage B: Berth 16 (2018/19):
   - dredging works for Berth 16 manoeuvring basin
   - development of a new berth (Berth 16)
   - construction of second rail loop (if required).
- Stage C: Berth 17:
   - dredging of manoeuvring basin for Berths 17, 18 and 19 areas and placement into the reclamation
   - construction of Berth 17 with associated services roads and cargo transfer facilities
   - construction of third rail loop (if required).
- Stage D: Berths 18 and 19:
   - sequential development of two berths (Berths 18 and 19) and associated services, roads, and cargo transfer facilities.

The following activities will occur at each stage of development:

- development of additional rail and wagon unloading/loading infrastructure
- landside infrastructure for cargo storage and transfer
- road and other infrastructure to support port operations.

B.17.1.2 Key Sources of Potential Effects During Construction

The key construction activities that relate to this assessment are short-term temporary activities:

- breakwater and bund construction, consisting of conventional earth/rock fill structures to retain the dredged fill, protect the reclamation from erosion and wave attack, and provide calm harbour conditions for ship loading and unloading operations
- harbour and channel dredging; requiring machinery such as backhoe excavators, grab dredge, cutter suction dredge and trailing suction hopper dredge
- reclamation works for land area required for cargo storage and operations including the placement and forming of dredged material from the harbour basin area to the bunded reclamation areas
- bulk earthworks and ground treatment, including capping (using imported granular material) and levelling of reclaimed land to nominal finished pavement level using machinery such as wide-track bulldozers (D6) and graders
- civil and structural works, including installation of stormwater, water supply, power, waste water, telecommunications
- construction of wharf structures for vessel berthing and mooring.

The dredging and rock dumping activities may result in visible turbid plumes. The extent of plumes and dispersion is discussed in Chapter B5 (Marine Sediment Quality).

B.17.1.3 Key Sources of Potential Effect During Operation

During operation, the key visible infrastructure associated with the PEP is anticipated to include:

- new breakwater, approximately 1 km seaward of the existing northern breakwater
- reclamation area of 100 ha backing the new berths to accommodate:
   - cargo operations zone of 54 m behind the wharf:

- cargo storage area 175 m deep to allow for material storage (generally enclosed with limited stockpiling on site) and associated handling equipment
- road reserve 25 m wide
- rail reserve 25 m wide, including a 200 m radius three track rail loop behind the cargo storage
- presence of up to six additional berths sized for vessels with a nominal length overall of 250 m indicatively including two container handling gantry cranes at Berths 14 and 15 each approximately 60 m (80 m at full extended height)
- presence of new aids to navigation (although these are not anticipated to result in a substantial visual change to the existing navigational situation)
- new western breakwater (if required) to protect the outer harbour.

Specific requirements for 'above-wharf' superstructure will be determined on a case-by-case basis by tenants for each berth. To assess the operational phase of the Project a variety of potential wharf configurations/tenants were considered. Future users will be subject to separate assessments once there is better certainty of its need and form.

It is expected that above-wharf facilities for port users in the PEP could include storage sheds, conveyors, shiploaders/unloaders, material receival facilities, administration and amenities buildings, tank farms and pipelines.

This Environment Impact Statement (EIS) covers infrastructure provided by Port of Townsville Limited (POTL) up to the top of reclamation and wharf. The assessment describes and illustrates indicative future conveyance, storage, loading and unloading of cargo.

The following assumptions were considered in the assessment (operational phase):

- Gantry cranes for container handling are generally considered to be the tallest elements likely to be located in the PEP. Gantry cranes are generally 60 m high and with the arm extended reach heights of approximately 80 m. The possible scenario of the ultimate development considered for this assessment assumes provision for two container handling gantry cranes (Berths 14 and 15).
- Dry bulk cargo would arrive by rail via the EAC and be unloaded through a purpose built rail car unloader on the rail loop, where it would be transported by conveyor to a covered stockpile or shed located on the reclamation behind the wharf. From there it would be loaded on to the ship via a conveyor feeding to a shiploader on the wharf, which will most likely be rail mounted and move along the ship from hatch to hatch. Conveyors would be covered to prevent dust, similar to existing port infrastructure.
- Two berths (Berths 18 and 19) have been as normally designated for liquid bulk import. At these locations, liquids would be unloaded via unloading arms on the wharf platform and conveyed by pressure pipeline to storage tanks, which would be located on the land inside the rail loop. From there, bulk liquids would be pumped into road tankers or rail tank wagons for distribution outside the port.

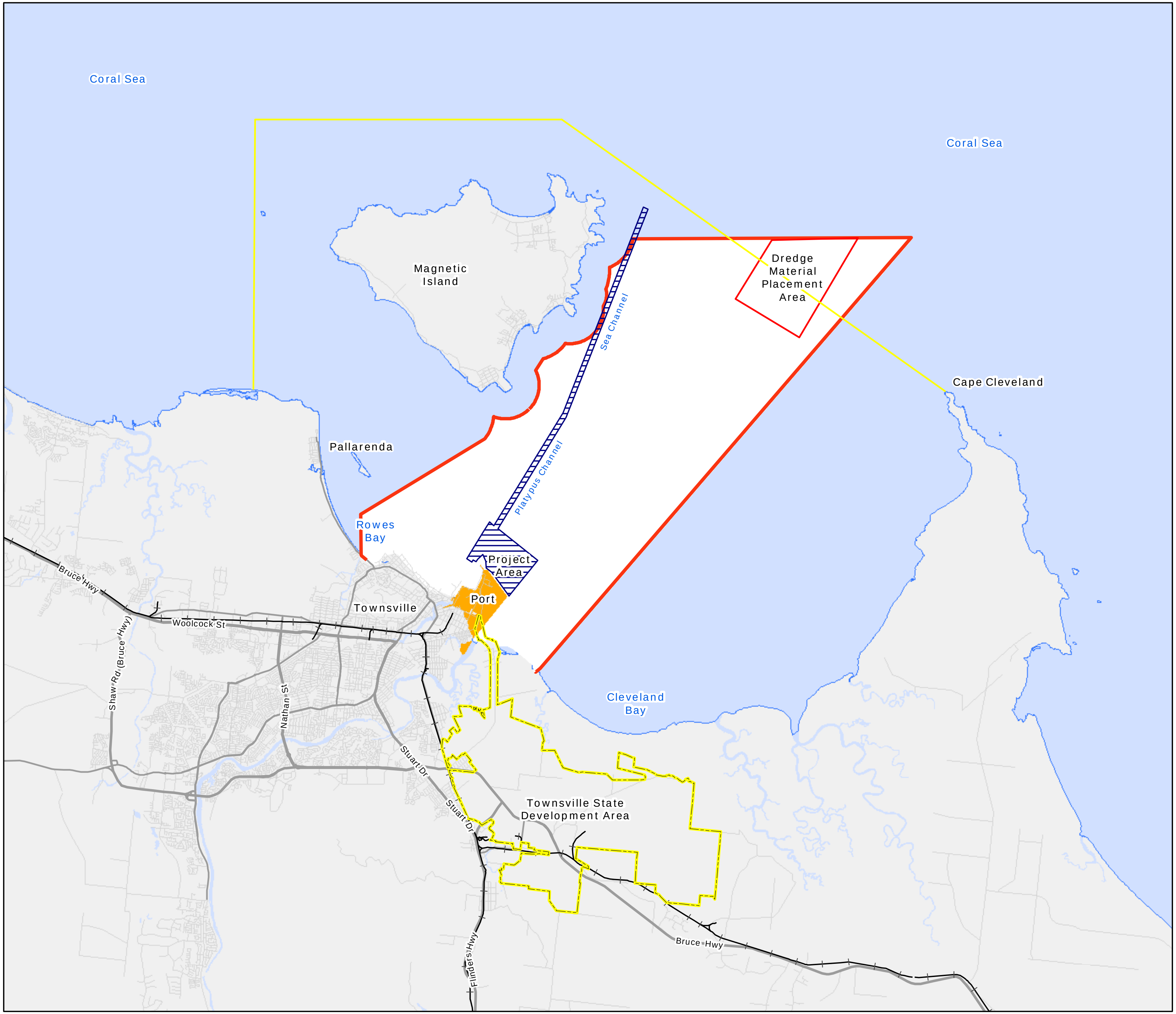
Infrastructure for construction as part of the PEP is considered permanent infrastructure and any decommissioning would be the result of future port rationalisation and/or changes in the needs of future port tenants.

The effect and subsequent impact on scenic amenity of any decommissioning works would essentially be the reverse of those experienced during the construction phase (i.e. a gradual removal of the infrastructure in the views instead of an additional of infrastructure). For the purposes of the impact on scenic amenity, further assessment was considered unnecessary beyond that undertaken for construction. Other potential impacts of decommissioning (for example, environmental, social and economic) are considered in the relevant chapters).

PORT EXPANSION PROJECT
EIS

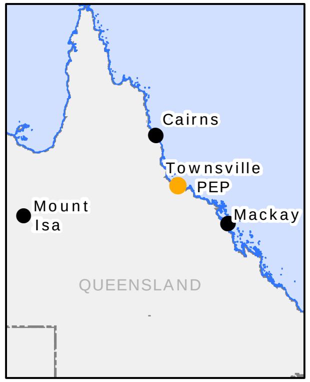
PEP Location Plan

Figure B.17.1



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary



N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_130

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012

B.17.2 Assessment Framework and Statutory Policies

B.17.2.1 Applicable Legislation and Policies

This section provides an overview of the key legislation and planning policies relating to the PEP and its implications on the scenic amenity character and views in the local area. It should be read in conjunction with Figure B.17.2, which shows the location of key designations related to scenic amenity.

B.17.2.1.1 Commonwealth Legislation

There is no specific national legislation requiring or directing the assessment of scenic amenity for major infrastructure projects. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legislative framework for protecting matters of national environmental and cultural values, which includes the Great Barrier Reef, declared a world heritage area in 1981. The Great Barrier Reef World Heritage Area (GBRWHA) extends approximately 2,000 km along the coast of Queensland and covers around 35,000,000 ha. The PEP is located on the coastline in the central sector of the GBRWHA.

For the Great Barrier Reef to obtain a world heritage area designation, it was required to demonstrate a number of internationally significant values including aesthetic attributes. In particular, of the four World Heritage Criteria associated with the GBRWHA designation, criteria of key consideration in the context of this assessment is '(vii) to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance'. The nomination, states that even though 'individual sites may not possess the most spectacular or outstanding single example...it is when the sites are viewed in broader perspective with a complex of many surrounding features of significance, the entire area may qualify to demonstrate an array of features of global significance.' The other criteria relevant to the GBRWHA designation such as 'contain the most important and significant natural habitats for in situ conservation of biological diversity' do not relate directly to landscape or visual values and are not considered further in this assessment.

The Great Barrier Reef Marine Park (GBRMP) is protected under the *Great Barrier Reef Marine Park Act 1975*, Commonwealth legislation that established the GBRMP and the Great Barrier Reef Marine Park Authority as a Commonwealth statutory authority responsible for its protection. The main object of the Act is to 'provide for the long-term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region' (s. 2A(1)). Another object is public enjoyment and appreciation (s. 2A(2)(a)(i)).

Although the main working areas of the Port of Townsville – the harbour, berths, and channels – are within an area excised from the GBRMP, POTL has an environmental policy that makes a commitment to 'minimise the risk of environmental harm through the identification, reporting, assessment, monitoring and control of environmental risks', which provides the context to this assessment.

Scenic qualities are a key aspect of the world heritage designation and GBRMP. The Project Area is located in the GBRWHA and the Great Barrier Reef National Heritage Place. The majority of the works, with the exception of a couple of kilometres of 'channel deepening', are in an area excised from the GBRMP (Figure B.17.2). The impact on the scenic qualities of the GBRWHA is explored in Section B.17.4.2 through representative viewpoints 5 and 11, which that fall either in or on edge the GBRWHA and GBRMP.

B.17.2.1.2 State Legislation

The Coordinator-General declared the Project to be a 'significant project' requiring an EIS under s. 26(1)(a) of the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act). The SDPWO Act and *Environmental Protection Act 1994* (EP Act) provide some general requirements for the coordination of environmental impact assessments that consider the potential impacts of a proposal on the social and environmental values, and any 'related matters'; which can reasonably be considered to include scenic amenity issues. Section 5.2.1 (Scenic Amenity and Lighting) of the ToR describes the assessment requirements for the Queensland Coordinator- General submission (Section B.17.4).

The Queensland Coastal Plan

The *Queensland Coastal Plan* was gazetted by the Department of Environment and Resource Management in February 2012. The plan was subsequently amended in October 2012 at the time of writing this EIS. The assessment has been undertaken against the provisions of the Queensland Coastal

Plan of February 2012. The Queensland Coastal Plan provides direction for effective protection and management of the coastal zone. The plan seeks to maintain the ‘unique natural values (such as world heritage areas)’ and their ‘popularity (such as the view from a popular lookout or destination)’; ensuring that developments in coastal landscapes are ‘undertaken in context with the surrounding landscape and/or built environment’ (DERM, 2012).

As the Project is located in a Coastal Management District, the visual management assessment provisions of the plan apply and have been incorporated into this assessment.

The plan has two main parts:

- *State Policy for Coastal Management* (January 2012): policy direction for natural resource management decision-makers about land on the coast, such as coastal reserves, beaches, esplanades and tidal areas.
- *State Planning Policy 3/11: Coastal Protection* (SPP 3/11) (January 2012): policy direction and assessment criteria to direct land use planning and development assessment decision-making under the *Sustainable Planning Act 2009*.

Scenic Amenity Policy H.1(a) specifically exempts ports from needing to assess scenic amenity; however, as the Queensland ToR.(5.2.1) requires that reference be made to the State Planning Policy Guidelines SPP 3/11 addressed below.

State Planning Policy 3/11 Guideline: Coastal Protection

SPP 3/11 is supported by the *State Planning Policy 3/11 Guideline: Coastal Protection* (DERM, 2012), which is intended to provide advice and information on interpreting and implementing SPP 3/11. In particular, Annex 4 provides a specific methodology for determining the scenic preference in the coastal zone and assessment criteria for determining if the visual effect of a development is acceptable. Annex 4 contains the material included in Annex 3 of the earlier *Coastal Plan Guideline* and is the guideline referred to in the ToR.

The method prescribed in Annex 4 does not constitute a full impact assessment on scenic amenity nor an approach that fully conforms to current EIS legislation and practice. The method should not be used to replace a standard technical scenic amenity impact assessment, but used as an additional supplementary tool in the assessment. The Annex 4 method alone would not be sufficiently robust for assessing and determining the acceptability of impacts on visual and scenic amenity as it does not, for example, provide a framework for the development of mitigation measures.

The method provided in Annex 3 of SPP 3/11 is principally divided into two parts:

- Determining (or estimating) the pre-change scenic preference of the coastal zone
- Determining if the visual effect of the development is acceptable.

Determining the pre-change scenic preference rating (SPR) of the coastal zone

Scenic preference is defined as ‘a rating of the community’s liking for scenery of open space compared to areas occupied by built structures, measured using photographs’ (DNR, 2001). Scenic preference is recorded through the use of a photograph, rating the image between one and ten, where a rating of one is least preferred and a rating of ten is most preferred.

Research in the South East Queensland *Regional Scenic Amenity Study* (Preston, 2005) demonstrated that highest rated coastal areas ‘depict natural scenes with water in the ocean, a bay, river or creek and natural vegetation with no evident development’.

The policy applies to areas ‘where the natural (undeveloped) character of the coast remains the predominant scenic character’ and does not apply to the following:

- views that comprise 100% urban domain
- areas over 500 m from the coastline, a riverbank or estuary
- areas with a pre-change SPR of five or less.

The methodology used for determining the pre-change SPR of the coastal zone is described in B.17.2.4.

Determining if the visual effect of development is acceptable

If the SPR is greater than 5 (out of 10), the second part of the guidelines assessment is undertaken to determine if the visual effect of the development is acceptable. The methodology used for determining the pre-change SPR of the coastal zone is also described in Section B.17.2.4.

Table B.17.1 Acceptable Level of Change (SPP 3/11)

Area Description	Pre-change SPR	Lowest acceptable SPR post-change
Area of high scenic preference	10	10
	9.0 to 9.9	9.0
	8.0 to 8.9	8.0
Area of locally important scenic preference	7.0 to 7.9	6.0
	6.0 to 6.9	5.0

For areas of 'high scenic preference' an acceptable change 'should not result in a post-change score of less than the pre-change score....for example if the pre-change SPR of a view is 9.3 it should not result in post-change SPR of less than 9.0 and should not be statistically significant'.

For areas of 'locally important scenic preference' an acceptable development (pre-change SPR of 6 or 7) 'should only result in an incremental change of one SPR point, for example, seven to six ...'

Townsville City–Port Strategic Plan

Townsville City-Port Strategic Plan (DI, 2007a) was developed under the *Integrated Planning Act 1997* and remains current under the *Sustainable Planning Act 2009*. It is used by POTL and the Townsville City Council to assist with their forward strategic planning. The objective of the plan is to provide a 'shared vision which decision makers from responsible agencies could use to guide development so as to achieve an effective and sustainable interface between Townsville's port area and the adjacent city area'. A key priority of the plan is to balance the protection and enhancement of the port's operations and efficiencies, while conserving the city's 'urban amenity and functionality'. The plan provides further detail on the projects listed in the *Townsville Economic Gateway Plan* (DI, 2007), which are located in close proximity to the PEP and will be considered in the cumulative impact assessment (Section B.17.6.)

B.17.2.1.3 Regional and Local Legislation and Planning Policy

A key objective of this section is to assess the current local planning context to gain an appreciation of recognised, local area visual/scenic values and to understand the mechanisms by which they are protected.

The *Townsville City Plan 2005* is in the process of being redrafted, to reflect the newly amalgamated local government area of Townsville and Thuringowa. The existing plan will remain in effect until a new planning scheme is formally adopted. Although the Port of Townsville locality is exempt from complying with the requirements of the plan, where possible the values listed in the plan relating to character, views and scenic amenity would be desirable to conserve and enhance in any future development proposals. The plan has a general desired environmental outcome to ensure 'development does not prejudice ... areas having significant scenic/visual appeal', including conservation areas and defined tourism areas. It also requires development to 'complement the physical setting of Townsville', including landscapes that 'contribute to the character of the City'.

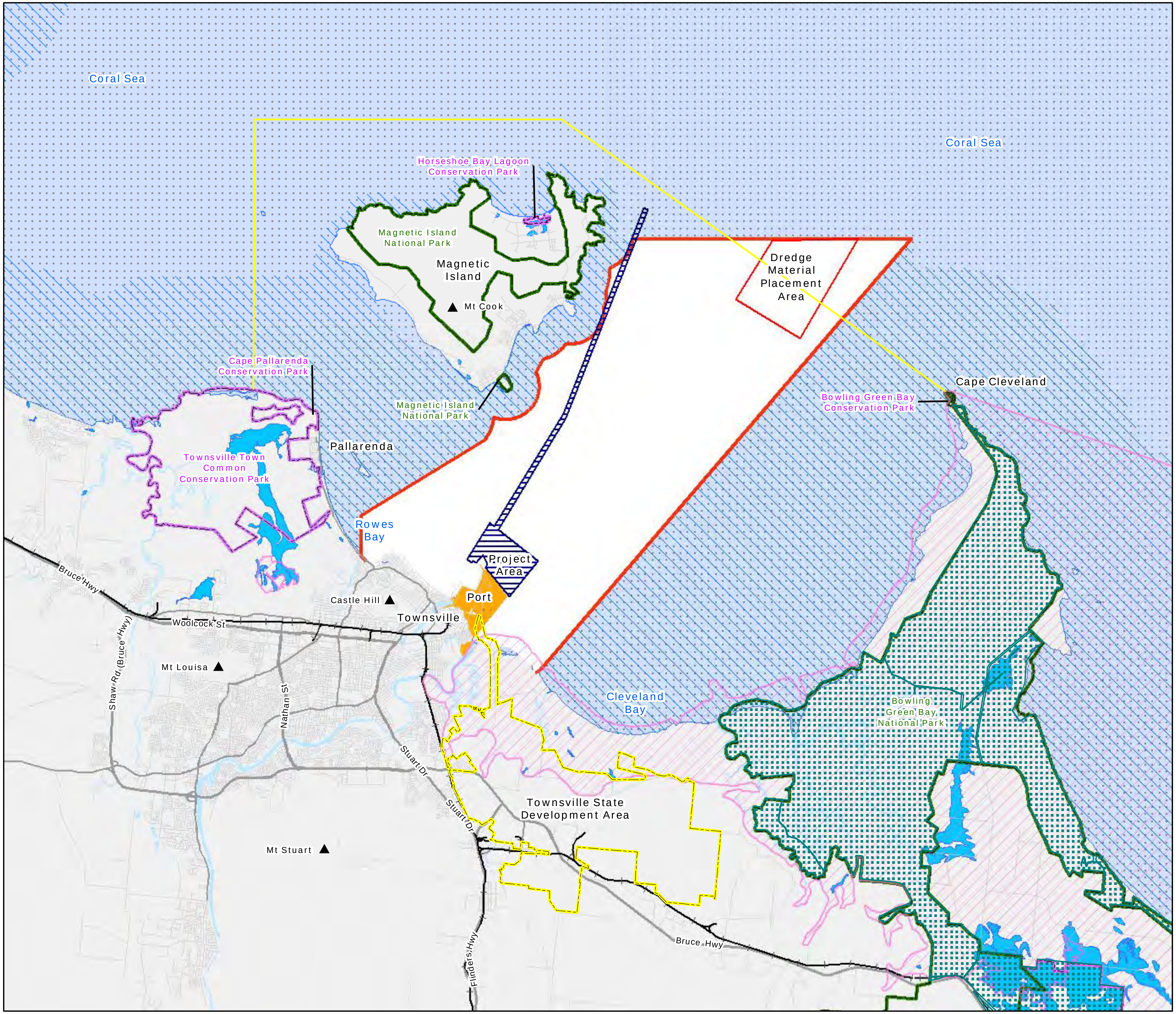
Planned development at the Port of Townsville is guided by the *Port of Townsville Land Use Plan 2010* (POTL, 2010b), which was prepared in accordance with the provisions of the *Transport Infrastructure Act 1994*. This plan provides the statutory framework for the management and assessment of developments on strategic port land in accordance with the *Sustainable Planning Act 2009* and the Integrated Development Assessment System. In particular, this plan identifies a strategic outcome to ensure that new development at the port 'promotes the economic growth of the port and ensures efficient port services while integrating with and enhancing the surrounding community'.

A series of planning codes and guidelines have also been developed to provide guidance when assessing whether a development complies with the provisions of the land use plan. These planning codes and guidelines recognise the importance of scenic amenity and provide common criteria for development on strategic port land in accordance with POTL's strategic vision (POTL, 2010c).

PORT EXPANSION PROJECT EIS

Designation Related to Scenic Amenity

Figure B.17.2



Legend

- Prominent Natural Landmarks
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Marine Park Exclusion Area
- Government Reserves
- National Park or Forest
- Bowling Green Bay Ramsar Site
- Directory of Important Wetland Sites (DIWA) - Burdekin - Townsville Coastal Aggregation (QLD 005)
- GBRWHA/National Heritage Place
- Great Barrier Reef Coast Marine Park
- Wetland Management Areas

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_125

StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
Wetlands - Queensland Goverment 2011
World Heritage Area - Queensland Goverment 2012
Ramsar - Queensland Goverment 2012

B.17.2.2 Methodology

This section outlines the methodology used to assess the potential effects, impacts and risks associated with the PEP. In addition to the ToR and Guidelines, the approach to the assessment has considered a number of other accepted guidelines:

- *Draft National Wind Farm Development Guidelines* (EPHC, 2010)
- *The Guidelines for Landscape and Visual Impact* Assessment, 2nd ed (LI &IEMA, 2002)
- *Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity* (SNH & CA, 2006).

The *Draft National Wind Farm Development Guidelines* is the only nationally recognised Australian methodology for considering impacts on scenic (or visual) amenity. The methodology set out in Section C of the guidelines has been referred to for this assessment; especially the guidance for assessing the impact on viewsheds and views, which is applicable to all large infrastructure, not just windfarms.

B.17.2.2.1 Approach to Defining the Scenic Amenity Baseline

The Study Area for the assessment on scenic amenity considers the landscape that has potential to fall in the viewshed ‘zone of theoretical visibility’ (ZTV) of the Project. For the purposes of this assessment, the Study Area has a radius of approximately 20 km in direct distance from the centre of the PEP.

The assessment of effects on scenic amenity has been made through an analysis of viewpoints in the Study Area. These were selected through a combination of desktop and site based assessments to represent the range of views from where and receptor types by whom the Project would be theoretically visible. The assessment also determined whether the effects are likely to be significant

B.17.2.2.2 Desktop Analysis of the Scenic Amenity

The first task of the assessment involved gathering existing data and other information on the scenic amenity and visual character of the landscape in and adjacent to the Study Area. Key information sources included:

- legislation and planning schemes from the Townsville City Council (TCC)
- digital aerial photography
- cadastral data (showing roads and all major features, built areas, etc.)
- hydrology/riparian corridors
- land use
- geology and soils
- vegetation (including Queensland Regional Ecosystem Mapping (DERM/DEHP?, ?))
- existing infrastructure, such as transmission lines, etc.
- important cultural heritage features
- previously completed reports and studies that relate to scenic amenity include the *Port of Townsville Preliminary Engineering and Environment Study* (AECOM, 2009) and the *Townsville Marine Precinct Project Environmental Impact Statement* (GHD, 2009a).

A preliminary desktop analysis was undertaken to determine the Study Area for the scenic amenity assessment. The scenic amenity, landscape and visual resource was analysed for the Study Area to inform the baseline assessment and the analysis included consideration of:

- underlying landscape (e.g. geology, soils, topographical structure)
- landcover (e.g. vegetation, land use and settlement patterns)
- landscape values in the context of scenic routes and trails, and landscape designations such as national parks and conservation reserves
- desktop site analysis (e.g., identification of recognised panoramas and views, key landmarks, and local peaks).

Where appropriate geographic information systems analysis was undertaken to assist the assessment through the preparation of digital elevation models and landform analysis. Initial landscape character types were created that formed the basis of site verification. Numerous plans assessing the ZTV of various aspects of the PEP were produced and results of these analyses generated a provisional list of viewpoints for testing on site. Likely receptors who may experience views of the Project include:

- residents living and/or working in Townsville
- residents living in Townsville's outer suburbs and nearby townships, such as Pallarenda
- visitors and tourists to the Townsville region, including those visiting Castle Hill, Mount Stuart Scenic Lookout, The Strand, Breakwater Marina, Kissing Point, The Rock Pool, the Jezzine Barracks (public access will not available until the Master Plan redevelopment works are complete (JBCT, 2010)) and other nearby attractors such as Magnetic Island, Townsville Town Common Conservation Park, Bowling Green Bay National Park and Cape Pallarenda Conservation Park
- residents and visitors using walking and cycling trails, the cycle route between Townsville and Cape Pallarenda and walking tracks and lookouts on Magnetic Island (e.g. Hawkings Point lookout)
- travellers passing over the site in airplanes e.g. flying into Townsville Airport.

The viewpoint selection process has been informed by available literature (e.g. tourism brochures, DERM's information on parks and reserves, TCC recreation maps, Queensland Heritage Register) and the team's knowledge of the area. The process highlighted key natural and cultural attractions in the Townsville region and verification on site was undertaken to ensure the selected viewpoints represented the 'worst-case' scenario, i.e. those views experiencing the greatest impact and the most important views for a range of likely receptors.

B.17.2.2.3 Zone of Theoretical Visibility Assessment

ZTV mapping of an area, in which a development may have an influence or effect upon views and subsequent scenic amenity, is often used as a tool to select representative viewpoints for more detailed assessment. ESRI ArcGIS (v9.3) (ESRI, 2011) software was used to model the ZTV. A digital elevation model was produced using 10 m contour resolution provided by POTL. The digital elevation model has a cell size of 10 x 10 m; this translates to the model having a unique z-axis height for every 10 x 10 m unit on the ground in the Study Area.

The ZTV assessment was run off this digital elevation model and assigned z-axis heights of the tallest PEP infrastructure, i.e. possible container handling gantry cranes at Berths 14 and 15, which are each approximately 60 m, but 80 m at full extended height. The location of the gantry cranes will have the z-axis height set at the expected maximum height (i.e. 80 m). The remainder of the viewing area is set at 1.8 m (average height of a person). The software used digitally determines the theoretical extent over which the tallest PEP features would be visible.

In interpreting the ZTV, the following issues were considered:

- The ZTV is only accurate to the resolution of the digital elevation model, in this case this resolution is 10 x 10 m. This translated to every 10 x 10 m cell on the ground giving a binary value of seeing the object or not seeing the object.
- The ZTV does not take into account intervening vegetation, buildings or minor changes in topography, such as road cuttings. As it only uses the landform it is a representative of the greatest extent of potential impact on scenic amenity possible.

B.17.2.2.4 Survey to Verify and Refine Understanding Scenic Amenity

A site survey was undertaken in July 2011 by two landscape planners/architects (both registered members of the Australian Institute of Landscape Architects and experienced in scenic amenity) to ground truth the findings of the desktop assessment and take photographs to:

- portray landscape character
- refine the viewpoint assessment and selection of viewpoints
- provide data for the production of photographic simulations and visualisations.

The site visits focused on those aspects of the landscape with potential to be of the greatest sensitivity to the Project, and on gaining an appreciation of those aspects of the Project most likely to affect scenic/visual values.

The selected viewpoints are identified and described in Section B.17.4.2. The location of each viewpoint was recorded on site using a hand-held GPS system. Records were also made in the form of site notes and photographs.

B.17.2.3 Approach to Identifying the Potential Impact of the Townsville PEP on Scenic Amenity

Assessment of impacts involved seven key steps, as illustrated in Figure B.17.3.

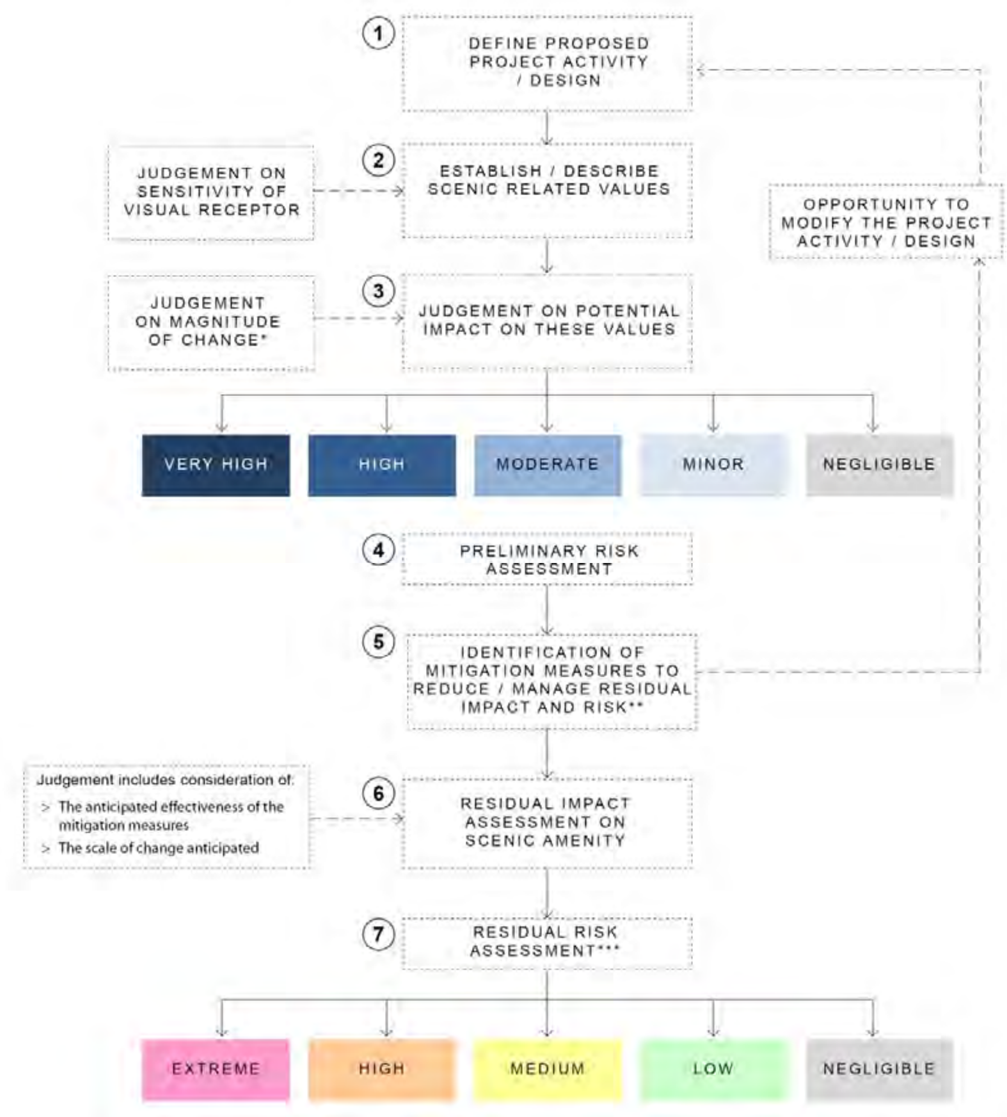


Figure B.17.3 Approach to Assessing Impact and Risk

* The judgement on the magnitude of change to the visual resource includes consideration of (i) the scale of change anticipated, (ii) the duration and nature of the impact, (iii) distance between the receptor and the Project, and (iv) the perceived contrast or integration with the landscape. The judgement has been made in the absence of any mitigation measures and/or standard operating procedures (which may reduce the magnitude of the impact) to present a worst-case scenario. This approach ensures that the potential risk of each receptor is fully understood so that mitigation can be proposed that addresses these concerns.

** Mitigation does not change the sensitivity of the visual resource, only the magnitude of the resultant effect and consequent residual impact and risk.

*** The judgement on residual impact and risk assumes the recommended mitigation measures for the standard operating procedures have been incorporated.

B.17.2.3.1 Judgement of Visual Sensitivity

As described earlier the assessment on scenic amenity is based on a representative viewpoint assessment. The representative viewpoints are used to illustrate the visual effect of the Project on scenic amenity. The judgement of visual sensitivity involved classification of the sensitivity of the receptors to the Project. For the purpose of this assessment, the sensitivity of a viewpoint is dependent upon:

- the importance of the view (e.g. the scenic qualities of the view, including the presence of other existing manmade elements in the view).
- the receptor (type and volume of receptor); for example, residents and visitors to important/valued landscapes or a designated lookout point are considered to have a higher sensitivity to their visual environment than, say, visitors to non-designated areas or motorists passing through the broader landscape
- the receptor's expectations of the scene and the activity or occupation that brings them to view.

Sensitivity is described as negligible, low, medium or high as set out in Table B.17.2.

B.17.2.3.2 Judgement of Magnitude of Change

The prediction of the magnitude of change in the landscape or the view, resulting from the Project, takes into account the current Project description. This includes some measures that have already been designed into the scheme to reduce the impact on scenic amenity but it does not consider the additional mitigation measures identified in Section B.17.5.

The magnitude of change upon a receptor depends on the nature, scale and duration of the particular change that is expected to occur. The effect on a view (and subsequent scenic amenity) will depend on the extent of visibility, degree of obstruction of existing features, degree of contrast with the existing view, angle of view, duration of view and distance from the development.

Magnitude of change is described as being negligible (virtually imperceptible), minor (detectible), moderate (noticeable), high (considerable) or very high (dominant), as defined and illustrated in Table B.17.2. Table B.17.2 is intended as a guide to the process only. The descriptions of magnitude and sensitivity are illustrative as there is no defined boundary between levels of impacts.

The magnitude of the scenic amenity impact is determined by the following factors:

- the scale of change in the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view occupied by the Project (e.g. full, glimpsed or filtered view)
- the distance between the receptor and the Project
- the perceived contrast or integration with the landscape
- the duration and nature of the impact, including:
    - temporary (up to 1 year)
    - short term (1 to 5 years)
    - medium term (5 to 20 years)
    - long term (20 to 50 years)
    - permanent/irreversible (in excess of 50 years).

B.17.2.3.3 Judgement of Impact on Scenic Amenity

The anticipated impact of the PEP has been assessed in both pre- and post-mitigation situations. Mitigation measures for Project activities are discussed in Section B.17.5. These have informed the residual impact assessment, based on a judgement on the effectiveness on the mitigation in reducing the severity of the impact.

As there is no established measurable technical thresholds for determining the significance of impacts on scenic amenity; the significance of impact (prior to mitigation) is determined by considering the sensitivity of the receptor and the magnitude of change expected as a result of the development, as shown in Table B.17.2. The anticipated residual impact of the Project on scenic amenity has been defined based on a judgement on the effectiveness or value of the mitigation measures, once integrated and fully established.

Impacts that are graded as being high or very high are those that in decision-making are given greatest weight, relative to other levels of impact on scenic amenity. They usually concern immediate landscapes around the development and close views experienced by sensitive receptors, such as residents and visitors to nearby attractors. Moderate levels of impact are also important to consider in the decision-making process. Impacts graded as minor warrant consideration but individually carry little weight in the decision-making process.

Impacts on scenic amenity are generally described as being indirect (i.e. physical changes to the landscape that affect the representative views), rather than direct. They can be widespread (i.e. affecting a large part of a view) or localised. Impacts can also be described as adverse (negative), beneficial (positive or improved) or neutral (impacts that may be considered positive by some receptors, negative by others and/or where changes do not enhance or detract from the view). For the purposes of this assessment, the direction of the impact on scenic amenity (i.e. adverse or beneficial) has been broadly discussed. Judgements on the significance of the residual impact have not been influenced by the direction of change due to the potential for subjective interpretation. Accordingly, the focus has been on the sensitivity of the representative viewpoint, the anticipated magnitude of the change, and the effectiveness or value of the mitigation.

Table B.17.2 Levels of Risk Consequence – Scenic Amenity

This table is a guide only. The descriptions of magnitude and sensitivity are illustrative only. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of impacts. A large number of receptors in a category that would otherwise be of low or moderate sensitivity may increase the sensitivity of the receptor.

			Magnitude of Change				
			Very High (Major)	**High (Considerable)**	**Moderate (Noticeable)**	**Minor (Detectable)**	**Negligible (Virtually Imperceptible)**
			Major changes in view at close distances, affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of view.	A considerable change in views at intermediate distances, resulting in a distinct new element in a significant part of the view.	A noticeable change to a moderate portion of the view, resulting in a clear new element in the view.	Recognisable/detectable change in view characteristics over a restricted area, but will not fundamentally change the view and character of the landscape.	An imperceptible or barely perceptible change to a very small part of the view.
Sensitivity of Viewpoint to Project		**Indicator**					
	High	Large numbers of receptors or those with proprietary interest and prolonged viewing opportunities such as residents and users of valued and/or well-used recreational facilities. Views from a regionally important locations whose interest is specifically focused on the scenic amenity of the landscape e.g. walking trails and lookouts at Magnetic Island National Park, Castle Hill, Mount Stuart Scenic Reserve.	Very High	High	Moderate	Moderate	Minor
	Medium	Medium numbers of receptors, such as residents and visitors with an interest in their environment e.g. those travelling along scenic drives, cycling routes, walking trails and visiting key areas of public realm e.g. The Strand, Kissing Point, The Rock Pool, historic precincts such as Melton Hill.	High	Moderate	Moderate	Minor	Minor
	Low	Small number of receptors, such as residents and visitors whose interest is not specifically focused on the landscape e.g. people commuting, people predominantly working indoors at their place of work, those travelling along major or minor roads where there are no stopping points or lookouts; therefore, having short-term viewing opportunities to the PEP.	Moderate	Moderate	Minor	Minor	Negligible
	Negligible	Very occasional numbers of receptors with a passing interest in their surroundings e.g. those travelling along minor routes with little opportunity to see the PEP. Receptors who have a vested interest in the port e.g. port workers.	Moderate	Minor	Minor	Negligible	Negligible

B.17.2.4 Approach to Applying the Methodology Outlined in SPP 3/11 Guideline

The method provided in Annex 4 (formerly Annex 3) of SPP 3/11 was addressed using the following prescribed process.

Determine the pre-change scenic preference rating of the coastal zone

The process entails a number of distinctive steps:

1. Select three (out of thirteen) representative viewpoints. The views selected illustrate the 'worst-case' impacts and are considered to be the 'most highly used and affected public viewing location in a maximum distance of five kilometres'. Viewpoints 1, 3 and 9 described in Section B.17.4.2 were selected. Viewpoint 9 was selected to illustrate the impact from the GBRWHA. Views 8, 10 and 11 from the GBRMP were excluded as they are over 5 km from the PEP.
2. Code the 'terrestrial objects' of the three viewpoints (i.e. exclude the sky). The process involves using transparent overlays to delineate four types of objects or characteristics: sky, visual domains (urban, rural, coast and bush), built visual elements and natural visual elements. The coding overlays are included in Appendix A.
3. Appendix S1.
4. Determine the average pre-change SPR of each viewpoint by calculating the area of the view of the four objects (or characteristics) and entering the percentage values into DERM's SPRAT 1 spreadsheet (DERM, 2005).

Determining if the Visual Effect of Development is Acceptable

For photos where the SPR is greater than 5 (out of 10), the second step of the assessment is undertaken to determine if the visual effect of the development is acceptable. Given the urban character of many views, only one out of the three viewpoints was rated above five and subject to this step of the assessment.

To summarise, the process entails:

1. sketching the outline of the development by either hand or photomontage and using ImageJ software (NIMH, 2012) to code the terrestrial objects into sky, visual domains (urban, rural, coast and bush), built visual elements and natural visual elements.
2. entering the pre-change and change values into DERM's SPRAT 2 spreadsheet (DERM, 2005) and using the following table to determine if the Project is within the threshold of acceptable change.

Table B.17.3 Determining Acceptability of SPR Change

Area Description	Pre-change SPR	Lowest acceptable SPR post-change
Area of high scenic preference	10	10
	9.0 to 9.9	9.0
	8.0 to 8.9	8.0
Area of locally important scenic preference	7.0 to 7.9	6.0
	6.0 to 6.9	5.0

For areas of high scenic preference an acceptable change 'should not result in a post-change score of less than the pre-change score … for example if the pre-change SPR of a view is 9.3 it should not result in post-change SPR of less than 9.0 and should not be statistically significant'.

For areas of locally important scenic preference an acceptable development (pre-change SPR of 6 or 7) 'should only result in an incremental change of one SPR point, for example, seven to six ...'.

The assessment results are detailed in the individual viewpoints assessments outlined in Section B.17.4.2.

Limitations Associated with the Queensland Coastal Plan Guideline Annex 4

The methodology outlined in annex has not yet been extensively used and is to used in any other state or country. A number of limitations that were experienced when undertaking the assessment process should be considered when reviewing the results described in later sections:

- A photo is a single 'snap-shot in time'. Built and natural elements in the natural, rural, coastal and urban landscapes change all the time, e.g. buildings are added, plants grow taller, trees are removed and palm fronds fall. Should the exercise by conducted even one day or one month later, the result may be different.
- The requirement for sky to take up approximately one fifth of a photo is not always possible or appropriate, due to the context of each individual image.
- There are difficulties with coding power lines in photos when viewed 'in the sky'. The guideline states that the sky is to be excluded from the SPR calculation, for example, this was experienced when assessing Viewpoint 1 (Section B.17.4.2). To illustrate the worst case and obtain a higher existing SPR, the powerlines were removed from the assessment, although it would be expected that they may lower the scenic preference.
- To undertake the coding of elements using a photomontage or hand technique 'exactly' is virtually impossible and the end ratings can be distorted and variable. As part of the quality assurance process, two landscape professionals coded the images, which resulted in marginally different results. This slightly altered the overall SPR, but did not affect the overall outcomes of the assessment.
- The coding of the image into individual built and natural elements is subject to the interpretation of the assessor given the ambiguous and complex nature of the individual codes (visual elements to be recorded for each polygon) in Table 5 of Annex 4 of the guideline. For example, for 'built visual elements' there is no specific category for industrial elements (such as gantries and car parks) and it is up to the individual assessor to determine an appropriate category.
- The ImageJ software does not allow for percentages less than one and the result is either rounded up or down. Given many elements in long distance images are less than one, this leads to a distortion of the SPR.
- The individual infrastructure and exact configurations to be incorporated into the PEP will be determined on a case-by-case basis, by individual leases of the site. Assumptions were made illustrate the effect (and subsequent impact) in the ZTV, photomontages and to calculate the post-change SPR value.

B.17.2.5 Approach to Identifying Residual Risk of the PEP

The key risks identified for the scenic amenity impact assessment are documented in Section B.17.1, including a risk rating based on the magnitude of impact anticipated (consequence) and the likelihood of the impact occurring, before and after the integration of mitigation measures. For example, using the risk matrix shown in Section B.17.1, a viewpoint with a high impact in scenic amenity, combined with a likely likelihood rating associated with the introduction of the PEP would have a high-risk rating.

The scale and function of any major port development allows little opportunity to modify the design of the scheme components to mitigate adverse impacts on scenic amenity. The preliminary stage of the PEP allows some critical mitigation to be established to avoid, reduce and/or manage the impact on and risk to scenic amenity during construction and operations, as part of an iterative EIS process.

Broad definitions to describe the level of residual risk on scenic amenity resulting from the PEP have been defined in **Error! Reference source not found.**. For example, the impact of the PEP might initially have a high-risk level when considering the sensitivity of the viewpoint combined with the magnitude of change. Once the effectiveness or value of the mitigation measures have been fully considered (e.g. use a colour palette for built form that blends with the predominant background colours, design of retaining structures, adoption of strategic planting), the associated level of risk may reduce slightly due to the reduction in visual prominence; for example, to a medium residual risk.

Table B.17.4 Event Consequence Guide – Scenic Amenity Impact

Ref	Environmental Impact	Description
1	Negligible	Change that is barely visible, at a very long distance, or visible for a very short duration, and/or is expected to blend with the existing view.
2	Minor	Minor changes experienced by a small number of receptors at long distances or visible for a short duration, and/or are expected to blend in with the existing view to a moderate extent.
3	Moderate	Clearly perceptible changes experienced by a medium number of receptors with an interest in their environment, resulting in either a distinct new element in a significant part of the view, or a less concentrated change.
4	High	Major changes experienced by a large number of receptors or those with proprietary interest in their environment, affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of view.
5	Very High	Severe or total change in a substantial part of close and intermediate range views over long durations, which detrimentally impact a large number of receptors or those with proprietary interest in the visual/scenic landscape.

B.17.2.6 Approach to Identifying the Cumulative Impact of the PEP

The aim of the cumulative scenic amenity impact assessment is to describe and assess the ways in which the PEP would have additional impacts when considered together with other consented projects of a similar scale in the region. Information to inform the assessment is based on an understanding of the PEP (Section B.17.1) and publicly available information on similar scale projects within a 20 km radius from the Project Area. In light of the Project ZTV, which indicates areas of land where the Project is likely to be visible, this 20 km area was considered to be sufficient to recognise potential cumulative impacts on scenic amenity.

Cumulative scenic amenity impacts resulting from the Project and other significant projects in the region are described in Section B.17.6.

B.17.3 Existing Values, Uses and Characteristics

This section provides a broad description of the existing scenic amenity values of the landscape and visual character potentially affected by the Project, including key landscape features, panoramas and views that have, or could be expected to have, value to the community whether of local, regional, state, national or international significance.

B.17.3.1 Study Area Context

Townsville is located on the flat floodplains of the Ross and Bohle rivers, which flow from the foothills of the Hervey and Mount Stuart ranges towards Cleveland Bay. The city has evolved between two unique wetland landscapes; the Townsville Town Common National Park to the north, and Bowling Green National Park to the south. The city is also located on the coast of the GBRWHA and GBRMPA, and near Magnetic Island, much of which is National Park. These areas provide a distinctive natural backdrop to the city and are valuable recreational assets enjoyed by residents and domestic and international tourists.

The landscape in and around Townsville includes several prominent rugged outcrops of granite rock, notably Castle Hill, Mount Louisa and Mount Stuart, and Mount Cook at Magnetic Island (Figure B.17.4). The 'visual landscape character' (TCC, 2005b) of these outcrops, including the ridges, steep slopes and stands of natural vegetation, are unique city landmarks or focal points, which provide a distinctive skyline to the city. Castle Hill and Mount Stuart (both recognised as areas of high scenic amenity in the *Townsville-Thuringowa Strategy Plan* (DCILGPS, 2000)) provide popular vantage points, where residents and visitors can appreciate expansive views over the city and its surrounds. Other prominent hills in Townsville's urban area that also offer elevated views over the city include the residential precincts of Melton Hill (one of Townsville's first suburbs) and Yarrawonga.

The city has evolved in close association with the Port of Townsville, located at the mouth of the Ross River and separated from the city centre, marina and entertainment centre by Ross Creek. The port was established in 1864 to service the newly settled rural hinterland through the export of agricultural products. Agricultural exports (particularly sugar and fertiliser, as well as molasses, live cattle and meat products) still play a role in the port operation. The port's more recent growth has been dominated by the exploration, extraction, processing and export of Queensland's vast mineral resources (e.g. copper, zinc and lead concentrates), as well as the import of mineral products (e.g. nickel ore, copper anode and various concentrates), oil and petroleum products and sulphur. The PEP is part of the Port of Townsville's strategy to accommodate future global trade demands and support the surrounding region.

B.17.3.2 Port Expansion Local Context

The landscape character of the Port of Townsville is dominated by flat low-lying land (approximately 4.5 m Australian height datum) at the mouth of the Ross River and Ross Creek, in Cleveland Bay. The landscape has been considerably modified to support functions of the port. Much of the northern area of the Port of Townsville was developed through reclamation works during the 1960s and 1970s, to provide space for the expansion of oil facilities, bulk stores, berths and terminals (including a liquefied petroleum gas terminal and bulk steel store). Further reclamation of land (through re-use of dredge material) during the 1980s and 1990s provided approximately 100 ha of reclaimed land for future development (POTL, 2008a), including a rail loop to support new berths and cargo storage and handling facilities.

The site for the PEP is directly north of the Townsville State Development Area (TSDA). The TSDA is located on approximately 4,900 ha of land south of the Ross River, by Cleveland Bay. TSDA includes the Stuart Industrial Area (a key focus area approved for future heavy industry) and the EAC approved to improve transport access from the east and south to the port. The Townsville Port Access Road, currently under construction and expected to be completed in 2012, will reduce heavy vehicle traffic movements in adjoining residential areas such as Oonoonba and South Townsville. The EAC will ultimately provide rail access to the existing port and PEP. Only the rail infrastructure to be built within the port boundary is included in this assessment. The TSDA does not form part of the base case for this assessment. Implications of the future TSDA on scenic amenity are further discussed in the cumulative impact section (Section B.17.6).

Other key development projects planned near the port include:

- Townsville Marine Industries Precinct: Stage 1, a small boats' facility adjacent to Benwell Road on the eastern side of the port, is largely complete and is mostly tenanted. The Townsville Marine Precinct is considered part of the base case for the PEP scenic amenity assessment.
- POTL is proposing the construction of Berth 12, a new bulk-handling berth outside the existing harbour adjacent to Berth 11, with a possible bulk materials storage area on the Eastern Reclamation. This project is not being assessed as part of the PEP, but is considered as being constructed and completed prior to the PEP commencing and forms part of the base case.
- Various berth modifications and rationalisation inside the existing inner harbour, either underway or planned by POTL, including the reconstruction of Berths 4, 8 and 10A, are not being assessed as part of the PEP, but will be considered as being completed for the purpose of the base case.
- The construction of Berths 10B and 10C (B10X Project) and the diversion of Ross Creek are currently being investigated by POTL and are at an early planning stage. Approval has not yet been sought for this work. If approved, this work may be underway during the construction of the PEP, but will be assessed and completed as a separate project and will not be considered as part of the base case for this assessment.

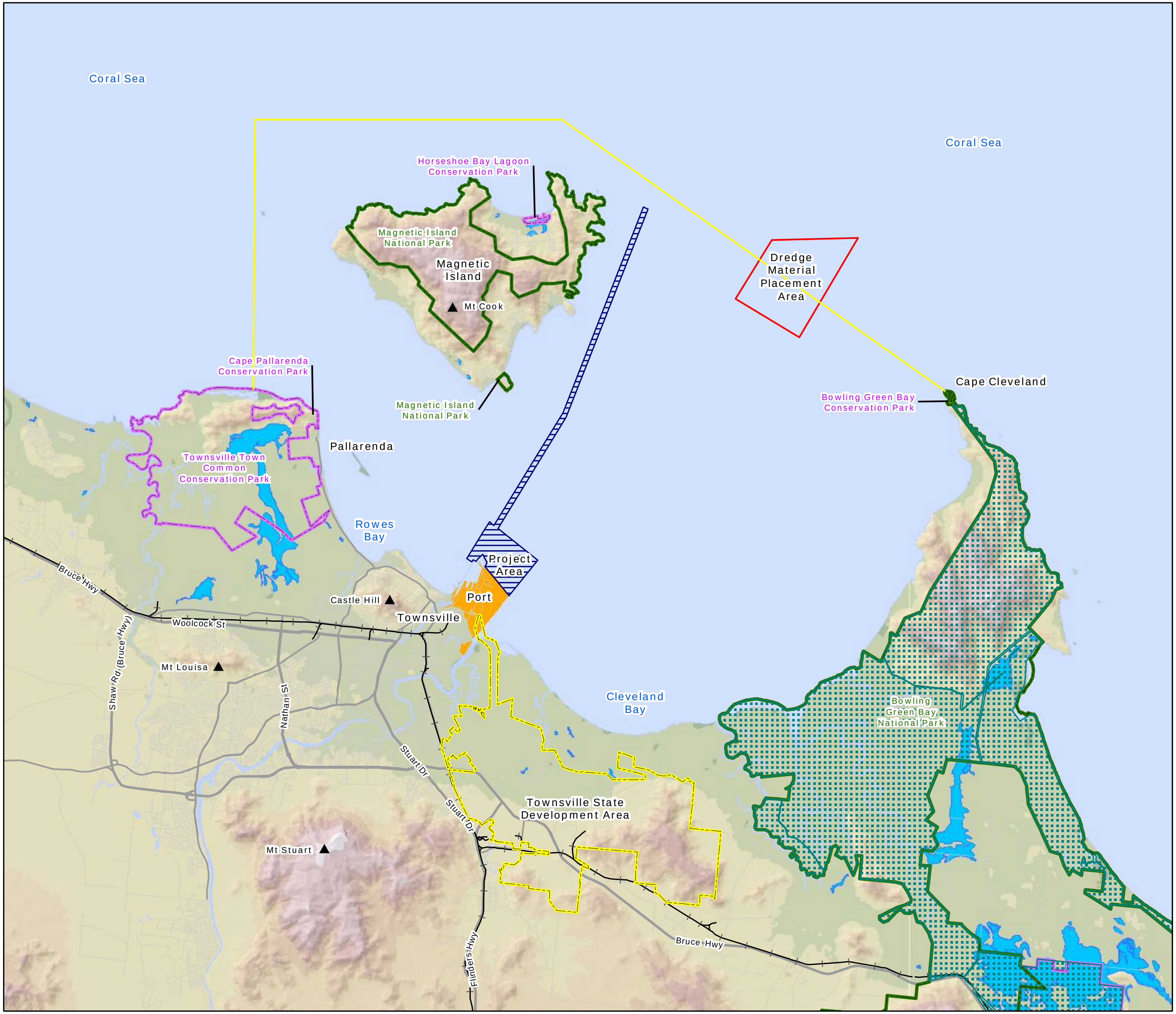
The following projects have been identified in the *Townsville City-Port Strategic Plan* (DI, 2007a), and are in close proximity to the Project. As the planning, design and approvals for these projects have not progressed since the release of the plan, they have not been considered part of the base case for the PEP assessment on scenic amenity. The implication of these projects on scenic amenity values, in addition to the PEP, is further discussed in the cumulative impact section (Section B.17.6).

- new ferry terminal and road bridge over Ross Creek, connecting The Strand with Archer Street
- pedestrian bridge and links between Flinders Street East and Palmer Street.

PORT EXPANSION PROJECT EIS

Topography and Drainage

Figure B.17.4



Legend

- Prominent Natural Landmarks
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Government Reserves
- National Park or Forest
- Bowling Green Bay Ramsar Site
- Wetland Management Areas

Elevation (in metres)

- Below - 0m
- 0 - 10m
- 11 - 50m
- 51 - 100m
- 101 - 200m
- 201 - 300m
- 301- 500m
- 501 - 1000m

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_126

B.17.3.3 Lighting Baseline Assessment

In order to understand the likely impacts of lighting associated with the Project on visual values, a qualitative assessment to determine existing light sources has been undertaken. The following key sources of artificial light associated with industrial activities at the port and surrounding land uses were identified during a night-time site survey in the Study Area during July 2011:

- lighting in the existing port, including:
  - 15 m light poles with standard, functional road luminaries
  - asymmetrical floodlights mounted at 25 m high
  - along the crane arms and gantries, warehouses
  - at the berths, container yards and from berthed vessels
  - along the conveyor belt carriageways
- lighting in the Flinders Street East promenade, north of Dean Street, including streetscape floodlights (Figure B.17.5)
- lighting in the Palmer Street precinct, including street lighting and lighting in buildings (e.g. offices and hotels
- lighting at the Jupiters Townsville Hotel and Casino, including red and purple feature lighting illuminating the building facades (Figure B.17.5).

Figure B.17.5 Existing Night-time Lighting at the Port and Surrounds

A qualitative assessment on the impact of lighting on visual values is considered in the representative viewpoint assessment (Section B.17.4.2); a quantitative, engineering lighting assessment is provided in Appendix S2.

B.17.3.4 Selection of Representative Viewpoints

To understand the potential impact of the Project in the context of the existing scenic and visual character of the landscape several representative viewpoints have been selected based on the criteria outlined in the methodology (Section B.17.2.2). The selected viewpoints represent a range of receptors likely to be affected by the PEP at different viewing distances (short, medium, long range views) and intend to illustrate the worst-case scenario or places with the greatest visual exposure to the PEP.

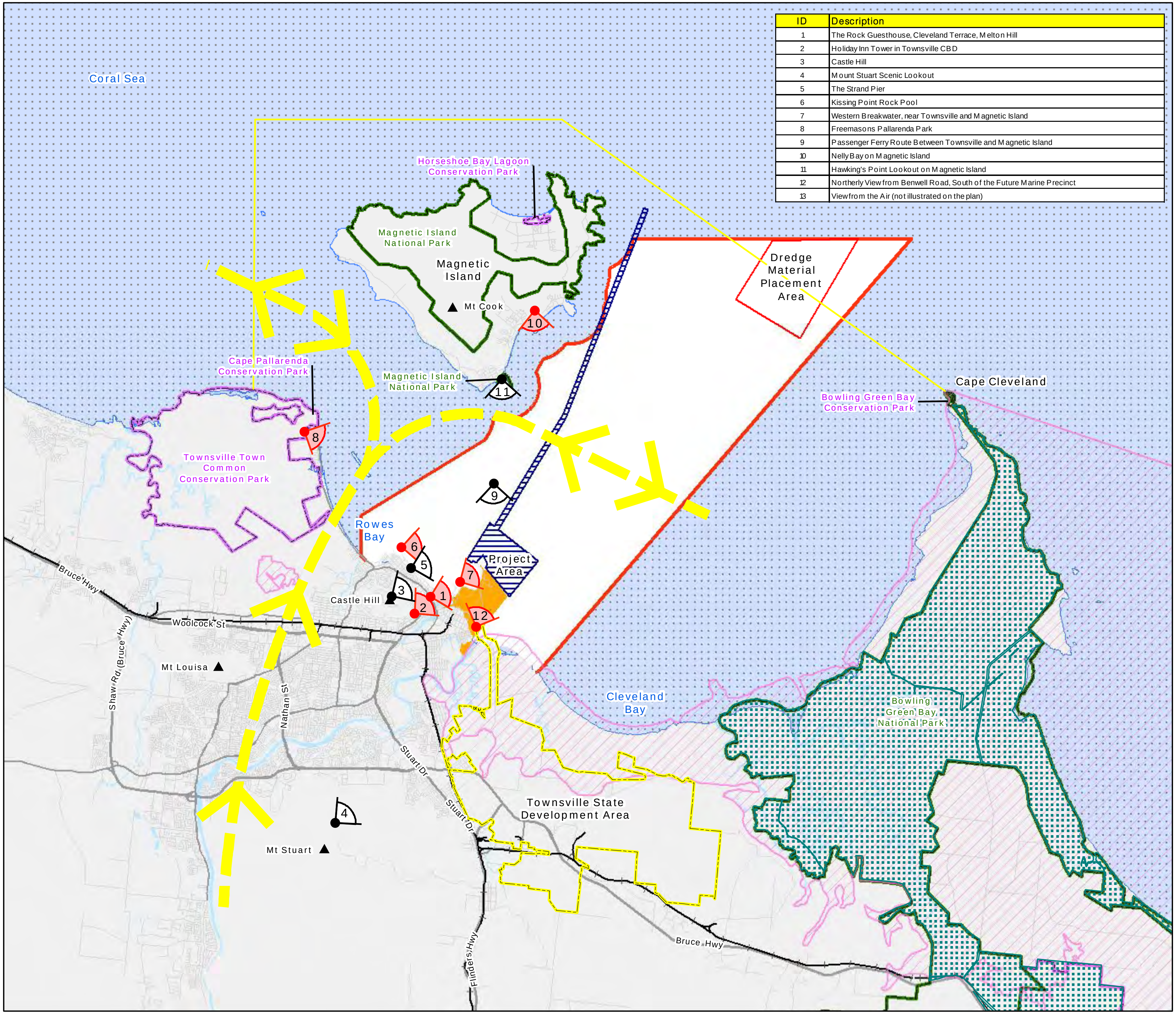
A total of thirteen viewpoints have been selected for this assessment. The location of these viewpoints is illustrated on Figure B.17.6 and a description of the existing visual character, inherent sensitivities of each viewpoint, along with a judgement on the anticipated impact of the PEP has been provided in Section B.17.4.2. The selected viewpoints are:

1. The Rocks Guesthouse, Cleveland Terrace, Melton Hill
2. Holiday Inn Hotel, Townsville CBD
3. Castle Hill
4. Mount Stuart Scenic Lookout
5. The Strand Pier
6. Kissing Point Rock Pool
7. Western Breakwater, near Townsville Entertainment Centre
8. Freemasons Pallarenda Park
9. Passenger ferry route between Townsville and Magnetic Island
10. Hawkings Point lookout on Magnetic Island
11. Nelly Bay on Magnetic Island
12. Northerly view from Benwell Road, south of the Townsville Marine Precinct (under construction at the time of site survey)
13. View from the air.

PORT EXPANSION PROJECT EIS

Representative Viewpoint Location Plan

Figure B.17.6



ID	Description
1	The Rock Guesthouse, Cleveland Terrace, Melton Hill
2	Holiday Inn Tower in Townsville CBD
3	Castle Hill
4	Mount Stuart Scenic Lookout
5	The Strand Pier
6	Kissing Point Rock Pool
7	Western Breakwater, near Townsville and Magnetic Island
8	Freemasons Pallarenda Park
9	Passenger Ferry Route Between Townsville and Magnetic Island
10	Nelly Bay on Magnetic Island
11	Hawking's Point Lookout on Magnetic Island
12	Northerly View from Benwell Road, South of the Future Marine Precinct
13	View from the Air (not illustrated on the plan)

Legend

- Prominent Natural Landmarks
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Marine Park Exclusion Area
- Government Reserves
- National Park or Forest
- Bowling Green Bay Ramsar Site
- Directory of Important Wetland Sites (DIWA) - Burdekin - Townsville Coastal Aggregation (QLD 005)
- GBRWHA/National Heritage Place
- Flight Path
- Photomontage Location
- Viewpoint Location

N

Scale: 1:200,000 (when printed at A4)

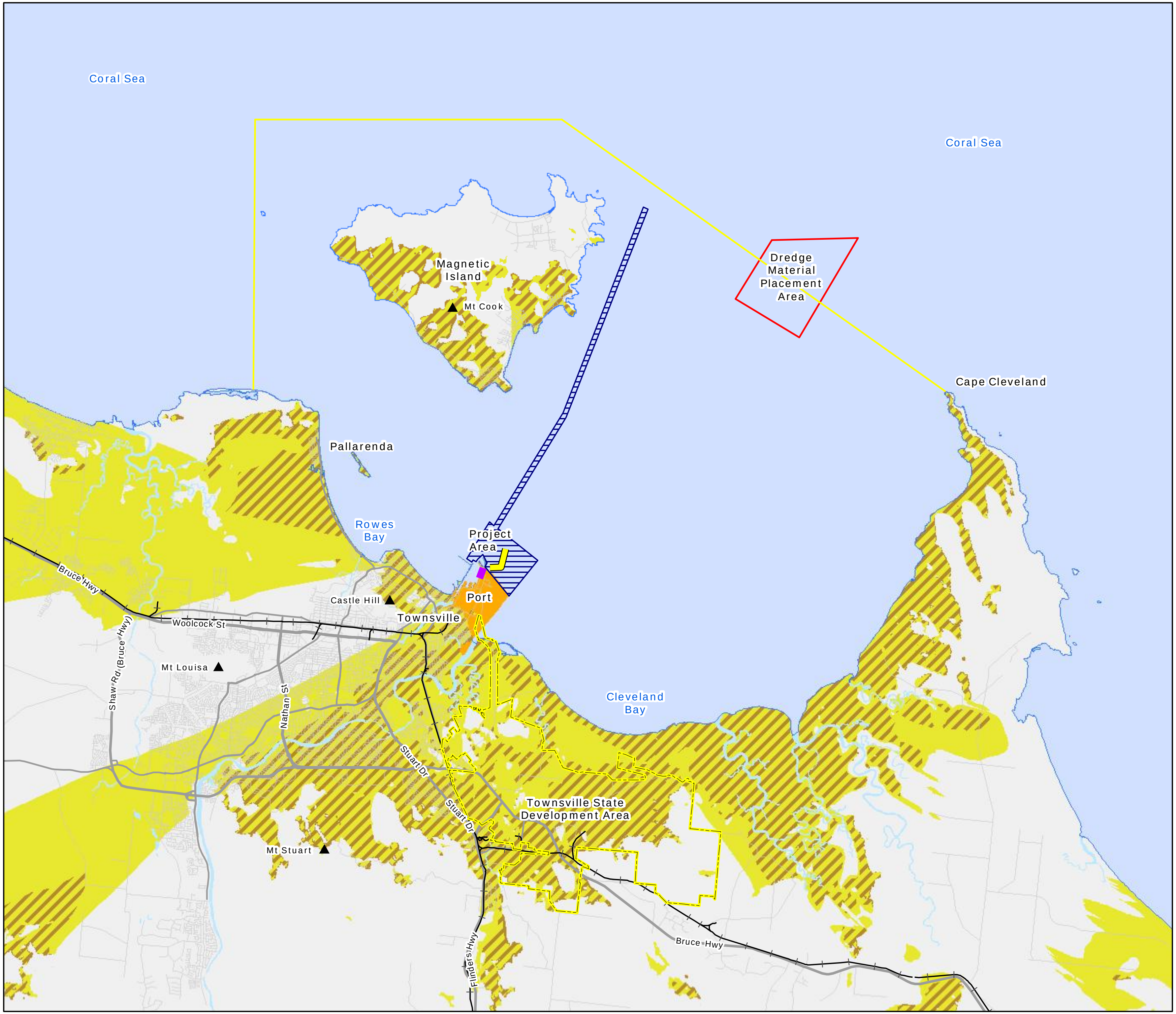
0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_128



PORT EXPANSION PROJECT EIS

Comparative ZTV Analysis

Figure B.17.7

Legend

- Prominent Natural Landmarks
- Highways
- Main Roads
- Local Roads
- Railway Line
- Indicative Location of Existing Cranes
- Indicative Location of Proposed Cranes
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

ZTV - Zones of Theoretical Visibilty

- Existing
- Both
- Proposed

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_127

B.17.4 Assessment of Potential Impacts

The visual prominence and proximity of the port to residences and properties in Townsville, as well as local attractors (including parks and lookouts) and routes in the Townsville area, means that the identification and ongoing management of such issues is a key priority for POTL.

B.17.4.1 Zone of Theoretical Visibility Assessment

A comparative assessment was undertaken of the current ZTV of significant port infrastructure and of the likely infrastructure associated with the PEP. The results are presented in Figure B.17.7. The intention of the ZTV assessment is to illustrate areas of the landscape and associated receptors that have the potential to experience views to PEP activities. The methodology for the ZTV is described in B.17.2.2.3. In summary, the ZTV uses the digital elevation model and has assigned z-axis heights of the tallest possible infrastructure (i.e. the container handling gantry cranes that are approximately 60 m; 80 m at full extended height). For comparison, Figure B.17.7 illustrates both the PEP and existing port ZTV, to illustrate the magnitude of change associated with the Project.

As Figure B.17.7 shows, the majority of the area from which the PEP is theoretically visible already experiences potential views of the current port activities, as indicated by the existing visibility. On Magnetic Island to the north, there is virtually no difference between the existing port ZTV and the PEP ZTV, with the elevated area associated with Mount Cook acting as a natural viewshed. Similarly, the elevated land associated with Cape Cleveland to the north-east curtails views from this direction resulting in a broadly similar ZTV for the existing port and PEP. To the south, the viewshed is similarly curtailed by the elevated area associated with Mount Stuart, although some additional areas of port visibility are predicted near Hunter Street, albeit most of these additional areas fall in the TSDA. To the west, Castle Hill plays a significant role in curtailing views. The PEP may theoretically result in views of the port being perceptible from some additional residential streets to the south-west, immediately south and north of the Ross River Road, and west of the Rowes Bay area.

This modelling interpretation is theoretical, being based solely on contour data. Hence, it is a worst-case scenario of potential visibility as it does not account for intervening vegetation, buildings or minor changes in topography. In reality from much of the area falling in the ZTV, actual views will not be possible due to screening from houses (in residential areas) or trees (in more natural areas). The representative viewpoint assessment presented below assists in interpreting this further.

B.17.4.2 Representative Viewpoint Assessment

Using the method set out in Table B.17.2, this section provides an assessment of the anticipated effects and subsequent impacts on scenic amenity associated with the PEP. The assessment has been organised into the following key receptor groups.

- Offsite receptors:
  - nearby residences/properties; for example, those living and/or working on properties near the PEP, including the Townsville CBD and South Townsville)
  - residents living in Townsville's outer suburbs and nearby townships, such as Pallarenda and on Magnetic Island.
  - residents, visitors and tourists visiting local attractors; for example, Castle Hill, Mount Stuart Scenic Lookout, The Strand, Breakwater Marina, Kissing Point, The Rock Pool, and other nearby sites such as Magnetic Island, Townsville Town Common Conservation Park, Bowling Green Bay National Park and Cape Pallarenda Conservation Park
  - residents and visitors using recreational tracks; for example, using walking and cycling trails, such as the cycle route between Townsville and Cape Pallarenda, and walking tracks and lookouts on Magnetic Island such as Hawkings Point lookout
  - residents and visitors travelling along scenic tourist drives and motorists using major and minor roads in the Study Area
  - users of aircraft such as airplanes, hot air balloons or paragliders.

- Onsite receptors:
  - people visiting and working at the Port of Townsville; representing views to key infrastructure in the PEP.

A summary of the potential impact of the PEP on these key receptor groups, including the description and evaluation of thirteen selected representative viewpoints, is provided in **Error! Reference source not found.**. The location of the selected viewpoints is shown on Figure B.17.6. Detailed consideration of quantitative lighting impacts is presented in Appendix S2.

A number of photomontage representations have been compiled to indicatively illustrate the long-term visual implications of the PEP. The photomontages have been produced from Viewpoints 3, 4, 5, 9, and 11. All have been produced based on a 'theoretical' layout. Actual above-wharf projects will be based on the requirements of the future port tenants and products, and will be subject to separate development approvals. The *Port Land Use Plan* will be updated to reflect use in future strategic port land.

For the purpose of producing the photomontages the following cargo handling and storage facilities are illustrated:

- container gantry cranes
- shipping loaders and unloaders
- container storage areas
- cargo storage sheds
- covered stockpiles
- administration facilities
- conveyors
- tank farms
- dredge pond.

B.17.4.2.1 Offsite Receptor – Nearby Residence/Property

Although the activities associated with the construction and operation of the PEP are not anticipated to directly impact any properties adjacent or near to (i.e. in approximately a 2 km radius of the port) the Project Area, several properties are likely to withstand some indirect impacts:

- a slight increase in the transit of light vehicles carrying workforce and visitors between places of accommodation in Townsville (e.g. the CBD or Palmer Street precinct) and the port on a daily basis; this is likely to affect the scenic amenity of properties (including residential and commercial properties) in South Townsville (e.g. in close proximity to Boundary Street, Archer Street, Palmer Street, McIlwraith Street and Dean Street)
- properties (including residential and commercial properties) located in close proximity to the port from which residents are likely to experience clear views to PEP activities during construction and operation, including properties with a northern or eastern aspect at Melton Hill (e.g. properties along Melton Terrace, Cleveland Terrace, Carter Street and Herbert Street).

The Townsville Port Access Road will provide direct road access between the Flinders and Bruce highways and the port, reducing heavy vehicle traffic in residential areas such as South Townsville. Until this road is complete, residents and users of residential and commercial properties in close proximity to Railway Avenue and Boundary Street will continue to be adversely affected by the heavy vehicle traffic travelling to and from the port. For the purposes of this assessment it is assumed that this road is operational and the impact on scenic amenity from traffic generated by the Project is not considered to be significant and is not considered further in this assessment.

Viewpoint 1 has been selected to represent views from a nearby residential area, in this example from Cleveland Terrace, which has clear elevated north-easterly views to the PEP.

Table B.17.5 The Rocks Guesthouse, Cleveland Terrace, Melton Hill (Figure B.17.10)

Assessment	Description
Baseline	
Location, description and visual domain	▪ This viewpoint represents elevated north-easterly views from the Cleveland Terrace in Melton Hill, adjacent to a residential property known as the 'Rocks Guesthouse' (c. 1897 to c. 1900). ▪ Due to its slightly elevated location the view represents the worst-case views for residents to the north, west and east of the city, but is representative of a broader range of residential receptors close to the PEP. Many residential views will actually experience lesser impacts than that represented (e.g. South Townsville). ▪ Melton Hill is a small historic precinct located on an elevated rocky spur, between Townsville's CBD and Breakwater Marina. It is in one of Townsville's older suburbs, comprising several unique late nineteenth and early twentieth century buildings. ▪ The Melton Hill precinct is a place of historic interest in Townsville for tourists, residents and visitors, referred to in Townsville tourist literature.
Key sensitivities	▪ Medium sensitivity of receptors, including residents and visitors to Melton Hill, an important historic precinct in Townsville. ▪ 'Panoramic views of the Coral Sea, Magnetic Island and Cleveland Bay' (DERM, 2006b) from the Rocks Guesthouse, which are sensitive to change or disruption.
Overall inherent sensitivity	Medium
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	Although the existing activities and infrastructure associated with the port are visible from this point (particularly the Queensland Sugar bulk storage sheds, Cement Australia silo, and the cranes at Berth 2 and Berth 3), the PEP would further influence this view throughout the construction and operational phases. The breakwater(s) and reclamation area will include up to six wharves to fit Panamax sized bulk ships, container handling gantry cranes, shiploaders/unloaders, cargo operations zone, materials storage areas, internal access roads and rail loops, and dredge ponds. The reclamation would extend approximately 1 km seaward of the existing northern breakwater, and would be visible from this point, beyond the existing cranes at Berth 2 and 3 (Figure B.17.10). Activities during the construction phase (e.g. the breakwater and bund construction, harbour dredging, reclamation works, bulk earthworks and ground treatment, civil works, and installation of wharf structures for the berthing, mooring, loading and unloading ships) would also be visible from this point. This would potentially include visibility of turbidity plumes in Cleveland Bay and dust in the air resulting from rock dumping and dredging activities (short-term impact). The baseline lighting assessment illustrated that a high level of existing lighting exists both in foreground of the view associated with the residential development and in the middle ground of the view, associated with the port. The introduction of additional port lighting would extend the level of lighting in the middle ground of the view and would represent an incremental increase in light levels compared to the current situation. The port lighting is enjoyed by many receptors; from a scenic amenity perspective is considered of neutral effect. Given the close proximity of the view and the low value placed by most receptors on port scenery and port infrastructure, the additional infrastructure during both construction and operational phases during the day are predicted to generate an adverse change. Considering all of the above, the Project activities would be seen in the context of the existing port activities and infrastructure; therefore, the associated magnitude of change in this view would be moderate (noticeable).
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the medium sensitivity to change combined with a moderate magnitude of change for both construction and operational phases.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the medium sensitivity to change combined with a moderate magnitude of change.

Assessment	Description
SPR	The view is not an 'area of high scenic preference' or an 'area of locally important scenic preference'.
Pre-change SPR	2.9
Post-change SPR	N/A as the pre-change SPR is below 5.
Acceptability criteria	The change is not statistically significant. Based on the requirements of Queensland Coastal Plan, the Project is an acceptable outcome, from this viewpoint.

B.17.4.2.2 Offsite Receptor – Residents Living in Townsville CBD and Outer Suburbs

The PEP is anticipated to affect the scenic amenity of several properties (including residential and commercial properties) in Townsville and its surrounding suburbs or townships:

- Elevated clear views to the PEP activities during construction and operation from residential and short-term accommodation towers in the Townsville CBD and Palmer Street precinct, as indicated in Viewpoint 2 from the Holiday Inn Hotel (Figure B.17.11).
- Elevated suburbs with properties comprising a northern or and eastern aspect such as Yarrawonga, which are likely to experience clear views to the PEP activities during construction and operation. Elevated views from Yarrawonga properties are likely to be similar to those obtained from Castle Hill (Viewpoint 3, Figure B.17.12), although less elevated (approximately 110 m at the highest point).
- Filtered views through coastline vegetation from properties located in suburbs along the Cleveland Bay coastline, including properties along The Strand in Townsville and along Cape Pallarenda Road, north of Townsville. Viewpoint 11 is considered to represent the worst case for these low-level receptors.

Table B.17.6 Viewpoint 2 – Holiday Inn Tower in Townsville CBD

Assessment	Description
Baseline	
Location, description and visual domain	▪ This viewpoint represents elevated views from the CBD. ▪ The view represents the worst-case views for residents to the north, south and west of the city. ▪ Townsville CBD comprises a number of high-rise accommodation and tourist towers and it is predicted that as the city grows in the future more of these towers will be developed. ▪ Figure B.17.11
Key sensitivities	▪ High sensitivity of receptors, including residents and visitors to Townsville CBD. ▪ Panoramic views of the CBD and existing port in the fore and middle ground of the view, while the Cleveland Bay is in the backdrop of the view. These areas are sensitive to change or disruption.
Overall inherent sensitivity	High
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	Although the existing activities and infrastructure associated with the port are visible from this point (particularly the Queensland Sugar bulk storage sheds, Cement Australia silo and the cranes at Berth 2 and Berth 3), the PEP would further influence this view throughout the construction and operational phases. The PEP would be seen in the context of the existing port activities and infrastructure, including the Townsville Marine Precinct and Eastern Reclamation (port land for expanding current port operations and material storage); therefore, the character of the view experienced would not change during the construction and operational phases. Given the close proximity of the view, this additional infrastructure during both construction and operational phases are predicted to generate an adverse change. The viewpoint photograph combined with the baseline lighting assessment illustrate that a high level of existing lighting exists both in the foreground of the view associated with Townsville CBD and in the middle ground associated with the port.

Assessment	Description
	The introduction of additional port lighting would extend the level of lighting in the middle to background of the view and would represent an incremental increase in light levels compared to the current situation. As previously stated this lighting would be considered an enhancement of the scenic or visual amenity by many receptors at night. Considering all of the above, the Project activities would be seen in the context of the existing port activities and infrastructure; the associated magnitude of change in this view would be moderate (noticeable).
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the high sensitivity to change combined with a moderate magnitude of change for both construction and operational phases.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the high sensitivity to change combined with a moderate magnitude of change for both construction and operational phases.

B.17.4.2.3 Offsite Receptor – Local Attractors

Townsville and its surrounds provide a wealth of attractors for its residents, as well as visitors and tourists, including:

- nature conservation values and areas of high scenic amenity that offer a variety of nature-based and outdoor recreation opportunities; including the mountainous backdrop of Castle Hill, Magnetic Island National Park, Cape Cleveland, and Mount Stuart (as noted in the *Townsville-Thuringowa Strategy Plan* (2000)), Bowling Green National Park, and beaches/coastal areas such as Cape Pallarenda, the GBRWHA and Cleveland Bay (also used for recreational boating)
- open space and recreation assets and facilities, including Breakwater Marina, The Strand and Kissing Point Rock Pool
- key commercial, retail and entertainment centres or venues, such as Townsville CBD, Palmer Street precinct and Townsville Entertainment Centre

These places were visited during the site visit in July 2011, to assess the potential visibility of the PEP activities during construction and operation. The following representative viewpoints were selected and evaluated for the effect on scenic amenity as these are considered to have clear views to the PEP:

- north-easterly views from Castle Hill (Viewpoint 3)
- northerly views from Mount Stuart Scenic Lookout (Viewpoint 4)
- easterly views from The Strand Pier (Viewpoint 5)
- easterly views from Kissing Point Rock Pool (Viewpoint 6)
- north-easterly views from the western breakwater and Townsville Entertainment Centre (Viewpoint 7)
- north-easterly views from Freemasons Pallarenda Park (Viewpoint 8)
- southerly views from the passenger ferry route between Townsville and Magnetic Island (Viewpoint 9)
- southerly views from Nelly Bay ferry terminal area on Magnetic Island (Viewpoint 10).

Table B.17.7 Viewpoint 3 – Castle Hill

Assessment	Description
Baseline	**Description**
Location and description	▪ This viewpoint represents north-easterly views from Castle Hill, an isolated pink granite outcrop; an iconic landmark in the heart of Townsville (as noted in the *Townsville-Thuringowa Strategy Plan* (2000)). ▪ This viewpoint is considered representative of views from the air, given the elevated view and bird's eye perspective. ▪ Castle Hill is listed on the Queensland Heritage Register and valued as 'one of the most distinctive natural features on the Queensland coast, and remains an imposing backdrop to the heart of Townsville' (DERM, 1993). ▪ A key vantage point that offers panoramic views across Townsville and its

Assessment	Description
	setting, including The Strand, Cleveland Bay, Magnetic Island and the sweeping coastline to Cape Pallarenda in the north and Bowling Green National Park in the south. ▪ Includes several lookout platforms that attract large numbers of receptors daily, including tourists, visitors, and residents walking, running and cycling along Castle Hill Road for recreation and fitness. ▪ The port is 2.5 km away from this viewpoint and is entirely visible. The PEP lies approximately 3.8 km to the north-east of the vantage point. ▪ Figure B.17.12 and Figure B.17.13
Key sensitivities	▪ Its value in the Queensland Heritage Register as a 'popular tourist and instructional venue in Townsville, with education groups regularly using the reserve to study natural environments, community history and urban geography' (DERM, 1993). ▪ Castle Hill is 'an important icon in community and tourist advertising and promotional activities' (DERM, 1993). ▪ The viewpoint represents views from a location of state importance where the user's interest is specifically focused on the landscape.
Overall inherent sensitivity	High
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	The activities and infrastructure associated with the PEP during construction and operation would be noticeable over a restricted area of the viewshed from this point, resulting in a clear new element in the middle ground of the view (indicatively shown in Figure B.17.13. The PEP would be seen in the context of the existing port activities and infrastructure, including the Townsville Marine Precinct and Eastern Reclamation (port land for expanding current port operations and material storage); therefore, the character of the view experienced would not change during the construction and operational stages. Given the elevated and close nature of this view, many activities during the construction phase would also be visible from this point, including potential turbidity plumes in Cleveland Bay and dust in the air resulting from rock dumping and dredging activities (short-term impact). The baseline lighting assessment illustrated that a high level of existing lighting exists both in the foreground of the view associated with Townsville CBD and residential suburbs and in the middle ground of the view associated with the port. The introduction of additional port lighting would extend the level of lighting in the middle to background of the view and would represent an incremental increase in light levels compared to the current situation. Receptors regularly access Castle Hill at night and can be observed looking in the direction of the port, indicating that the port lighting would not necessarily be considered an adverse impact. Given the elevated nature of this view it is considered to partially represent closer distance views from the air. One of the key flight paths into Townsville Airport is in close proximity to Castle Hill. From both the land and air, given the additional infrastructure would be viewed as an extension of the industrial landscape into the seascape, the magnitude of change is considered to be moderate (noticeable) and adverse in nature.
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the high sensitivity to change combined with a moderate magnitude of change.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the high sensitivity to change combined with a moderate magnitude of change.
SPR	The view is not an 'area of high scenic preference' or an 'area of locally important scenic preference'.
Pre-change SPR	2.5
Post-change SPR	N/A as the pre-change SPR is below 5.
Acceptability criteria	The change is not statistically significant. Based on the requirements of QCP, the Project is an acceptable outcome, from this viewpoint.

Table B.17.8 Viewpoint 4 – Mount Stuart Scenic Lookout

Assessment	Description
Baseline	**Description**
Location and description	▪ This viewpoint represents northerly views from Mount Stuart Scenic Reserve lookout, located approximately 10 km south-west of the Townsville CBD. ▪ Mount Stuart summit is a popular scenic lookout with interpretative signage and offers elevated panoramic views of Townsville City and its setting, including Cleveland Bay in the south and the Paluma Range in the north. ▪ This viewpoint is considered representative of views from the air, given the elevated view and bird's eye perspective and is in close proximity to one of the key flight paths into Townsville airport. ▪ The lookout is one of the key places of interest in the Townville region for tourists, visitors and residents cycling along Mount Stuart Road for recreation and fitness. ▪ The port is approximately 12 km in direct distance to the north-east of this viewpoint and is entirely visible. ▪ Figure B.17.14 and Figure B.17.15
Key sensitivities	▪ The viewpoint represents views from a popular scenic vantage point, where the user's interest is specifically focused on the landscape.
Overall inherent sensitivity	High
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	The activities and infrastructure associated with the PEP during construction and operation would be recognisable or detectable in a restricted area of the viewshed from this point (indicatively shown in Figure B.17.14), but would not fundamentally change the character of this view. This is clearly illustrated in the photomontage in Figure B.17.15. The change would be similar for longer distance views from the air. The baseline lighting assessment illustrated that a high level of existing lighting exists in the middle ground of the view associated with Townsville CBD and residential suburbs and the port. The introduction of additional port lighting would extend the level of lighting in the background of the view and would represent an incremental increase in light levels compared to the current situation. It would be scarcely noticeable in the context of more prominent foreground lighting sources. The PEP would be seen in the context of the existing port activities and infrastructure, including the Townsville Marine Precinct and Eastern Reclamation, and would only result in a minor (detectable) magnitude of change overall. Given the long distance nature of this view, the Project Area only makes up a small portion of the view and is a neutral change both during the day and night.
Judgement of significance of impact (daytime and night-time)	Moderate neutral impact, due to the high sensitivity to change combined with a minor magnitude of change.

Table B.17.9 Viewpoint 5 – The Strand Pier

Assessment	Description
Baseline	
Location and description	▪ This viewpoint represents easterly views from The Strand Pier, located approximately 1.5 km north-west of the Breakwater Marina. ▪ The viewpoint overlooks the GBRWHA and the area excised from the GBRMP. This viewpoint represents the impact on the scenic values of the GBRWHA. ▪ The Strand is a Townsville landmark, consisting of a 2.2 km 'world-class beachfront promenade custom-built for enjoyment' (TCC, 2010b) with bike and walking paths, parkland, picnic spots, restaurants, swimming beaches and panoramic water views across Cleveland Bay. ▪ The Strand Pier is a popular location for passive recreation (e.g. fishing, walking, reading) for both tourists and residents, extending 60 m into Cleveland Bay from Strand Park. ▪ The Port of Townsville including the PEP is approximately 2 km in direct

Assessment	Description
	distance to the east of this viewpoint and is entirely visible. ▪ Figure B.17.16 and Figure B.17.17
Key sensitivities	▪ The viewpoint represents views from a popular recreational and scenic vantage point; predicted to be visited by a medium number of receptors with an interest in their environment.
Overall inherent sensitivity	**Medium**
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	Although the existing activities and infrastructure associated with the port are clearly visible from this viewpoint (particularly Berth 11, the new BP bitumen import facility tanks, the cranes at Berth 2 and Berth3), the PEP would further influence this view throughout the construction and operational phases. The breakwater(s) and reclamation area would be visible from this point beyond the existing Berth 11 (indicatively shown in Figure B.17.16 and Figure B.17.17). Activities during the construction phase would be visible from this point, including potential turbidity plumes in Cleveland Bay and dust in the air resulting from rock dumping and dredging activities (short-term impact). The Project's activities would impact some views of the GBRWHA including this viewpoint. These activities would be viewed in the context of the existing industrial landscape of Cleveland Bay. The Cleveland Bay area of the GBRWHA scenic amenity is already undermined by the existing industrial development (noting that the port had been established for some 117 years before the world heritage area was declared) and consequently this increases the ability of this bay to accommodate further industrial change and lowers the magnitude of change. Beyond Cleveland Bay the broader scenic values of the GBRWHA would be maintained. The baseline lighting assessment illustrated that a high level of existing lighting exists in the middle ground of the view associated with the port. The introduction of additional port lighting would extend the level of lighting in the middle ground of the view into the seascape and would represent an incremental increase in light levels compared to the current situation. The change is considered neutral; some people accessing these areas at night will like additional views of port lighting. As the PEP activities would be seen in the context of the existing port activities and infrastructure the character of the view experienced would not change; the associated magnitude of change in this view would be moderate (noticeable) and adverse in the day.
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the medium sensitivity to change combined with a moderate magnitude of change.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the medium sensitivity to change combined with a moderate magnitude of change.

Table B.17.10 Viewpoint 6 – Kissing Point Rock Pool

Assessment	Description
Baseline	
Location and description (daytime)	▪ This viewpoint represents easterly views from Kissing Point, adjacent to the Rock Pool, located approximately 2 km north-west of the Breakwater Marina. ▪ The viewpoint is on the edge of and overlooks the GBRWHA. It also overlooks the area excised from the GBRMP. This viewpoint represents the impact on the scenic values of the GBRWHA. ▪ The Strand terminates in the north at Kissing Point, which is a Townsville landmark recognised for its military (including Kissing Point Fort and the Jezzine Barracks) and social history. ▪ Kissing Point also has long been associated with recreation, including the city's first golf course and construction of the first city baths, later replaced by the Rock Pool. ▪ The Rock Pool, parkland and restaurant at Kissing Point is a popular spot for residents and tourists.

Assessment	Description
	▪ The port is approximately 3.4 km in direct distance to the east of this viewpoint and is entirely visible. ▪ Figure B.17.18
Key sensitivities	▪ The viewpoint represents views from a popular recreational and scenic vantage point with historic importance; predicted to be visited by a medium number of receptors with an interest in their environment.
Overall inherent sensitivity	Medium
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	Although the existing activities and infrastructure associated with the port are clearly visible from this point (particularly Berth 11, the cranes at Berth 2 and Berth 3, and the Queensland Sugar bulk storage sheds), the PEP would further influence this view throughout the construction and operational phases. The breakwater(s) and reclamation area would be visible from this point beyond the existing Berth 11 (indicatively shown in Figure B.17.18). Activities during the construction phase would also be visible from this point, including potential turbidity plumes in Cleveland Bay and dust in the air resulting from rock dumping and dredging activities (short-term impact). The Project's activities would impact views of the GBRWHA from Kissing Point Rock. These activities would be viewed in the context of the existing industrial landscape of Cleveland Bay. The Cleveland Bay area of the GBRWHA scenic amenity is already undermined by the existing industrial development and consequently this increases the ability of this bay to accommodate further industrial change and lowers the magnitude of change. Beyond Cleveland Bay the broader scenic values of the GBRWHA would be maintained. The baseline lighting assessment illustrated that a high level of existing lighting exists in the middle ground of the view associated with the existing port infrastructure. The introduction of additional port lighting would extend the level of lighting in the middle ground of the view into the seascape and would represent an incremental increase in light levels compared to the current situation. The change is considered neutral as some people accessing these areas at night are anticipated to like additional views of port lighting. As the PEP activities would be seen in the context of the existing port activities and infrastructure, representing intensification rather than the introduction of uncharacteristic new elements into the view, the associated magnitude of change in this view would reduce to moderate (noticeable). This change is considered adverse during daylight hours, given the extension would extend the industrial landscape considerably further into the natural seascape setting.
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the medium sensitivity to change combined with a moderate magnitude of change.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the medium sensitivity to change combined with a moderate magnitude of change.

Table B.17.11 Viewpoint 7 – Western Breakwater, near Townsville Entertainment Centre

Assessment	Description
Baseline	
Location and description	▪ This viewpoint represents north-easterly views from the western breakwater and Townsville Entertainment Centre, which are separated from the port by Ross Creek. ▪ The viewpoint is on the edge of and overlooks the GBRWHA. It also overlooks the area excised from the GBRMP. This viewpoint represents the impact on the scenic values of the GBRWHA. The western breakwater is a popular location for passive recreation (e.g. fishing, walking, reading) for both tourists and residents, extending approximately 800 m into Cleveland Bay from Townsville Entertainment Centre, offering panoramic views to the port and across Cleveland Bay to Magnetic Island. ▪ Figure B.17.19

Assessment	Description
Key sensitivities	▪ The viewpoint represents views from a location predicted to be visited by a medium number of receptors such as residents and visitors with an interest in their environment, including visitors to the western breakwater and the nearby Townsville Entertainment Centre.
Overall inherent sensitivity	Medium
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	Although the existing activities and infrastructure associated with the port are prominent from this point (particularly the new BP bitumen import facility tanks, Queensland Sugar bulk storage sheds, and Berths 1, 2, 3, 10 and 11, including the container handling gantry cranes at Berth 2 and Berth 3) the PEP would further influence this view throughout the construction and operational phases. The breakwater(s) and reclamation area would be visible from this point beyond the existing Berth 1 and 11 (indicatively shown in Figure B.17.19. This industrial view is in the GBRWHA. The Project activities would be viewed only in the context of the existing industrial landscape of the existing port. This part of the GBRWHA scenic amenity is already undermined by the existing industrial development and consequently this increases the ability of this bay to accommodate further industrial change and lowers the magnitude of change. The baseline lighting assessment illustrated that a high level of existing lighting exists in the middle ground of the view associated with the port. The introduction of additional port lighting would extend the level of lighting in the background of the view and further into the seascape. This would represent an incremental increase in light levels compared to the current situation, but a neutral impact as some people accessing these areas at night are anticipated to like additional views of port lighting. Due to the close proximity to the PEP activities during construction (particularly the construction of the possible western breakwater) and operation in daylight hours, the overall magnitude of change is anticipated to be high (considerable) and adverse in nature, in this view, although would not contrast strongly with the existing character of the view.
Judgement of significance of impact (day time)	Moderate adverse impact, due to the medium sensitivity to change combined with a high magnitude of change.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the medium sensitivity to change combined with a high magnitude of change.

Table B.17.12 Viewpoint 8 – Freemasons Pallarenda Park

Assessment	Description
Baseline	
Location and description	▪ This viewpoint represents north-easterly views from Freemasons Pallarenda Park; a foreshore parkland located adjacent to the Townsville suburb of Pallarenda. ▪ The park is a popular place for visitors and, particularly, locals for recreation; offering a swimming beach, parkland with picnic facilities, play equipment and walking tracks, and panoramic water views across Cleveland Bay to Townsville, Castle Hill, Mount Stuart and Magnetic Island. ▪ This viewpoint represents the impact on the scenic values of the GBRWHA and GBRMP. The viewpoint is located on the edge of both the world heritage area and marine park. The fore and middle ground of the view (i.e. the beach and water) are considered part of the GBRWHA and GBRMP, while the waterscape adjacent to Townsville is located in an area excised from the GBRMP. ▪ The port is approximately 8.2 km in direct distance to the south-east of this viewpoint and is entirely visible. ▪ Figure B.17.20
Key sensitivities	▪ The viewpoint represents views from a popular recreational and scenic vantage point in the GBRWHA and GBRMP with historic importance (used as a military hospital during World War II), and is predicted to be visited by a medium number of receptors with an interest in their environment.

Assessment	Description
Overall inherent sensitivity	Medium
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	Although the existing activities and infrastructure associated with the port are clearly visible from this point (particularly the cranes at Berth 2 and Berth 3, the Queensland Sugar bulk storage sheds and Cement Australia silo) the PEP would further influence this view throughout the construction and operational phases. The breakwater(s) and reclamation area would be visible from this point beyond the existing Berth 11 (Figure B.17.20). The Project's activities would impact views of the GBRWHA and GBRMP from this park. These activities would be viewed in the context of the partially industrialised landscape of Cleveland Bay. The Cleveland Bay area of the GBRWHA and GBRMP scenic amenity is already undermined by the existing industrial development and consequently this increases the ability of the bay to accommodate further industrial change and lowers the magnitude of change. Beyond Cleveland Bay the broader scenic values of the GBRWHA and GBRMP would be maintained. This viewpoint is anticipated to have limited numbers of receptors at night; as it is not closed to the public it is considered in the assessment. The baseline lighting assessment illustrated that a high level of existing lighting exists in the background of the view associated with the port and Townsville CBD. The introduction of additional port lighting would extend the level of lighting in the background of the view and further into the seascape. This would represent an incremental increase in light levels compared to the current situation but would not necessarily be considered as an adverse change given the existing context. As the PEP activities would be seen in the context of the existing port activities and infrastructure in the daytime, the associated magnitude of change in this view would be moderate (noticeable) given it would be of a similar character to the existing view. This change is considered to be adverse during the daytime given the extension would extend the industrial landscape further into the natural seascape setting.
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the medium sensitivity to change combined with a medium magnitude of change.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the medium sensitivity to change combined with a medium magnitude of change.

Table B.17.13 Viewpoint 9 – Passenger Ferry Route Between Townsville and Magnetic Island

Assessment	Description
Baseline	
Location and description	▪ This viewpoint represents southerly views from the passenger ferry route between Townsville and Magnetic Island. ▪ The ferry route (also followed by the Magnetic Island barge) is approximately 11.5 km long and provides the primary public transport corridor between Townsville and the Nelly Bay Marina at Magnetic Island for both residents and domestic and international tourists. ▪ From this point in the ferry route, the port is approximately 3.7 km in direct distance to the south, and is entirely visible in the context of Townsville City and the surrounding mountain ranges, including Mount Stuart. ▪ This point lies in the GBRWHA, but in an area excised from the GBRMP. ▪ Figure B.17.21 and Figure B.17.22
Key sensitivities	▪ The viewpoint represents views from a key transport corridor, and is predicted to be visited by a medium number of receptors with an interest in their environment, travelling between Townsville and Magnetic Island.
Overall inherent sensitivity	Medium
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	Although the existing activities and infrastructure associated with the port are clearly visible from this point (particularly Berth 11, cranes at Berth 2 and Berth 3, Cement Australia silo, Incitec Pivot fertiliser storage and handling facilities, and Queensland Sugar bulk storage sheds) the PEP would further influence the foreground of this

Assessment	Description
	view throughout the construction and operational phases. The new breakwaters and reclamation area would be highly visible from this point in front of Berth 11 (indicatively shown in Figure B.17.21 and Figure B.17.22). Activities during the construction phase would be visible from this point, including potential turbidity plumes in Cleveland Bay and dust in the air resulting from rock dumping and dredging activities (short-term impact) The Project's activities would impact views of the GBRWHA from the ferry. These activities would be viewed in the context of the partially industrialised landscape of Cleveland Bay. The Cleveland Bay area of the GBRWHA scenic amenity is already undermined by the existing industrial development and consequently this increases the ability of the bay to accommodate further industrial change and lowers the magnitude of change. Beyond Cleveland Bay the broader scenic values of the GBRWHA would be maintained. As the ferry runs until midnight consideration of views at night has been included in the assessment. The baseline lighting assessment illustrated that a high level of existing lighting exists in the middle ground of the view associated with the port infrastructure. The introduction of additional port lighting would extend the level of lighting in the middle ground of the view into the seascape and would represent an incremental increase in light levels compared to the current situation. Since anyone experiencing this vantage point would have left the ferry terminal and travelled through the intensely lit port, it is considered unlikely that the lighting impacts at night would be considered to be negative. Impacts have been assessed as neutral. In the daytime, as the PEP activities would be seen against the backdrop of the existing port activities and the character of the view would not change, the associated magnitude of change in this view would be moderate (noticeable) and neutral in type.
Judgement of significance of impact (daytime and night-time)	Moderate neutral impact, due to the medium sensitivity to change combined with a moderate magnitude of change.
SPR	The view is an 'area of locally important scenic preference'
Pre-change SPR	7.9
Post-change SPR	7.8
Acceptability criteria	The change is not statistically significant. Based on the requirements of QCP, the Project is an acceptable outcome, from this viewpoint.

Table B.17.14 Viewpoint 10 – Nelly Bay, Magnetic Island

Assessment	Description
Baseline	
Location and description	▪ This viewpoint represents southerly views from the western part of Magnetic Island National Park overlooking Nelly Bay and its breakwater. ▪ Magnetic Island is an island off the coast of Townsville featuring 'spectacular natural landscapes and seascapes including boulder-strewn headlands, hoop pines, sandy beaches and fringing coral reefs' (DERM, 2006a). ▪ The view represents a key vantage point from Nelly Bay Ferry Terminal and offers panoramic views across Cleveland Bay to Townsville and its mountainous setting, including Castle Hill and Mount Stuart, similar to that obtained from Hawkings Point (Viewpoint 11). ▪ The view is anticipated to attract larger numbers of receptors daily than Hawkings Point, including tourists, visitors, and residents using the ferry terminal and marina precinct. ▪ This viewpoint has been selected to represent the impact on the scenic values of the GBRWHA and GBRMP. The majority of the waterscape in the middle to background of the view adjacent to Townsville is located in the area excised from the GBRMP; all of the waterscape is in the GBRWHA. The GBRWHA is recognised for its 'exceptional natural beauty and aesthetic importance'.

Assessment	Description
	▪ The port is approximately 8.8 km in direct distance to the south of this viewpoint and is entirely visible above the breakwater. ▪ Figure B.17.23
Key sensitivities	▪ The natural, cultural and historical value of Magnetic Island National Park, resulting in a popular tourist destination and iconic national asset. ▪ Even though the viewpoint is in the GBRWHA and represents views from a location of regional importance the receptors do not immediately qualify as 'high' sensitivity. Unlike the viewpoint at Hawkings Point (Viewpoint 11) where the user's interest is specifically focused on the landscape it is considered these receptors are considered less sensitive given they are in a more urbanised environment and many may be in transit from the ferry.
Overall inherent sensitivity	Medium
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	The activities and infrastructure associated with the PEP during construction and operation would be noticeable over a restricted area of the view, resulting in a clear new element in the view (indicatively shown in Figure B.17.23). The Project would impact this and similar views of the GBRWHA and GBRMP from Magnetic Island. Given the Project would be viewed in the context of a broader existing industrialised landscape of Cleveland Bay, the landscape of this part of the GBRWHA has more ability to accommodate some incremental industrial development. This consequently lowers the magnitude of change than would be the case if the development were to occur in a pristine natural setting. Only a small section of this designated landscape would be affected and the broader scenic values of the GBRWHA would be maintained beyond Cleveland Bay. This view would be accessible at night. The baseline lighting assessment illustrated that a high level of existing lighting exists in the background of the view associated with the port and Townsville CBD. The introduction of additional port lighting would extend the level of lighting in the background of the view and further into the seascape. This would represent an incremental increase in light levels compared to the current situation, but this is not perceived as an adverse effect on views, given some people accessing these areas at night are anticipated to like additional views of port lighting. As the PEP activities would be seen at some distance and in the context of the existing port activities and infrastructure this would not result in the introduction of new characteristics; the associated magnitude of change in this view would be moderate (noticeable). The PEP activities would extend the industrial landscape into an inherently natural seascape area. These activities would be viewed predominantly against the backdrop of a natural landscape and the change is considered adverse in type.
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the medium sensitivity to change combined with a moderate magnitude of change.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the medium sensitivity to change combined with a moderate magnitude of change.

B.17.4.2.4 Offsite Receptor – Recreational Tracks

Recreational trails and tracks in Townsville generally coincide with walking trails and cycle paths for residents (i.e. commuting for work, school, college, university, shops) and visitors (i.e. between local attractors and dedicated trails such as Riverwalk along the Ross River and Booroona walking trail). Key trails and tracks that are likely to experience views to the PEP include The Strand (Viewpoint 5), Castle Hill (Viewpoint 3) and the on-road cycle path between Townsville and Cape Pallarenda (DTMR, 2001).

Recreational trails and tracks outside of Townsville generally coincide with parks and reserves, such as Magnetic Island National Park, Cape Pallarenda Conservation Park, Bowling Green National Park and Townsville Town Common National Park, which are visited for their nature conservation values and high scenic amenity value, offering a variety of nature-based and outdoor recreation opportunities. Trails through these areas are often through flat coastal plain landscapes such as the Alligator Creek Falls walking track in Bowling Green National Park and the wetlands trail in Townsville Town Common Conservation Park, allowing very limited visibility with the port, as indicated in **Error! Reference source not found.**.

Figure B.17.8 South-easterly View Towards the PEP from Tegoora Rock Lookout, Townsville Town Common Conservation Park

At times, the flat coastal topography is broken by dramatic peaks and rocky outcrops (e.g. Castle Hill, Mount Stuart, Hawkings Point and Mount Cook at Magnetic Island), which also provide popular vantage points where residents and visitors can appreciate expansive views over the city and its surrounds. Viewpoint 11 (Figure B.17.24 and Figure B.17.25) represents views from Hawkings Point lookout at Magnetic Island National Park, which is a sensitive receptor (i.e. location of national importance where the user's interest is specifically focused on the landscape). The viewpoint was considered to have more direct, accessible views towards the PEP site than others visited (such as Tegoora Rock lookout and the wetlands trail in Townsville Town Common Conservation Park, and Alligator Creek Falls walking track in Bowling Green National Park).

Table B.17.15 Viewpoint 11 – Hawkings Point Lookout, Magnetic Island

Assessment	Description
Baseline Assessment	
Location and description	▪ This viewpoint represents elevated southerly views from Hawkings Point lookout, located in the southern part of Magnetic Island National Park overlooking Picnic Bay and its adjoining residential areas. ▪ Magnetic Island is an island off the coast of Townsville featuring 'spectacular natural landscapes and seascapes including boulder-strewn headlands, hoop pines, sandy beaches and fringing coral reefs' (DERM, 2006a). ▪ Hawkings Point lookout is a key vantage point identified in the Magnetic Island National Park walking track map (DERM, 2006a) that offers panoramic views across Cleveland Bay to Townsville and its mountainous setting, including Castle Hill and Mount Stuart. ▪ Hawkings Point lookout attracts a small number of receptors daily, including tourists, visitors, and residents using walking tracks for recreation and fitness. ▪ Similar to Viewpoint 10, this viewpoint has been selected to represent the impact on the scenic values of the GBRWHA and GBRMP. The majority of the waterscape in the middle to background of the view adjacent to Townsville is located in the area excised from the GBRMP. All of the waterscape is in the GBRWHA. The GBRWHA is recognised for its 'exceptional natural beauty and aesthetic importance'. ▪ The port is approximately 8 km in direct distance to the south of this viewpoint and is entirely visible above the tree line. ▪ Figure B.17.24 and Figure B.17.25
Key sensitivities	▪ The natural, cultural and historical value of Magnetic Island National Park, resulting in a popular tourist destination and iconic national asset. ▪ The viewpoint represents views from a location of national importance where the user's interest is specifically focused on the landscape.
Overall inherent sensitivity	High
Evaluation	

Assessment	Description
Judgement of magnitude of change (during both the construction and operational phases)	The activities and infrastructure associated with the PEP during construction and operation would be noticeable over a restricted area of the view from this viewing location, resulting in a clear new element in the view (indicatively shown in Figure B.17.25) The view is of the GBRWHA. The new industrial element would impact this and similar views of the GBRWHA and GBRMP from Magnetic Island. As these elements would be viewed in the context of a broader existing port industrial area, the scenic amenity of this part of the GBRWHA is already undermined by the existing industrial development, which consequently lowers the magnitude of change than would be the case against a pristine environment setting. Only a small section of this designated landscape would be affected and the broader scenic values of the GBRWHA would be maintained beyond Cleveland Bay. As this viewpoint is not easily accessible it is anticipated to have very limited numbers of receptors at night. As it is not closed to the public at night, it is considered in the assessment. The baseline lighting assessment illustrated that a high level of existing lighting exists in the background of the view associated with the port and Townsville CBD. The introduction of additional port lighting would extend the level of lighting in the background of the view and further into the seascape. This would represent an incremental increase in light levels compared to the current situation but would not be perceived as an adverse effect on views. As the PEP activities would be seen at some distance and in the context of the existing port activities and infrastructure this would not result in the introduction of new characteristics; the associated magnitude of change in this view would be moderate (noticeable). The PEP activities would extend the industrial landscape into the natural seascape. During the day, these activities would be viewed predominantly against the backdrop of a natural landscape and the change is considered adverse in type.
Judgement of significance of impact (daytime)	Moderate adverse impact, due to the high sensitivity to change combined with a moderate magnitude of change.
Judgement of significance of impact (night-time)	Moderate neutral impact, due to the high sensitivity to change combined with a moderate magnitude of change.

B.17.4.2.5 Offsite Receptor – Roads

The Townsville-Thuringowa region contains the largest urban population outside of South East Queensland. It has a diverse commercial and industrial base, as well as being an important tourist destination for international and domestic travellers. The region is supported by a road network that radiates to the north, west and south of the region, including national and state controlled roads that move significant volumes of freight. These include the Bruce Highway (links the region to the southern and northern areas of the state), the Flinders Highway (links the region with Mount Isa), the Townsville Port Access Road linking the Bruce Highway with the port, and Douglas Arterial (provides an entrance to the city from the west).

Road access to the port generally follows the national and state controlled roads, as well as Boundary Street. The completion of the Eastern Access Corridor (and, ultimately, the rail corridor) will largely remove freight traffic accessing the port from the local road system (Abbott Street, Railway Avenue and Boundary Street, through the suburbs of Oonoonba and South Townsville). This will lower the effects and subsequent scenic amenity impacts on residential properties in these areas. Construction and operational vehicles generated by the PEP will primarily use the EAC to access the port (Chapter B14 Transport and Infrastructure).

Scenic tourist drives in and around Townsville include:

- The Great Tropical Drive (a circular route between Townsville, Cairns and Charters Towers)
- The Great Green Way (between Townsville and Cairns)
- Western Heritage Drive (a circular route between Townsville, Charters Towers and Bluff Downs)
- Paluma Drive (a circular route between Townsville, Paluma and Hervey Range)
- Liquid Gold Drive (a circular route between Townsville, Ravenswood and Ayr).

These routes are not likely to have clear, direct views to the PEP due to distance and intervening built form, vegetation and landform, particularly Cape Pallarenda, which effectively blocks views to the port from the north.

Other roads in and around Townsville that already have views to the port are likely to experience views of the PEP activities during construction and operation. These include coastline streets such as The Strand and Cape Pallarenda Road, elevated areas such as Castle Hill Road (key access route for residents, visitors and tourists visiting Castle Hill) and elevated suburbs such as Yarrawonga (e.g. Yarrawonga Drive, Balmoral Drive and Stirling Drive (**Error! Reference source not found.**) and Melton Hill (e.g. Cleveland Terrace and Murray Street).

Figure B.17.9 Elevated View to the PEP from Stirling Drive, Yarrawonga

Viewpoint 12 represents views to the PEP area from Benwell Road, which is the primary access road to the port. This viewpoint is also representative of the worst-case scenario for residents in South Townsville and the Townsville Marine Precinct, which is anticipated to be complete prior to the PEP commencing.

Table B.17.16 Viewpoint 12 – Northerly View from Benwell Road, South of the Townsville Marine Precinct

Assessment	Description
Baseline	
Location and description	▪ This viewpoint provides expansive northerly views from the entrance road to the port along Benwell Road across Ross River mouth into Cleveland Bay. ▪ The view represents the worst-case view for residents living in suburbs along the Cleveland Bay coastline, including properties along The Strand in Townsville and along Cape Pallarenda Road, north of Townsville. ▪ The Eastern Reclamation Area is visible from this point, which coincides with the beginning of the Project Area. ▪ The Townsville Marine Precinct, once constructed on reclaimed land, would be a prominent feature in the foreground of this view, abutting the southern side of the Eastern Reclamation Area. ▪ Figure B.17.26
Key sensitivities	▪ Views from this point would primarily be experienced by those working or visiting the Port of Townsville, as well as those working or visiting the Townsville Marine Precinct.
Overall inherent sensitivity	Medium
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	This viewpoint has been used to demonstrate the location of the Project Area, in context to the Eastern Reclamation and Townsville Marine Precinct. The existing activities and infrastructure associated with the port (particularly the BHP Billiton Cannington and Incitec Pivot fertiliser storage and handling facilities) combined with

Assessment	Description
	the Townsville Marine Precinct development and Eastern Reclamation (once built up with expanded materials storage and port operations) would largely block views to the future construction and operation of the PEP (indicatively shown in Figure B.17.26). Similar to Viewpoint 8, this viewpoint is anticipated to have limited numbers of receptors at night. As it is not closed to the public at night it is considered in the assessment. The baseline lighting assessment illustrated that a high level of existing lighting exists in the background of the view associated with the port and Townsville CBD. The introduction of additional port lighting would extend the level of lighting in the background of the view. This would represent an incremental increase in light levels compared to the current situation. The type of visual impact at night is considered to be neutral as some people accessing these areas at night are anticipated to like additional views of port lighting. The PEP would only result in a minor (detectable) magnitude of change in this view, particularly as any changes would be in keeping with the existing character of the view. Given the small nature of this change it is considered to be neutral in type.
Judgement of significance of impact (daytime and night-time)	Minor neutral impact, due to the medium sensitivity to change combined with a minor magnitude of change.

B.17.4.2.6 Offsite Receptor – Air

The ToR requires the assessment of the visual impact from aerial views. For the purpose of this assessment, views from the air can be broadly described as:

- Receptors and subsequent views from commercial airplanes. These are the main receptors and include tourists and local people. The main flight path for commercial airplanes is illustrated on representative viewpoints plan (Figure B.17.6)
- Receptors and subsequent views from private chartered aircraft. There may also be a smaller numbers of receptors from private chartered airplanes and other aircraft such as helicopters, paragliders, hot air balloons etc. These are considered to be more sensitive than users of commercial airplanes, but given there would only be a handful of these users the emphasis in the ensuing viewpoint assessment is on commercial airplane users.

Table B.17.17 Viewpoint 13 – Indicative View from the Air

Assessment	Description
Baseline	
Location and description	▪ The two aerial photographs illustrate clear, direct views of the existing port and parts of the PEP. ▪ Unlike Viewpoint 3 and 4, which are considered to be bird's eye perspective views (i.e. at acute angles) and more typical of views achieved from aircraft, the aerial view is looking directly down at the Project and is considered the worst-case view for users of the air. ▪ The Eastern Reclamation Area is visible from this point, which coincides with the beginning to the Proejct Area. ▪ The Townsville Marine Precinct, once constructed on reclaimed land, would be a prominent feature in the view, abutting the southern side of the Eastern Reclamation Area. ▪ Figure B.17.27
Key sensitivities	▪ Views from the air would primarily be experienced by those in commercial airplanes who are either residents or visitors (workers and tourists) visiting Townsville and surrounding areas such as the GBRWHA. ▪ Only a small handful of private aircraft receptors would obtain this view. ▪ As the majority of the receptors from the air would be those in commercial planes the sensitivity of the receptors is based on the receptors in commercial planes. It is anticipated that these receptors would not have an interest specifically focused on the landscape and their sensitivity to change would be low.

Assessment	Description
Overall inherent sensitivity	Low
Evaluation	
Judgement of magnitude of change (during both the construction and operational phases)	All the existing activities and infrastructure associated with the Port of Townsville combined with the Townsville Marine Precinct development and Eastern Reclamation would be highly visible from the air during both the construction and operation of the PEP. As the changes would be viewed as an extension to an existing industrial area it would be viewed in keeping with the existing character of the view and the magnitude of change would be lower. This viewpoint is anticipated to have limited numbers of receptors at night given the airport terminal is closed between 23:00 and 04:30 and only a handful of aircraft would be flying at night. Some flights are anticipated to occur during non-daylight hours and are considered in the assessment. The baseline lighting assessment illustrated that a high level of existing lighting exists associated with the port and Townsville CBD. The introduction of additional port lighting would extend the level of lighting in the view and further into the seascape. This would represent an incremental increase in light levels compared to the current situation. The type of visual impact at night is considered to be neutral as most people anticipated to experience this view would enjoy seeing the port lighting. It is predicted that the PEP would result in a minor (detectable) magnitude of change in views from the air, primarily because the changes would be in keeping with the existing character of the view. During the day the impact would be considered adverse, while at night it would be considered neutral.
Judgement of significance of impact (daytime)	Minor adverse impact, due to the low sensitivity to change combined with a minor magnitude of change.
Judgement of significance of impact (night-time)	Minor neutral impact, due to the low sensitivity to change combined with a minor magnitude of change.

B.17.4.2.7 Onsite Receptor – People Visiting and Working at the Port

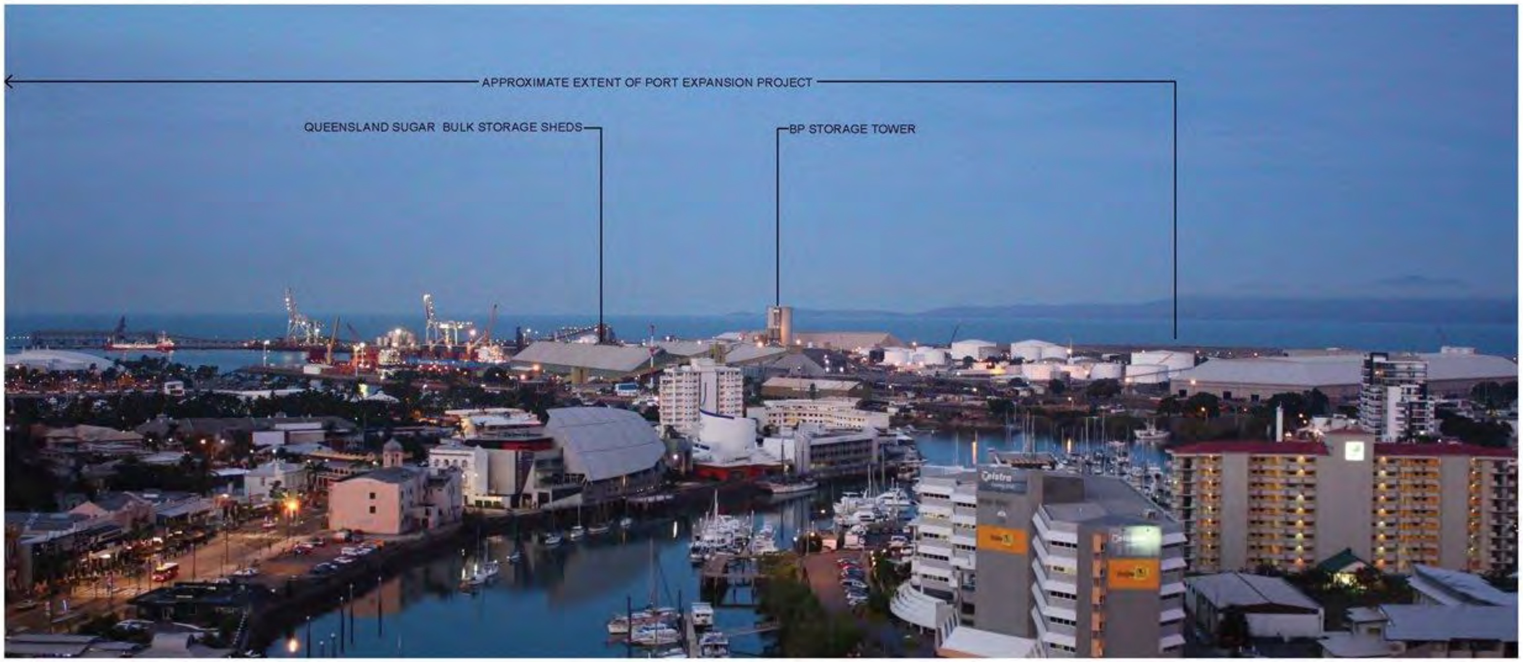
Receptors at the port (e.g. Port of Townsville employees, contractors, tenants and consultants) are considered to have a negligible sensitivity to the change associated with the PEP due to their inherent interests in the port livelihood (e.g. generally have a vested interest in the port and its future expansion). This assessment has focused on views to the PEP from sensitive receptors (e.g. publicly accessible places with the greatest visual exposure to the Project, scenic drives, cycling routes, walking trails, key areas of public realm); therefore, no onsite viewpoints have been included in the assessment.

VIEW CATEGORY: OFF-SITE - NEARBY RESIDENCE / PROPERTY

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 10: Viewpoint 1 - The Rocks Guesthouse, Melton Hill

Figure B.17.10 Viewpoint 1 – The Rocks Guesthouse, Melton Hill



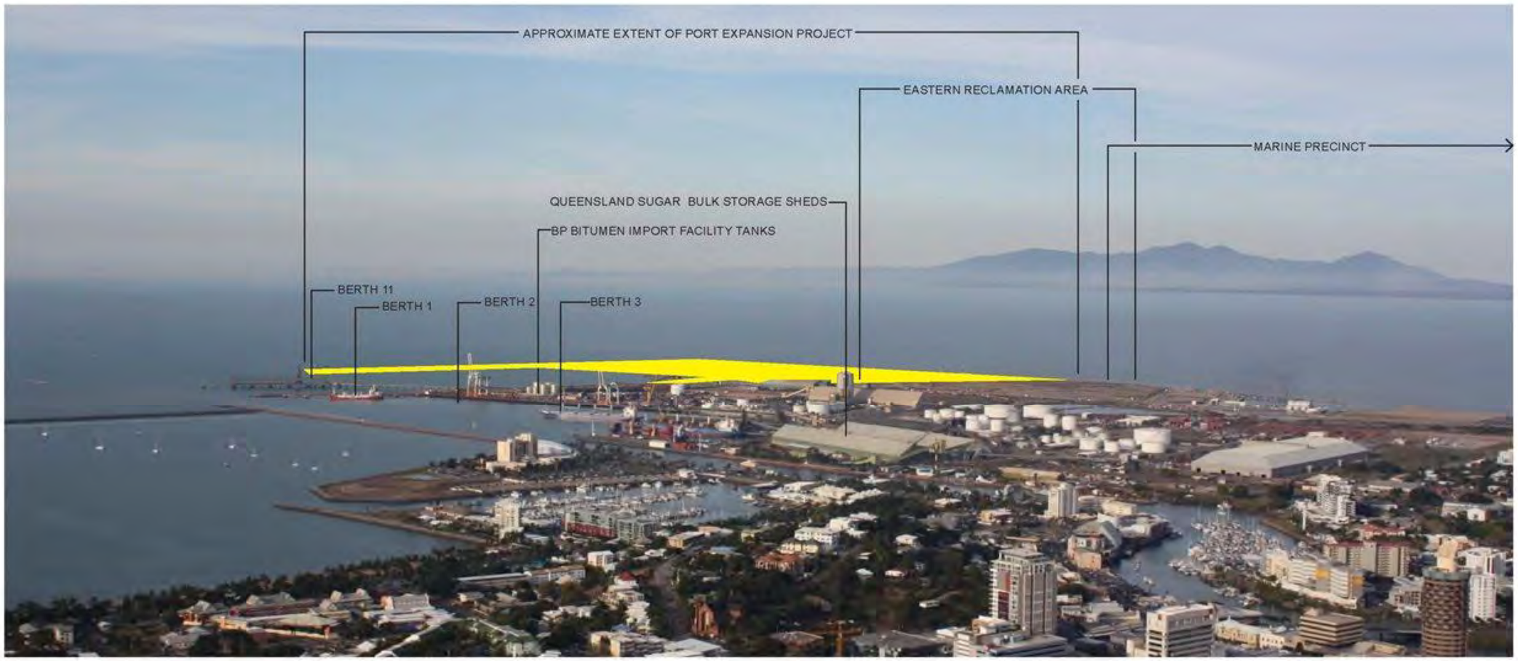
DATA FOR VIEWPOINT 1

VIEW CATEGORY:	OFF-SITE - NEARBY RESIDENCE / PROPERTY
LOCATION:	HOLIDAY INN HOTEL
GRID REFERENCE:	19°15'35.10"S 146°49'02.25"E
ELEVATION:	APPROXIMATELY 70 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY EAST NORTH EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 11: Viewpoint 2 - Holiday Inn Hotel

Figure B.17.11 Viewpoint 2 – Holiday Inn Hotel, in Townsville CBD



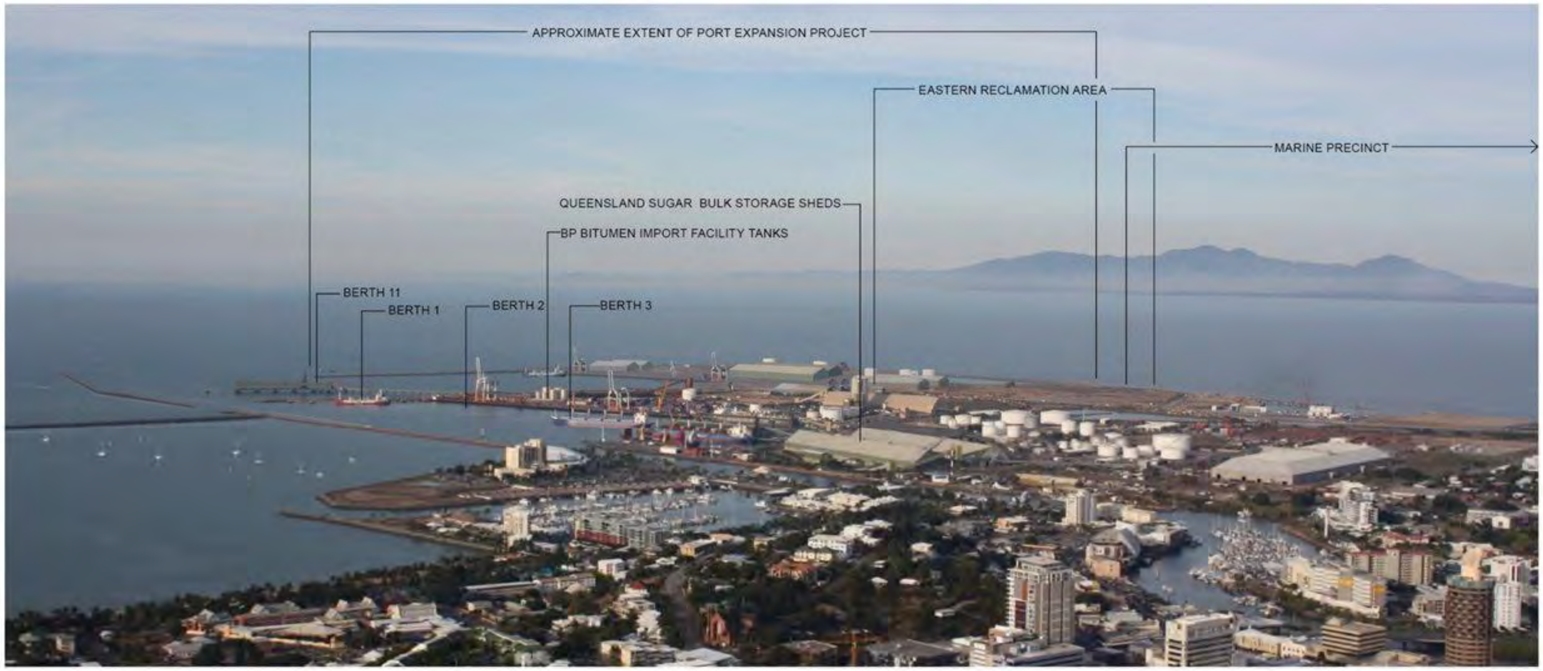
DATA FOR VIEWPOINT 2

VIEW CATEGORY:	**OFF-SITE - LOCAL ATTRACTOR**
LOCATION:	CASTLE HILL LOOKOUT
GRID REFERENCE:	19°15'29.73"S 146°48'19.10"S
ELEVATION:	229 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 4 KM NORTH EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 12: Viewpoint 3 - Castle Hill

Figure B.17.12 Viewpoint 3 – Castle Hill



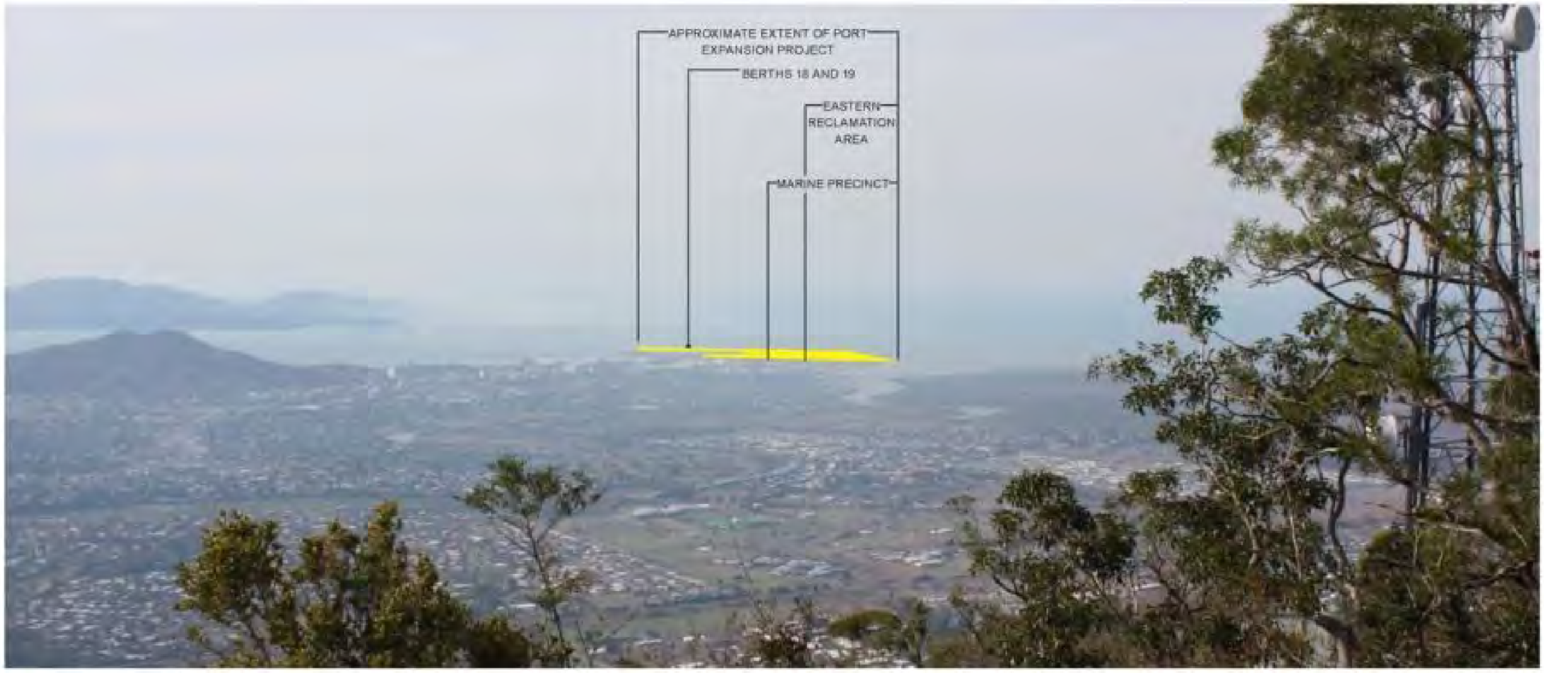
DATA FOR VIEWPOINT 3

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	CASTLE HILL LOOKOUT
GRID REFERENCE:	19°15'29.73"S 146°48'19.10"S
ELEVATION:	229 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 4 KM NORTH EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 13: Viewpoint 3: Photomontage from Castle Hill

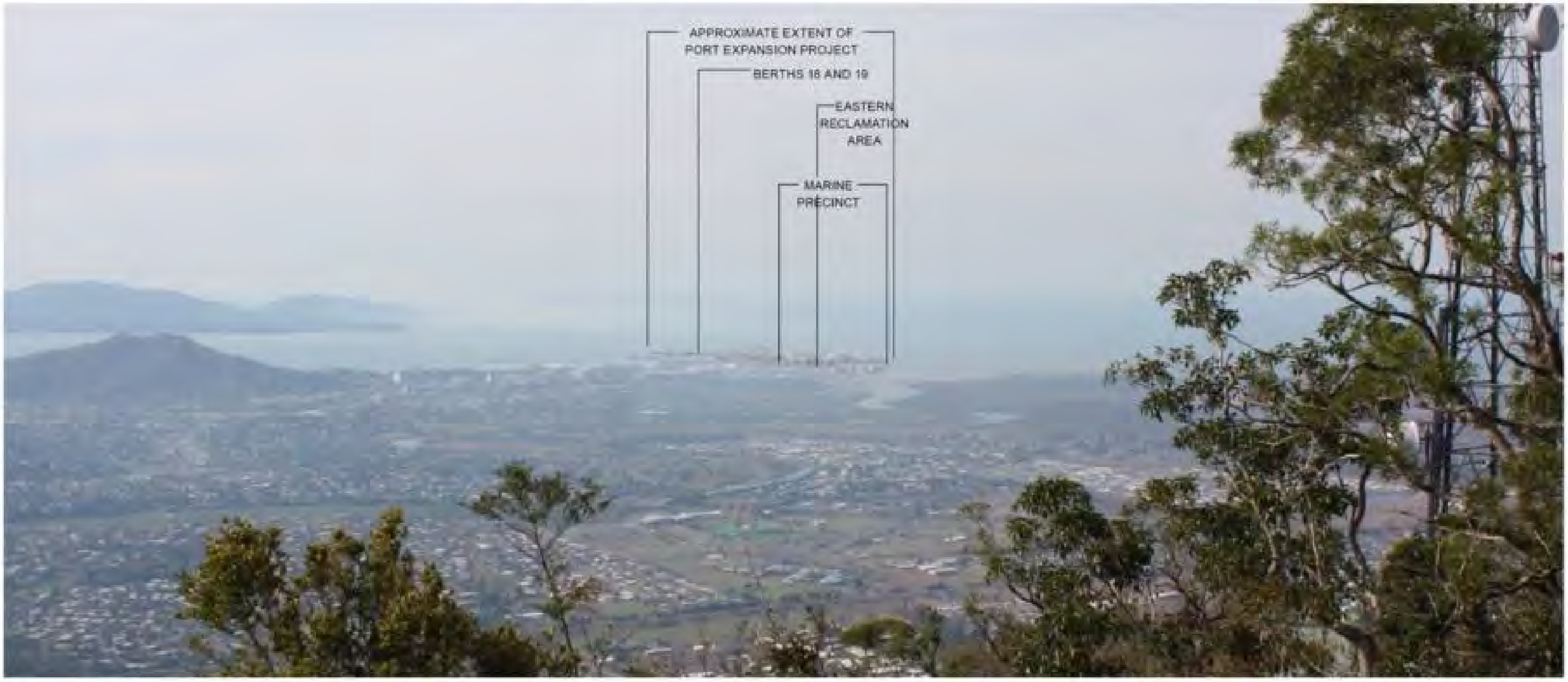
Figure B.17.13 Viewpoint 3 – Photomontage from Castle Hill



VIEW CATEGORY: OFF-SITE - LOCAL ATTRACTOR
LOCATION: MOUNT STUART SCENIC LOOKOUT

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT
Figure 14: Viewpoint 4 - Mount Stuart Scenic Lookout

Figure B.17.14 Viewpoint 4 – Mount Stuart Scenic Lookout



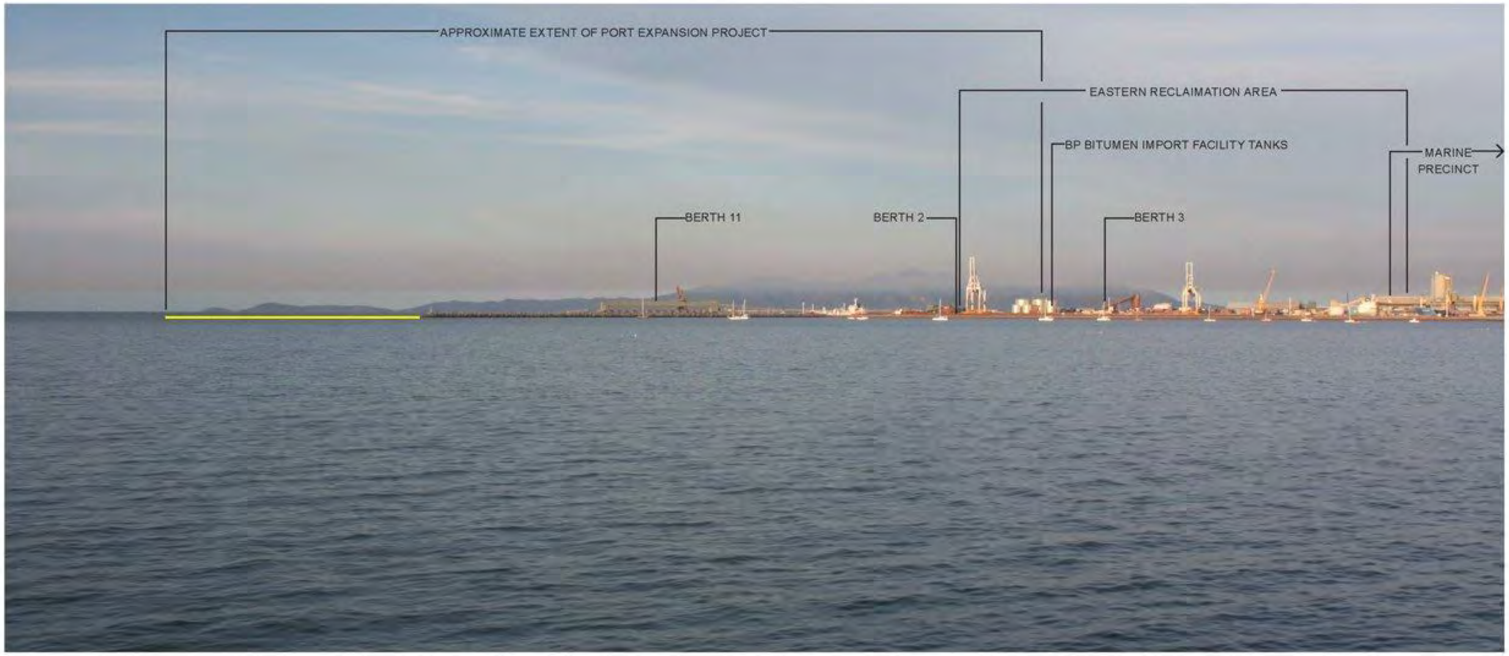
DATA FOR VIEWPOINT 4

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	MOUNT STUART SCENIC LOOKOUT
GRID REFERENCE:	[illegible]
ELEVATION:	[illegible]
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 12 KM NORTH EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 15: Viewpoint 4 - Photomontage from Mount Stuart Scenic Lookout

Figure B.17.15 Viewpoint 4 – Photomontage from Mount Stuart Scenic Lookout



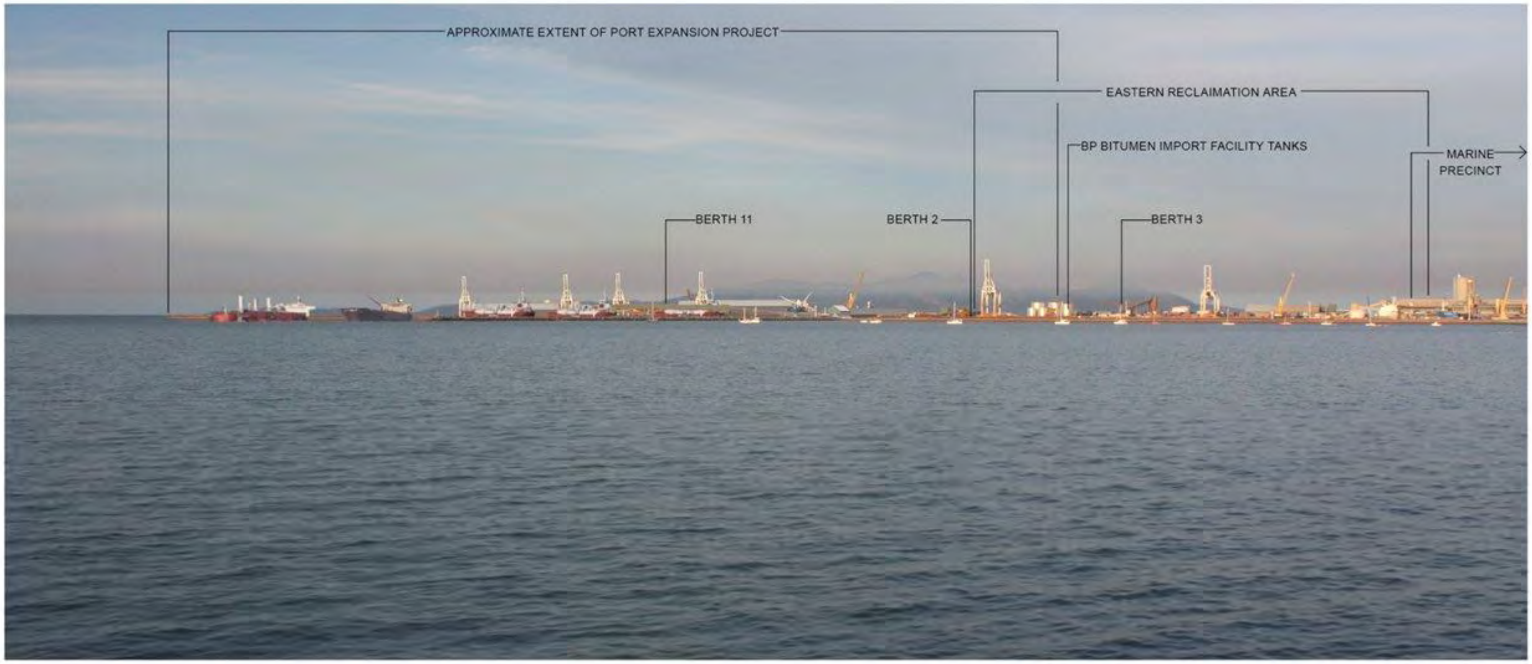
DATA FOR VIEWPOINT 4

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	THE STRAND JETTY
GRID REFERENCE:	19°14'30.52"S 146°48'40.35"E
ELEVATION:	1 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 3.3 KM EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 16: Viewpoint 5 - The Strand Pier

Figure B.17.16 Viewpoint 5 – The Strand Pier



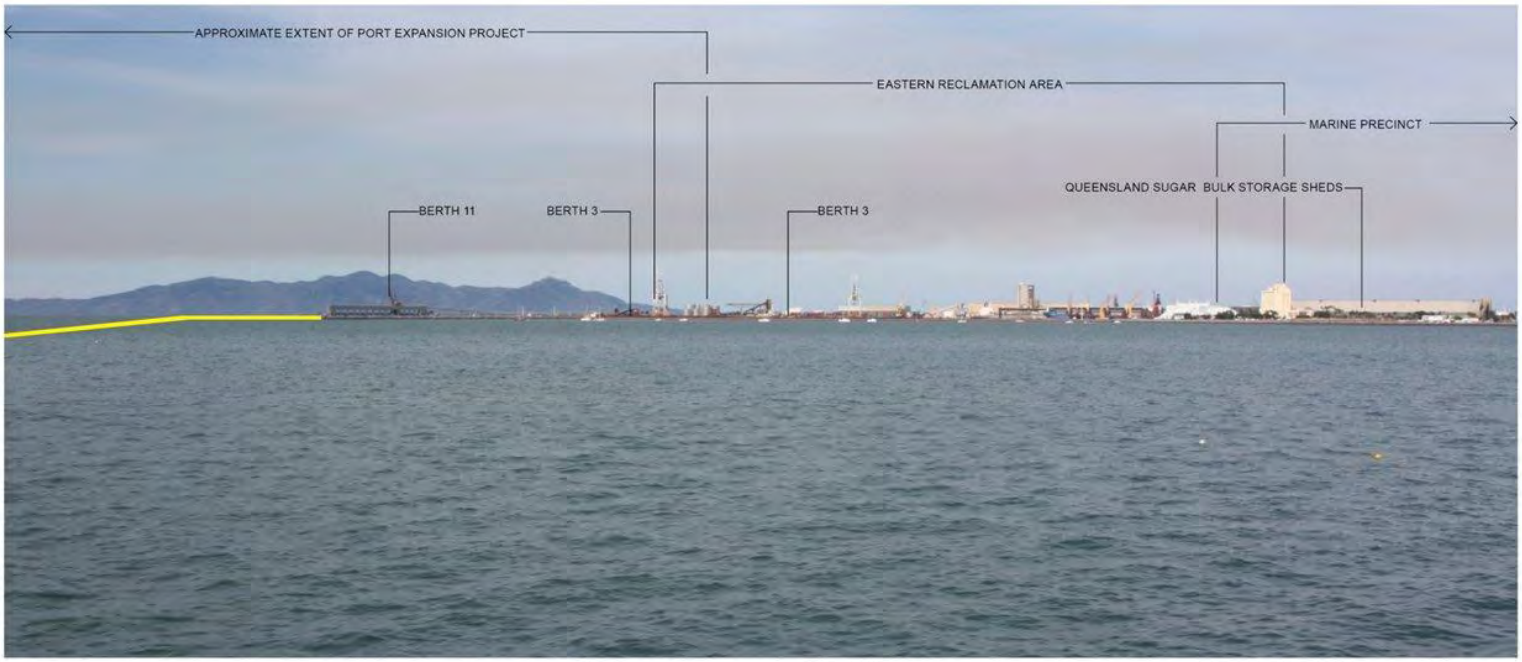
DATA FOR VIEWPOINT 5

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	THE STRAND JETTY
GRID REFERENCE:	19°14'38.52"S 146°48'40.35"E
ELEVATION:	1 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 3.3 KM EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 17: Viewpoint 5 - Photomontage from The Strand Pier

Figure B.17.17 Viewpoint 5 – Photomontage from The Strand Pier



DATA FOR VIEWPOINT 6

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION	KISSING POINT ROCK POOL
GRID REFERENCE	19°14'23.25"S 146°48'26.47"E
ELEVATION	4 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP	APPROXIMATELY 3.6 KM EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 18: Viewpoint 6 - Kissing Point Rock Pool

Figure B.17.18 Viewpoint 6 – Kissing Point Rock Pool

DATA FOR VIEWPOINT 7	
VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	WESTERN BREAKWATER, NEAR ENTERTAINMENT CENTRE
GRID REFERENCE:	19°15'01.16"S 146°49'44.35"E
ELEVATION:	2 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 1.4 KM NORTH EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 19: Viewpoint 7 - Western Breakwater, near Townsville Entertainment Centre

Figure B.17.19 Viewpoint 7 – Western Breakwater, near Townsville Entertainment Centre

DATA FOR VIEWPOINT 8

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	PALLARENDA PARK
GRID REFERENCE:	19°11'56.79"S 146°46'28.10"E
ELEVATION:	4 M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 9 KM NORTH EAST

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 20: Viewpoint 8 - Freemasons Pallarenda Park

Figure B.17.20 Viewpoint 8 – Freemasons Pallarenda Park

DATA FOR VIEWPOINT 9

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	FERRY ROUTE BETWEEN MAGNETIC ISLAND TO TOWNSVILLE
GRID REFERENCE:	[illegible]
ELEVATION:	0 M AHD (SEA LEVEL)
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 3.7 KM SOUTH

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 21: Viewpoint 9 - Passenger ferry route between Townsville and Magnetic Island

Figure B.17.21 Viewpoint 9 – Passenger Ferry Route Between Townsville and Magnetic Island

DATA FOR VIEWPOINT 9

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	FERRY ROUTE BETWEEN MAGNETIC ISLAND TO TOWNSVILLE
GRID REFERENCE:	[illegible]
ELEVATION:	0 M AHD (SEA LEVEL)
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY 5.[illegible] KM SOUTH

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 22: Viewpoint 9 - Photomontage from the passenger ferry route between Townsville and Magnetic Island

Figure B.17.22 Viewpoint 9 – Photomontage from Passenger Ferry Route Between Townsville and Magnetic Island

DATA FOR VIEWPOINT 11

VIEW CATEGORY:	OFF-SITE - LOCAL ATTRACTOR
LOCATION:	NELLY BAY ON MAGNETIC ISLAND
GRID REFERENCE:	[illegible]
ELEVATION:	[illegible] M AHD
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	APPROXIMATELY [illegible] KM SOUTH

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 23: Viewpoint 10 - Nelly Bay on Magnetic Island

Figure B.17.23 Viewpoint 10 – Nelly Bay on Magnetic Island

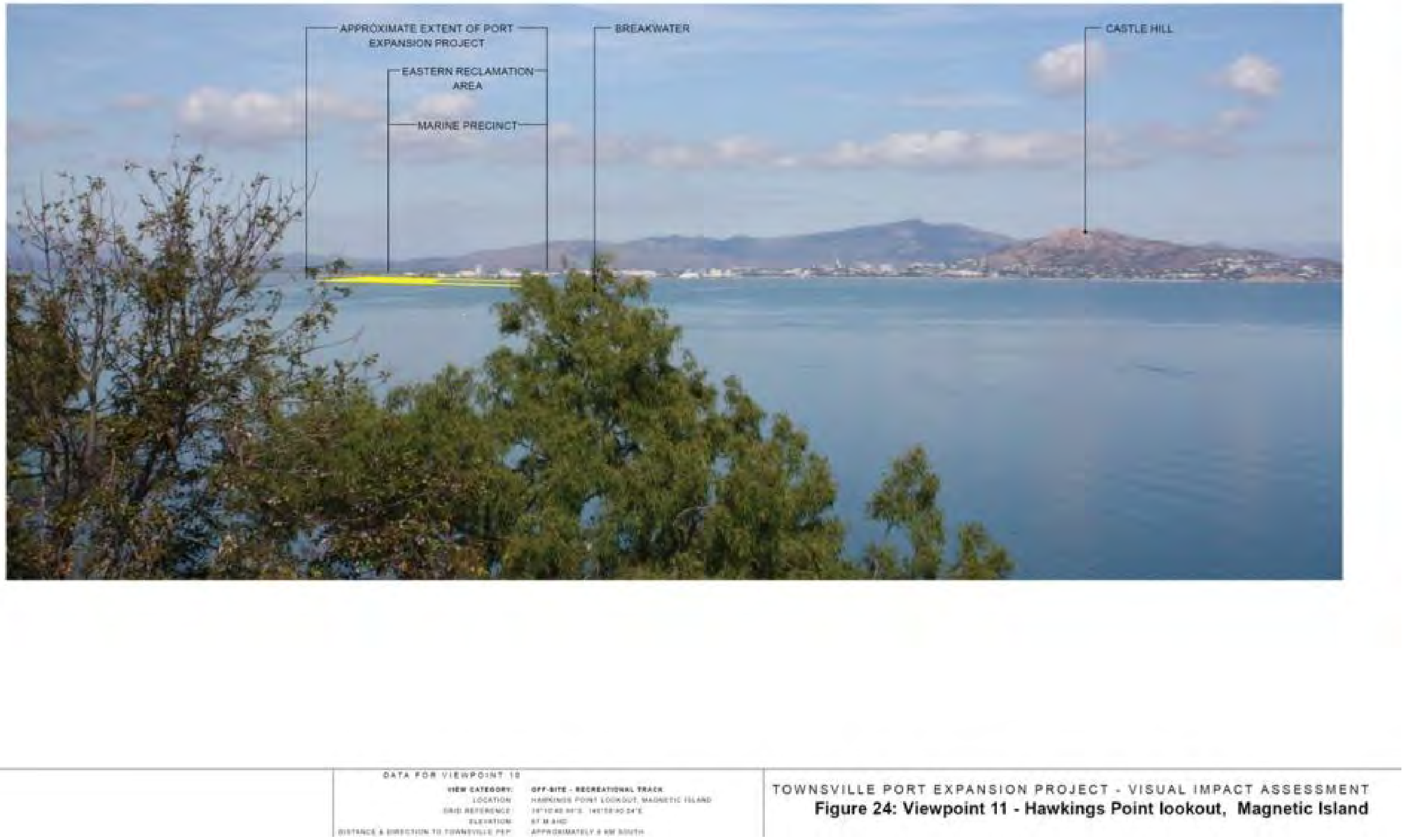
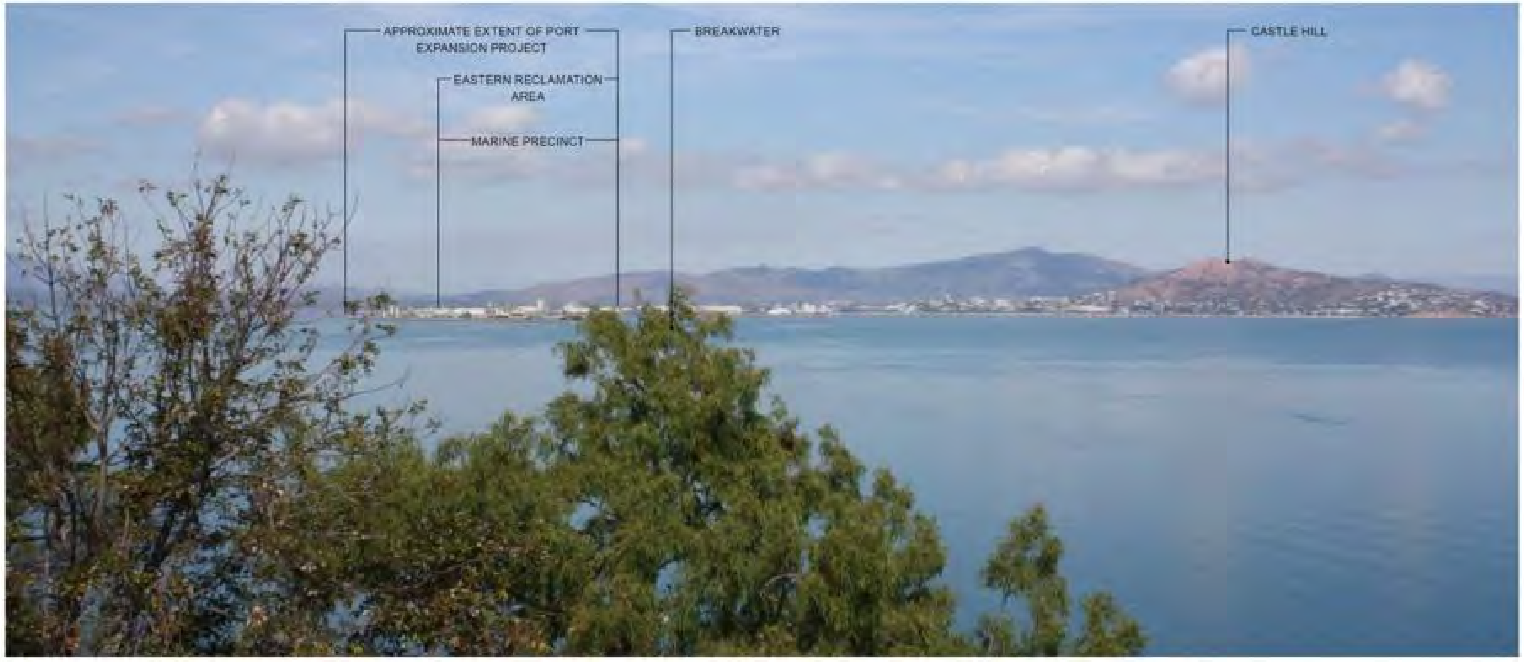


Figure B.17.24 Viewpoint 11 – Hawkings Point Lookout, Magnetic Island



DATA FOR VIEWPOINT 10

VIEW CATEGORY:	OFF-SITE - RECREATIONAL TRACK
LOCATION:	HAWKINGS POINT LOOKOUT, MAGNETIC ISLAND
GRID REFERENCE:	[illegible]
ELEVATION:	[illegible]
DISTANCE & DIRECTION TO TOWNSVILLE PEP:	[illegible]

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 25: Viewpoint 11 - Photomontage from Hawkings Point lookout, Magnetic Island

Figure B.17.25 Viewpoint 11 – Photomontage from Hawkings Point Lookout, Magnetic Island

DATA FOR VIEWPOINT 12

VIEW CATEGORY: OFF-SITE - PEOPLE TRAVELLING TOWARDS THE PORT
LOCATION: NORTHERLY VIEW FROM BENWELL ROAD
GRID REFERENCE: [illegible]
ELEVATION: [illegible]
DISTANCE & DIRECTION TO TOWNSVILLE PEP: APPROXIMATELY 2 KM NORTH

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT

Figure 26: Viewpoint 12 - Northerly view from Benwell Road, south of the future Marina Precinct

Figure B.17.26 Viewpoint 12 – Northerly View from Benwell Road, South of the Future Marine Precinct

DATA FOR VIEWPOINT 13
VIEW CATEGORY:
LOCATION:
GRID REFERENCE:
ELEVATION:
DISTANCE & DIRECTION TO TOWNSVILLE PEP:

TOWNSVILLE PORT EXPANSION PROJECT - VISUAL IMPACT ASSESSMENT
Figure 27: Viewpoint 13 - Representative view from the air

Figure B.17.27 Viewpoint 13 – Representative View from the Air

B.17.4.3 Scenic Amenity Impact Assessment Summary

The anticipated impacts of the Project on scenic amenity during the daytime is summarised in Table B.17.18, based on the thirteen selected representative viewpoints. These viewpoints take into account the existing port facilities and document the anticipated change in impact due to the PEP. Night-time impacts due to lighting are typically of the same level of significance but are more neutral in effect since many viewers will prefer night-time views of port lighting and will access vantage points (such as Castle Hill) to enjoy the view.

Table B.17.18 Summary of Impact of the PEP on Publicly Accessible Viewpoints

Viewpoint	Overall inherent sensitivity	Magnitude of Change	Significance of unmitigated impact
Nearby residence/property			
Viewpoint 1 – The Rocks Guesthouse, Cleveland Terrace, Melton Hill (Figure B.17.10)	Medium	Moderate (noticeable)	Moderate (adverse)
Residents living in Townsville's CBD and outer suburbs			
Viewpoint 2 – Holiday Inn Tower in Townsville CBD (Figure B.17.11)	High	Moderate (noticeable)	Moderate (adverse)
Local attractors			
Viewpoint 3 – Castle Hill (Figure B.17.12 and Figure B.17.13)	High	Moderate (noticeable)	Moderate (adverse)
Viewpoint 4 – Mount Stuart scenic lookout (Figure B.17.14 and Figure B.17.15)	High	Minor (detectable)	Moderate (neutral)
Viewpoint 5 – The Strand Pier (Figure B.17.16 and Figure B.17.17)	Medium	Moderate (noticeable)	Moderate (adverse)
Viewpoint 6 – Kissing Point Rock Pool (Figure B.17.18)	Medium	Moderate (noticeable)	Moderate (adverse)
Viewpoint 7 – Western Breakwater, near Townsville Entertainment Centre (Figure B.17.19)	Medium	High (considerable)	Moderate (adverse)
Viewpoint 8 – Freemasons Pallarenda Park (Figure B.17.20)	Medium	Moderate (noticeable)	Moderate (adverse)
Viewpoint 9 – Passenger ferry route between Townsville and Magnetic Island (Figure B.17.21 and Figure B.17.22)	Medium	Moderate (noticeable)	Moderate (neutral)
Viewpoint 10 – Nelly Bay on Magnetic Island (Figure B.17.23)			
Recreational tracks			
Viewpoint 11 – Hawkings Point lookout, Magnetic Island (Figure B.17.24 and Figure B.17.25)	High	Moderate (noticeable)	Moderate (adverse)
Roads			
Viewpoint 12 – Northerly view from Benwell Road, south of Townsville Marine Precinct (Figure B.17.26)	Medium	Minor (detectable)	Minor (neutral)
Air			
Viewpoint 13 – Representative view from the air (Figure B.17.27)	Medium	Minor (detectable)	Minor (neutral)
People visiting and working at the port			
No viewpoints used to represent views from this receptor group.			

B.17.4.4 Key Landscape Opportunities and Constraints[1]

In summary, the PEP is an extension to the existing operational port at Townsville. The port is located on a flat (partly reclaimed) floodplain between the Ross River and Ross Creek, adjacent to Townsville CBD. The Project would result in the extension of the port boundary approximately 1 km northwards from the

1

mainland, through reclamation of subtidal land, forming a prominent peninsular, similar in form and visual impact, to the current port adjacent to the existing northern breakwater.

Although the bowl shape landscape of Cleveland Bay provides visual containment of the port from the wider landscape through two key headlands (Cape Pallarenda in the north and Cape Cleveland in the south), the activities associated with the PEP during construction and operations are likely to affect several near and distant receptor groups. As illustrated by Table B.17.18 the worst of these impacts are of moderate adverse significance. Receptors include nearby residents and properties, aircraft users, visitors to local attractors, users of recreational tracks, (such as The Strand and Castle Hill), motorists and people visiting and working at the Port of Townsville. Many of the viewpoints selected are representative of more than one receptor group; for example, Castle Hill represents local attraction as well as elevated residential areas of Townsville, while Hawkings Point represents recreational tracks as well as potential views from residential areas on Magnetic Island around Picnic Bay.

It is predicted the PEP would generate moderate, adverse impacts on the scenic qualities of GBRWHA, but only in the local context of Cleveland Bay. The assessment of Viewpoints 5 to 8 (on the mainland), 9 (from the passenger ferry to Magnetic Island) and 10 and 11 (from Magnetic Island) were used to illustrate the impact of the scenic values of the GBRWHA. These viewpoints illustrate that during both the construction and operational phases the greatest impact on views of this landscape would be of moderate significance.

An intensification of night-time light levels associated with the Project is anticipated. Night lighting can be divided into light glow, which is effectively the glow of night lighting off air particles, and light spill, which refers to those areas from which light sources are visible. This increase in night-time light levels is predicted to impact all the views assessed. In all cases, the viewed change is anticipated to be an incremental increase in existing light levels. Given the context of the existing port lighting and because the lit port is often appreciated for its visual qualities (e.g. from Castle Hill), the impacts of lighting on visual character is generally considered to be neutral (of medium to moderate significance). This assessment only considers the qualitative visual impact of lighting on the specific viewpoints assessed. For a detailed quantitative engineering lighting assessment refer to Appendix S2.

The prominent location of the PEP (being at a waterfront peninsular close to the CBD) combined with the functional requirements of port-related activities and infrastructure (i.e. siting and built form/style of buildings and structures to suit their function/purpose, use of regulated materials and colours), means there are limited opportunities to mitigate visual amenity impacts. In particular, the anticipated size of the PEP infrastructure and the requirement to be adjacent to open water allows little opportunity for mitigation measures seeking to ‘screen’ or ‘hide’ the facility through use of landform modification (e.g. mounding, terracing) or screen planting, which are options frequently used to mitigate and integrate industrial projects into their landscape setting. The key focus in the earlier engineering and environmental work sought to reduce the footprint, which would in turn reduce the impact on scenic amenity of the PEP (Chapter A3).

The PEP will be leased to separate entities (currently unknown at this stage), who will develop their own facilities, infrastructure and buildings, to fulfil their needs. Although this limits the capacity to provide detailed mitigation measures using built form or infrastructure at this stage in the process, the mitigation framework set out in Section B.17.5 seeks to prioritise the management of the Project Area character through careful planning, design and ongoing management, in order to reduce the scenic amenity impact.

B.17.5 Mitigation Measures and Residual Impacts

- Avoidance (i.e. prevent the impact occurring) through concept and detailed design (e.g. through site selection and siting of infrastructure).
- Mitigation during construction and operations, including:
  - Mitigation during construction (e.g. management of earthworks).
  - PEP spatial layout, design and amenity (e.g. streetscape design, use of planting, location of car parking, placement of buildings and structures on site). These measures would not reduce the visibility of the Project, but would either aim to integrate the Project into the surrounding landscape, as far as possible or provide measures that would in effect be ‘compensatory’. The

measures would aim to improve the overall values of the local landscape with the intention of making the Project more acceptable to the wider community.

- Built form (i.e. style of built form, use of building materials, finishes and colours for buildings and structures on site).
- Management of lighting and in particular lighting design to reduce light spill from the Project in so far as consistent with existing Operational Health and Safety and land use codes.

These opportunities would need to be consistent with existing controls in local land use plans, codes and guidelines.

The assessment process, particularly the identification of key sources of existing and potential impact on scenic amenity values (Section B.17.4) and relevant legislation and policies (Section B.17.2.1), has highlighted the importance of considering how mitigation measures may be effectively integrated into PEP design, to reduce and manage the impact on views and the scenic amenity in and around Townsville.

The PEP infrastructure will be located on future reclaimed land; mitigation of direct impacts to existing landscape is limited. As a first priority, mitigation associated with protecting the scenic and visual amenity generally seeks to eliminate or reduce the extent of direct adverse impacts through careful siting. There is negligible opportunity to change the siting due to the requirement for the PEP to be located adjacent to the existing port land and open water.

The second priority seeks to ensure sensitive integration through careful design, layout and selection of materials and treatments to manage potential adverse scenic amenity and visual impacts. These measures would not reduce the visibility of the Project, but aim to integrate it into the surrounding landscape (as far as possible); for example, by reducing the reflectivity of the material selected. In addition, compensatory (indirect) measures have been included that aim to improve the interface between the port and adjacent residential areas in South Townsville. These types of measures aim to integrate the Project into the landscape and improve the overall values of the local and immediately adjacent landscape. These works could assist in making the Project more acceptable to the wider community.

The assessment also illustrated how scenic amenity impacts can be reduced for the life of the Project through seeking sustainable management processes to monitor and review the mitigation measures during operation, for example, through ongoing vegetation management to restrict views.

The mitigation measures have been divided into the following sections:

- mitigation during construction
- spatial layout, design and amenity
- built form
- management of lighting.

B.17.5.1 Mitigation During Construction

The practical requirements of port-related construction activities (e.g. breakwater and bund construction, harbour dredging, reclamation works) allow little intervention for the purposes of reducing impacts on scenic amenity; however, the following measures are recommended:

- Management of potential airborne dust related impacts. Key sources of potential impact include the earthworks activities, movement of vehicles across unsealed areas, transport of sand and other spoil, loading and unloading materials, stockpiling sand on reclamation. Potential control measures are detailed in Chapter B9 (Air Quality). From a visual/scenic perspective, measures include:
    - Progressive stabilisation of reclaimed land and reducing disturbed and exposed areas (e.g. access road verges)
    - Dust suppression (e.g. covering truck loads, use water carts or water sprays to dampen disturbed areas, use rumble grids at site exit points to reduce dust on public roads, use of wind-breaks or drift fences around stockpiles).

- Design shore protection and breakwaters to reflect existing forms. Where feasible, re-use existing rock armour from the existing north-eastern revetment.
- Maintain a high standard of site cleanliness and presentation at all times. Use good quality unobtrusive fencing and coordinated signage. Regularly remove and appropriately dispose of rubbish. Investigate the use of billboards on construction fencing in frequently used public areas to explain the Project or for local artwork.

B.17.5.2 Mitigation During Operation

B.17.5.2.1 Spatial Layout, Design and Scenic Amenity

Appropriate landscaping is important for amenity and plays an important role in buffering incompatible uses and activities. It is recognised that the specific infrastructure included in the PEP is dependent on future tenants, and was unknown at the time of the assessment. It is recommended that, through the landscape use plan, guidelines and codes, the tenants of the PEP investigate inclusion of landscape works to improve the overall scenic/visual amenity of their individual sites. While not directly associated with the PEP, there would be a potential benefit to the scenic amenity of the entire port, associated with the provision of landscape works as offsite, compensatory and indirect mitigation to better resolve the interface between the port and adjacent residential areas in South Townsville; for example, along Archer Street. Treatment in the offsite location along this road could follow the character of the Port of Townsville Environmental Park (part of the port's buffer zone, as identified in the *Port of Townsville Land Use Plan 2010*), including recreational and educational areas for members of the public to use. This would assist in providing an 'aesthetically pleasing environment' and reduce the impact of the port's industrial landscape on the scenic amenity of the adjacent residential landscape (POTL, 2010b).

Onsite and offsite opportunities for the PEP to result in a positive spatial layout, design and amenity include:

- Collaborate with those undertaking landscaping works off site (e.g. TCC) to create a coordinated and strategic approach to landscaping across the port and surrounding lands. In particular enhance and strengthen the character of the port entrance; consider a continuation of the informal streetscape planting along the northern section of the primary access road to the port, along Benwell Road, including such species as *Melaleuca leucadendra* (weeping paperbark) and *Lomandra longifolia* (mat rush), as illustrated in Figure B.17.28. Plant species should be locally endemic and native varieties that comply with existing local and POTL land use plans, codes and guidelines, and appropriate to the estuarine and reclaimed environment.
- Where practical, include streetscape planting along internal road reserves (such as Benwell Road, Figure B.17.29) or planting in other areas to improve the visual appearance for people working/visiting the port and people viewing the port from viewpoints such as Castle Hill. There is also an opportunity to consider integration of infiltration swales to capture stormwater runoff and water streetscape planting. To improve the success and visual/aesthetic appearance of planting all works would need to be consistent with existing controls in local land use plans, codes and guidelines.

Figure B.17.28 Existing Streetscape Character of the Southern Part of Benwell Road

Figure B.17.29 Existing Character of a Newly Constructed Internal Port Road

B.17.5.2.2 Built Form

The functional requirements of port-related activities and infrastructure (i.e. siting and built form/style of buildings and structures to suit their function/purpose, use of regulated materials and colours) mean there are limited opportunities to mitigate scenic amenity impacts. In addition, the Project Area will be leased to tenants (currently unknown at this stage), who will develop their own facilities, infrastructure and buildings, to fulfil their needs. This limits the capacity of the built form mitigation at this stage in the process.

Other opportunities include management of the future use of materials for the port facilities and buildings. Principles should be established by POTL to influence proposals in the Project Area; for example, avoiding materials that generate glare by using muted, non-reflective and dull finishes wherever possible, without compromising safety aspects. It is recognised that some storage structures may have to be painted with reflective coatings to comply with operational health and safety requirements.

B.17.5.2.3 Management of Lighting

Lighting will be designed to meet operational health and safety requirements and to reduce light spill from the site. A separate lighting assessment report (Appendix S2) was undertaken and sets out recommendations that include measures to manage the effects of lighting associated with the PEP.

B.17.5.3 Residual Impacts

The residual impact assessment is based on the same method of assessment and the same thirteen representative viewpoints in Sections B.17.2.2 and B.17.4, respectively. In determining the residual impact, the sensitivity of receptors remains the same. The magnitude of change has the potential to decrease, as a result of the proposed mitigation measures. This, in turn, can reduce the significance level of impact.

Proposed mitigation measures relate to small-scale activities such as streetscape planting and selection of colours and materials that seek to blend the built form with predominant background colours. Although this may locally reduce impacts, given the impossibility and inappropriateness of using landform and vegetation to screen any waterfront facilities they are not sufficiently bold enough to change the magnitude category (e.g. from a moderate or noticeable change to a minor or detectable change). Therefore, reduction in the severity of the scenic amenity impact from each viewpoint is not achievable.

B.17.6 Cumulative Impacts

Cumulative impacts may be defined as the additional changes caused by a proposed development in conjunction with other similar scale developments or as the combined effect of a set of developments, taken together. The degree to which cumulative effects occur, or may occur, as a result of more than one large-scale project (such as the PEP) being constructed, are a product of:

- the distance between each proposed development

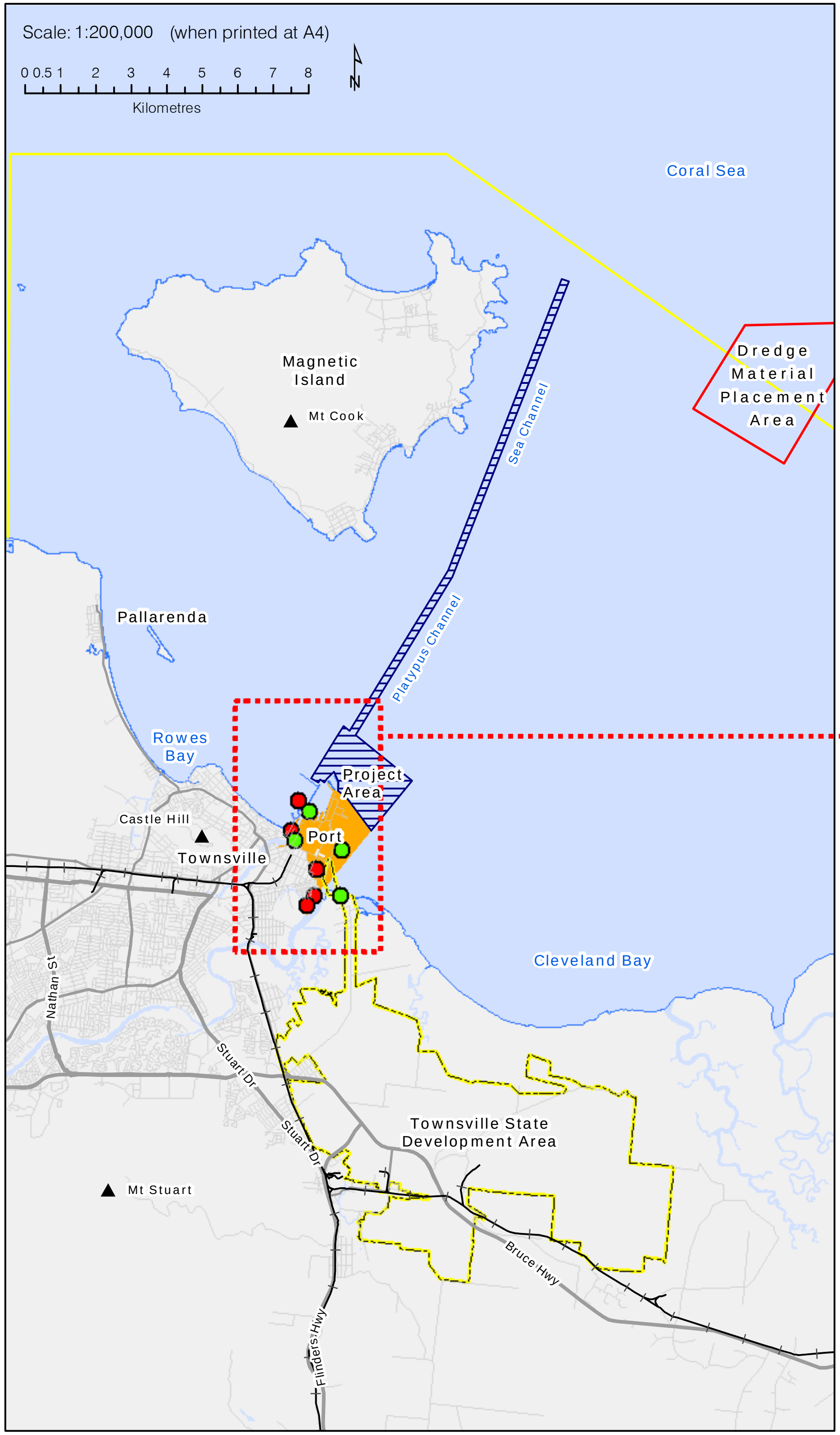
- the interrelationship between their zones of visual influence (i.e. the 'combined visibility' or potential for visibility of one or more developments)
- the overall character of the landscape and its sensitivity to such developments
- the siting of the developments
- the way in which the landscape is experienced.

In light of the Project ZTV, which indicate areas of land where the PEP is likely to be visible (Figure B.17.7); an area of 20 km radius from the Project Area was considered sufficient to recognise potential cumulative impacts on scenic amenity. To understand any key land use changes and proposed projects in this area, a variety of reports and plans have been reviewed:

- *Townsville City-Port Strategic Plan* (DI, 2007a)
- *Port of Townsville Land Use Plan* (POTL, 2010b)
- *Townsville City Plan 2005* and associated maps
- Coordinator-General project maps
- publically available EIS
- Department of Employment, Economic Development and Innovation media releases
- state development areas and schemes
- *Northern Economic Triangle Infrastructure Plan 2007-2012* (DI, 2007).

The *Townsville City-Port Strategic Plan* (DI, 2007a) has been has been developed in consultation with POTL, TCC and other key stakeholders, including the departments of Tourism, Major Events, Small Business and the Commonwealth Games, Transport and Main Roads, and Treasury and Trade. The plan assists with forward strategic planning for POTL and TCC, primarily focusing on the port interface area, and examines the interconnections between the various projects.

The projects have been assessed in Table B.17.19 . The outcome of the assessment determined whether the developments were to be included in the assessment of cumulative impacts. These projects are illustrated on Figure B.17.30.



PORT EXPANSION PROJECT EIS

Cumulative Assessment

Figure B.17.30

Legend

- Prominent Natural Landmarks
- Projects Not Considered in the Cumulative Assessment
- Projects Considered in the Cumulative Assessment
- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_128

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery (insert) - Port of Townsville 2011.
Cumulative Assessment - AECOM 2012.

Table B.17.19 Projects Within a 20 km Radius of the PEP

Proposed Project	Proponent(s)	Location, Distance and Direction from the PEP	Description	Stage/Timing	Considered In The Cumulative Assessment
Townsville Marine Precinct	POTL; previously identified as a key project in the *Townsville City-Port Strategic Plan* (DI, 2007a)	Adjacent to Benwell Road, on the eastern side of the port.	The proposal comprises: ▪ marine industry including a commercial slipway, barge ramp, ship-lift, docking facility and associated marine facilities to support vessel fabrication and maintenance ▪ approximately 50 trawler berths and 2 trawler maintenance berths ▪ potential relocation of the Volunteer Coast Guard office and mooring ▪ potential for private pile moorings.	Approved by the Governor in Council in 2010. Stage 1 has already been constructed and tenanted.	No. Construction of this project was finished during the assessment time. It is considered in the baseline assessment.
Townsville Recreational Boating Park	TCC and the Queensland Government	On the river bank between Fifth and Seventh Avenues, Railway Estate to the south of the port.	An initiative to provide the recreational boating community with a major sheltered all-tide facility. Facilities will include: ▪ four boat ramps each with four lanes (16 lanes in total) and a floating walkway ▪ two pontoons (one DDA compliant) ▪ approximately 360 parking spaces for vehicles with trailers ▪ an overflow car park for use by individual cars ▪ public toilet facilities ▪ security lighting ▪ enhanced green spaces.	EPBC referral has been lodged and construction is anticipated between 2012-2016.	No. No inter-visibility is anticipated given intervening landcover screening views between this Project and PEP.
TSDA	Department of Employment, Economic Development and Innovation (Declared 2003 under the *SDPWO Act*). The TSDA is managed by the *Development Scheme for the Townsville State*	Approximately 3 km south of the PEP.	Future development of the TSDA (approximately 4,900 ha) includes the Stuart Industrial Area and will provide services from industrial projects on the TSDA to the Port of Townsville. The TSDA is likely to result in the transformation of tracts of largely undeveloped floodplain landscape between the Flinders Highway and the coastline into an extensive large-scale, industrial landscape with conservation of open space precincts coinciding with sensitive landscape features, such as the Cleveland Bay coastline, Ross River and Stuart	Approved by the Governor in Council in 2003. The Townsville Port Access Road in the EAC is currently under construction and is due for completion in 2012.	Yes. The TSDA covers an extensive area of currently undeveloped greenfield land. If the construction of the TSDA coincides with the construction of the PEP, cumulative impacts are likely. This is due to the close proximity between the PEP and the TSDA;

Proposed Project	Proponent(s)	Location, Distance and Direction from the PEP	Description	Stage/Timing	Considered In The Cumulative Assessment
	Development Area (adopted in 2010) (DEEDI, 2010)		Creek. Target industries for the TSDA include: ▪ transport and logistics ▪ port-related industry, such as stockpiling and minerals processing ▪ medium and light industry directly linked to transport and port industries.		particularly when viewed from elevated locations such as Castle Hill and Mount Stuart Lookout, where both projects would be visible. The designation of the TSDA indicates acceptance of landscape change - including intensification of industrial landscapes - in the Townsville area at the state government level.
Proposed EAC Rail/Road Infrastructure	Department of Employment, Economic Development and Innovation	Linear corridor linking the TSDA and the port.	A multi-modal corridor providing materials transportation infrastructure (road and rail) and utility services between the TSDA and the port.	The road component of the EAC (Townsville Port Access Road) is currently under construction, due for completion in late 2012.	Yes. Construction of the rail component of the EAC is anticipated to occur during the PEP construction phase. Cumulative impacts are likely. Cumulative impacts on scenic amenity would be experienced from elevated viewpoints such as Castle Hill and Mount Stuart Lookout, where both projects would be visible.
Berth 10 Expansion (B10x)	POTL	The proposed terminal is located on the western embankment of Ross Creek. The proposal is on approximately 80 ha of land presently under tidal water and lying seaward of Jupiters Townsville Hotel and Casino and the entertainment centre.	The extension of Berth 10 in the Port of Townsville provides POTL with the opportunity to position for the future through the creation of two new general cargo berths. The Berth 10 Extension will involve: ▪ reclamation to create land behind the new berths ▪ the diversion of Ross Creek to the west of the new reclamation ▪ new wharf, revetments and breakwater structures	The Coordinator- General has not yet declared the Project to be a 'significant project' under s. 25(1)(a) of the SDPWO Act. It is expected the Project will be declared a significant project and the proponent will be required to prepare an EIS. The EIS process commenced in January	Yes: Given the close proximity of Berth 10 Expansion to the PEP, cumulative scenic amenity impacts are predicted. Cumulative impacts on scenic amenity would be experienced from locations where both projects may be viewed. It is predicted that in nearly

Proposed Project	Proponent(s)	Location, Distance and Direction from the PEP	Description	Stage/Timing	Considered In The Cumulative Assessment
			▪ dredging works to provide deep water access to the new wharf structures ▪ civil works for landside infrastructure.	2012.	all the viewpoints used in this assessment would be visible.
Port Industrial Park (Nexus Port Business Park)	POTL; previously identified as a key project in the *Townsville City-Port Strategic Plan* (DI, 2007a)	Bounded by Benwell Road, Archer Street, Boundary Street, and the Port of Townsville Environmental Park.	Light industry, warehouses and associated offices.	Complete	No. This project has been constructed and forms part of the base case for the assessment.
South Townsville Residential Village	POTL and TCC, as identified in the *Townsville City-Port Strategic Plan* (DI, 2007a)	Located 2.5 km south of the PEP, along the Ross River, on land left vacant by relocation of the marine industries.	Small lot pattern of residential subdivision with marina docks and walkway access alongside the Ross River.	This is a visionary project that relies on the relocation and redevelopment of the present marine industries.	No. This project has not been progressed since the release of the *Townsville City-Port Strategic Plan*.
Ross Creek East Transport and Commercial Precinct	POTL and TCC, as identified in the *Townsville City-Port Strategic Plan* (DI, 2007a) and the *Port Development Plan 2010-2040* (POTL, 2010a)	Located approximately 1.7 km south-west of the PEP, along the eastern side of Ross Creek.	Redevelopment of waterfront lands in Ross Creek East as industrial and commercial marine activities are relocated and consolidated in a new facility in Ross River.	The *Port Development Plan 2010-2040* (POTL, 2010a) indicates that development would take place between 2011 and 2016.	Yes. This project is currently being progressed and may be viewed simultaneously with PEP particularly from elevated locations such as Castle Hill and Mount Stuart.
Ross Creek West Tourism and Commercial Precinct	POTL and TCC, as identified in the *Townsville City-Port Strategic Plan* (DI, 2007a) and the *Port Development Plan 2010-2040* (POTL, 2010a)	Located approximately 1.8 km south-west of the PEP, along the western side of Ross Creek, near Jupiters Townsville Hotel and Casino and the entertainment centre.	New tourist and office accommodation, charter boat facilities, pedestrian promenade and a café strip.	This is a visionary project that relies on the relocation and redevelopment of the present ferry terminal and associated parking area, as well as the realignment of Sir Leslie Thiess Drive. The *Port Development Plan 2010-2040* (POTL, 2010a) indicates that development would take place between 2012 and 2017.	No. This project has not been progressed since the release of the *Townsville City-Port Strategic Plan*.

B.17.7 Assessment Summary

B.17.7.1 Risk Summary

This section provides a summary of the risk assessment of the PEP influence on scenic amenity. The assessment has assigned levels of likelihood and consequence in accordance with Table B.17.20, Table B.17.21 and Table B.17.22.

The likelihood (Table B.17.20) and consequence (Table B.17.21) ratings have been combined to create a risk level for the PEP using the matrix structure shown in Table B.17.22. To ensure the worst-case scenario has been identified for each event, the likelihood of each event occurring has been assumed 'likely' (i.e. the likelihood that the PEP will go ahead and influence the scenic amenity). The potential impacts to scenic amenity for the thirteen viewpoints are summarised in Table B.17.23 and are based on a judgement on the effectiveness on the mitigation in reducing the severity of the impact and associated risk. As discussed in Section B.17.5, the mitigation measures are not capable of substantially reducing the magnitude of change; therefore, the residual scenic amenity impact or consequence from each viewpoint has not been reduced. Accordingly, Viewpoints 1 to 11 are considered to have a medium risk.

Table B.17.20 Event Likelihood Guide

Ref	Descriptor	Description
1	Highly unlikely/rare	The event occurs only in exceptional circumstances
2	Unlikely	The event could occur but not expected
3	Possible	The event could occur
4	Likely	The event will probably occur in most circumstances

Table B.17.21 Event Consequence Guide

Ref	Descriptor	Description
1	Negligible	Change that is barely visible, at a very long distance, or visible for a very short duration, and/or is expected to blend with the existing view.
2	Minor	Minor changes experienced by a small number of receptors at long distances or visible for a short duration, and/or are expected to blend in with the existing view to a moderate extent.
3	Moderate	Clearly perceptible changes experienced by a medium number of receptors with an interest in their environment, resulting in either a distinct new element in a significant part of the view, or a less concentrated change.
4	High	Major changes experienced by a large number of receptors or those with proprietary interest in their environment, affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of view.

Table B.17.22 Likelihood and Consequence Risk Matrix – Scenic Amenity

		Magnitude (Consequence)				
		Negligible	Minor	Moderate	High	Very High
Likelihood	Highly unlikely/rare	Negligible	Negligible	Low	Medium	High
	Unlikely	Negligible	Low	Low	Medium	High
	Possible	Negligible	Low	Medium	Medium	High
	Likely	Low	Medium	Medium	High	Critical
	Almost certain	Low	Medium	High	Critical	Critical

Table B.17.23 Impact Assessment Summary – Scenic Amenity

Risk Type	Risk Descriptions	Summary of Key Mitigations	Risk Allocation			Residual Risk		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Residual Risk
Nearby residence/ property	Viewpoint 1 (Rocks Guesthouse) represents views from receptors of medium sensitivity, including residents and visitors to Cleveland Terrace in Melton Hill, near to the Rocks Guesthouse. The existing activities and infrastructure associated with the port are visible from this point. The PEP would further influence this view throughout the construction and operational phases, resulting in a moderate scenic amenity impact or consequence overall.	Although the mitigation measures recommended for the PEP spatial layout, design, amenity and built form (Section B.17.5) would help to integrate the PEP into the local landscape, there is little opportunity to noticeably reduce impact on scenic amenity or consequence of the PEP.	4	3	Medium	4	3	Medium
Residents living in Townsville CBD and outer suburbs	Elevated views of construction and eventual operational activities from Yarrawonga are anticipated to be similar to those obtained from Castle Hill (Viewpoint 3) and accommodation towers in the Townsville CBD (Viewpoint 2). Views are anticipated through coastline vegetation from properties along Cleveland Bay coastline. This would result in a moderate scenic amenity impact or consequence overall,	As above	4	3	Medium	4	3	Medium
Local attractors	Viewpoint 3 (Castle Hill) represents views from a key vantage point in Townsville, including receptors of high sensitivity visiting Castle Hill. From this point, the port and Project Area is entirely visible. Although the PEP would result in a clear new element in the view, it would be viewed in context with the existing port activities and infrastructure and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium
	Viewpoint 4 (Mount Stuart) represents views from a popular scenic lookout approximately 10 km south-west of Townsville, including receptors of high sensitivity visiting the summit. Although the PEP would be recognisable or detectable over a distant and restricted area of the viewshed from this point, it would be seen in context with the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium
	Viewpoint 5 (The Strand) represents views from a popular vantage point and place for passive recreation along the Townsville foreshore, including receptors of a medium	As above	4	3	Medium	4	3	Medium

Risk Type	Risk Descriptions	Summary of Key Mitigations	Risk Allocation			Residual Risk		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Residual Risk
	sensitivity visiting The Strand Pier. Although the PEP would be visible from this point beyond the existing Berth 11, it would be seen in the context of the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.							
	Viewpoint 6 (Kissing Point) represents views from a popular place for recreation along the Townsville foreshore, including receptors of a medium sensitivity visiting the Kissing Point Rock Pool. Although the PEP would be visible from this point beyond the existing Berth 11, it would be seen in the context of the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium
	Viewpoint 7 (Western Breakwater) represents views from a popular location along the Townsville foreshore, including tourists and visitors to Townsville Entertainment Centre and the western breakwater. This viewpoint offers panoramic views to the port and across Cleveland Bay to Magnetic Island. Although the PEP would further influence this view throughout the construction and operational phases, it would be seen in the context of the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium
	Viewpoint 8 (Freemasons Pallarenda Park) represents north-easterly views from a foreshore parkland located adjacent to the Townsville suburb of Pallarenda. The port is approximately 5 km in direct distance to the north-east of this viewpoint and is entirely visible. Although the PEP would be visible from this point beyond the existing Berth 11, it would be seen in the context of the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium
	Viewpoint 9 represents southerly views from the passenger ferry route between Townsville and the Nelly Bay Marina at Magnetic Island; a primary public transport corridor for both residents and domestic and international tourists. From this point, the port is entirely visible in the context of Townsville city and the surrounding mountain ranges. Although the PEP would be entirely visible in the middle ground of this view (in front of Berth 11), it would be seen in the context of the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium

Risk Type	Risk Descriptions	Summary of Key Mitigations	Risk Allocation			Residual Risk		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Residual Risk
	Viewpoint 10 (Nelly Bay) represents views from the ferry terminal at Nelly Bay on Magnetic Island. The terminal represents the entry point to Magnetic Island for both residents and domestic and international tourists. The viewpoint provides panoramic views across Cleveland Bay to Townsville (including the port) against its mountainous setting. Although the PEP would result in a clear new element in the view (visible in front of Berth 11), it would be seen in the context of the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium
Recreational tracks	Viewpoint 11 (Hawkings Point) represents views from a key vantage point identified in the Magnetic Island National Park walking track map. This lookout offers panoramic views across Cleveland Bay to Townsville (including the port) against its mountainous setting. Although the PEP would result in a clear new element in the view (visible in front of Berth 11), it would be seen in the context of the existing port activities and infrastructure, and would only result in a moderate scenic amenity impact or consequence overall.	As above	4	3	Medium	4	3	Medium
Roads	Viewpoint 12 (Benwell Road) represents views from the entrance road to the Port of Townsville. It has been used to demonstrate the location of the Project Area, in context to the existing port (particularly the Eastern Reclamation Area) and Townsville Marine Precinct. The existing activities and infrastructure associated with the port (particularly the BHP Billiton Cannington and Incitec Pivot fertiliser storage and handling facilities) combined with the future development of the Eastern Reclamation Area and Townsville Marine Precinct would largely block views to the construction and operation of the PEP. The PEP would only result in a moderate scenic amenity impact or consequence overall.	As above	4	2	Medium	4	2	Medium
Air	Viewpoint 13 represents views for users in both commercial aircraft and private aircraft. From the air, the Project Area is entirely visible. Although the PEP would be entirely visible in these views it would be seen in the context of the existing port activities and infrastructure, and would only result in a minor scenic amenity impact or consequence overall.	As above	4	2	Medium	4	2	Medium

B.17.7.2 Compliance with the Queensland Coastal Plan

The findings of the SPP 3/11 Guideline Annex 4 are illustrated in Table B.17.24.

Table B.17.24 Coastal Plan Assessment Summary

Viewpoint	Pre-change SPR	Post-change SPR	Significant Change[1]
Viewpoint 1	2.9	Not applicable as pre-change SPR was less than 5.	N/A
Viewpoint 3	2.5	Not applicable as pre-change SPR was less than 5.	N/A
Viewpoint 9	7.9	7.8	Yes
Acceptability criteria	The change was not significant as none of three images assessed was rated as a 'significant change'		

Annex 4 states 'The change is statistically significant if the assessment of two of three (2/3) or three of three (3/3) of the photos result in a significant change'. The assessment of the three photographs illustrated the visual change was not significant, as none of three images assessed was rated as a 'significant change'.

The Project complies with Queensland Coastal Plan, as an acceptable level of scenic preference change was determined through the assessment of the three photographs.

B.17.7.3 Assessment Summary

The Project will result in the extension of the existing port boundary approximately 1 km northwards from the mainland, through reclamation of subtidal land, forming a prominent peninsular.

The bowl shape landscape of Cleveland Bay provides visual containment of the port from the wider landscape through two key headlands (Cape Pallarenda in the north and Cape Cleveland in the south). However, the activities associated with the PEP during its construction and operations are likely to affect several near and distance receptor groups and the scenic values of the GBRWHA designation. These receptor groups are likely to include residents and properties, visitors to local attractors, roads and recreational tracks, such as The Strand and Castle Hill, and people visiting and working at the port.

Thirteen representative viewpoints were used to assess the likely scenic amenity impact of the Project on such receptors. Key activities during the construction and operational phases that are anticipated to affect these receptors include:

- an increase in the transit of light vehicles carrying workforce and visitors between places of accommodation in Townsville and the port on a daily basis
- some increased movement of heavy vehicles, although the completion of the Townsville Port Access Road in the EAC will considerably alleviate the scenic amenity impact of traffic on the local road network
- activities occurring during the construction of the PEP (e.g. the breakwater and bund construction, harbour dredging, reclamation works, bulk earthworks and ground treatment, civil works, and installation of wharf structures) would be visible from each of the thirteen representative viewpoints; including potential visibility of temporary potential turbid plumes in Cleveland Bay during rock dumping and dredging activities
- operational impacts of the Project would also be perceived from each of the thirteen representative viewpoints, including the presence of container handling gantry cranes, vessel berths, shiploaders and unloaders, cargo operations zone, materials and cargo storage area, internal access roads, rail loop, dredge pond and the movement of Panamax sized bulk ships across the bay.

As the PEP activities would be seen in the context of the existing port activities and infrastructure, the associated impact to the thirteen representative viewpoints would only be a moderate, or in the case of Viewpoints 12 and 13, a minor impact. This moderate (worst-case) long-term change in visual character associated with the PEP in addition to the existing port activities during operations is illustrated in the photomontages (Figure B.17.13 and Figure B.17.15). The character of the view experienced from affected viewpoints would not change; there would be an intensification of port infrastructure, but no uncharacteristic new elements would be introduced.

Most views were assessed to experience an adverse change. The three views assessed as a neutral change were those at a longer distance, where (in most cases) the Project would be viewed against an existing industrial landscape backdrop.

The most important designated landscape in the Study Area is the GBRWHA and both the construction and operational activities of the PEP are predicted to impact on the scenic values of views of the GBRWHA and GBRMP. As discussed above, the shape of Cleveland Bay combined with the two key headlands of Cape Pallarenda and Cape Cleveland and Magnetic Island contains, or limits, the scenic amenity impacts on the wider area of the GBRWHA and GBRMP. Given the construction and operational activities associated with the Project would be viewed in the context of a broader existing industrial area, this area of the GBRWHA is already undermined by the existing industrial development, which consequently lowers the magnitude of change. The port was constructed in 1864 and has been progressively expanded since that time. It was a well established port at the time the world heritage area was declared in 1981. In addition, only a small area of this designated landscape would be affected and the broader scenic values of the GBRWHA would be maintained beyond Cleveland Bay. Considering the above, and as illustrated in all of the views in the representative viewpoint assessment across the GBRWHA, both the construction and operational phases will cause, at greatest, an impact of moderate significance on the scenic values of the GBRWHA.

Views from the air are considered in Viewpoints 3, 4 and 13. Receptors experiencing longer distance views from aircraft would scarcely be able to discern the PEP in the context of existing industrial and urban development, as illustrated in Viewpoint 4 from Mount Stuart. In closer distance views (Viewpoint 13) all activities associated with the port may be visible. They would be seen in the context of the existing port activities, which lowers the magnitude of change and subsequent significance of impact to minor.

An assessment of the visual impact of lighting was undertaken through the representative viewpoint assessment. This was a qualitative assessment. For a detailed quantitative engineering lighting assessment refer to Appendix S2. It is predicted that there would be an intensification of night-time light levels in close proximity to the Project. Night lighting can be divided into light glow, which is effectively the glow of night lighting off air particles, and light spill, which refers to those areas from which light sources are visible. This increase in night-time light levels is predicted to impact all the views assessed. In all cases the viewed change is anticipated to be an incremental increase in existing light levels of neutral effect due to the existing lit context and because many receptors are anticipated to like views of the port at night.

The prominent location of the PEP (being at a waterfront peninsular close to the Townsville CBD) combined with the functional requirements of port-related activities and infrastructure (i.e. siting and built form/style of buildings and structures to suit their function/purpose, use of regulated materials and colours) means there are limited opportunities to mitigate the anticipated scenic amenity impact on key receptors. Nonetheless, the mitigation framework (Section B.17.5) seeks to prioritise the management of the Project Area character through careful planning, design and ongoing management in order to reduce the impact on scenic amenity.

The cumulative impact assessment judged that, out of the nine projects reviewed in the assessment, four would potentially result in cumulative visual impacts. These projects were the TSDA (including the rail component construction of which is anticipated to coincide with the PEP), Berth 10 Expansion (B10X), the Eastern Access Corridor, and Ross Creek East Transport and Commercial Precinct. This is due to the close proximity of the PEP and the four projects. When viewed from elevated locations such as Castle Hill and Mount Stuart Lookout, the PEP would be viewed simultaneously with these projects. Impacts for each project would be mitigated through the separate development assessments and approvals.

Port Expansion Project EIS

Part B

Chapter B18 – Port Operations

AECOM BMT WBM

B.18 Port Operations

B.18.1 Relevance of the Project to Port Operations and its Activities

This section identifies the potential impacts of the Port Expansion Project (PEP) on port operations and discusses measures to manage them. These measures will be addressed by Port of Townsville Limited (POTL) in conjunction with other relevant stakeholders. The focus is on shipping operations. The above-wharf development of cargo handling facilities will be by POTL's as yet unidentified tenants, who will eventually lease port land and berth facilities, and will construct their own operating infrastructure as and when they take up their leases. The necessary planning and operating assessments and approvals will be independently undertaken by those tenants at the appropriate time.

The assessment of landside transport operations is included in Section B14.

The Maritime Operations Management Plan (Section C2.4) gives a comprehensive account of the mitigation measures required to manage potential impacts on the environment, vessel safety and operational efficiency of the port.

The PEP layout and infrastructure requirements arose from the *Port of Townsville Master Plan* (Maunsell AECOM, 2007), which recommended that future port expansion take the form of a new facility to be constructed seaward of the existing northern breakwater. The development of that concept, put forward in the Master Plan, was based on the following strategy elements:

- provide, in a staged manner, development of vessel berths to meet the forecast trade for Port of Townsville
- include provision for future changes in shipping fleet/vessel types
- maximise the beneficial re-use of dredged material to achieve environmental and economic imperatives
- maintain flexibility in the timing of staged dredging and reclamation to allow future development to respond to trade growth
- to the extent possible, ensure that future development of the port beyond the 40 year planning horizon will not be compromised by inappropriate development in the short term.

Using these principles, the development concept was furthered in the *Townsville Port Expansion Project Preliminary Engineering and Environment Study* (AECOM, 2009).

The PEP has evolved from comprehensive master planning in the port and surrounds, involving a number of planning processes with key stakeholders. Consideration has been given to the supply chain activities and planning of land transport systems. The PEP design recognises existing port infrastructure and future port activities, and seeks to integrate the development of port components to achieve an optimum path of development. The design considered the cumulative spatial and capacity planning requirements of cargo handling facilities, road, rail and shipping in relation to:

- existing port facilities
- projects under construction and being planned at the time of preparing the EIS
- PEP development

The operations that will result from the PEP will be conducted using the same road and rail networks and shipping channels as the existing port and other developments that are being planned by POTL. As such the PEP planning and design was integrated with the broader port operations.

POTL, as the port authority, will be responsible for developing and managing the PEP. The operational framework will be a progressive expansion of existing port infrastructure and operations under the same management structure. Other key stakeholders that will play a role in the development of infrastructure and the management of operations are:

- port tenants who will develop and conduct cargo handling operations
- Maritime Safety Queensland (MSQ) and the Regional Harbour Master who are the authority responsible for navigation in the Port of Townsville
- Queensland Rail as the authority responsible for the rail network and managing rail operations

- Department of Transport and Main Roads as the authority responsible for the state controlled roads leading into the Port, plus Townsville City Council as the authority responsible for local roads leading in to the Port.

B.18.2 Assessment Framework and Statutory Policies

The port operations will be conducted under a range of Commonwealth and state government legislation.

B.18.2.1 Commonwealth

The key Commonwealth legislation that have been identified as relevant to port operations (and its planning and development) of facilities (including Acts implementing relevant international conventions) include:

- *Maritime Transport and Offshore Facilities Security Act 2003* and *Regulations 2003*
- *Navigation Act 1912*
- *Ship Registration Act 1981*
- *Australian Maritime Safety Authority Act 1990*
- *Environment Protection (Sea Dumping) Act 1981* and *Regulations 1983*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*
- *Great Barrier Reef Marine Park Act 1975* and *Regulations 1983*
- *Quarantine Act 1908.*

In addition, a number of international conventions agreed by the Commonwealth that apply to the management of shipping in Australian waters. These include:

- International Convention for the Prevention of Pollution from Ships (IMO, 2011)
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (IMO, 1972)
- International Convention on Oil Pollution Preparedness, Response and Cooperation 1990 (IMO, 1990)
- Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances 2000 (IMO, 2007)
- International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001 (IMO, 2001)
- International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 (IMO, 2004).

Commonwealth plans and guidelines also to be considered include:

- *Australian Ballast Water Management Requirements Version 5, 2011* (DAFF, 2011)
- *National Biofouling Management Guidelines for Commercial Vessels, 2009* (Commonwealth of Australia, 2009)
- *Australian Marine Pest Monitoring Guidelines Version 2.0 2010* (DAFF, 2010a)
- *Australian Marine Pest Monitoring Manual Version 2.0* (DAFF, 2010b)
- *National Plan to Combat Pollution of the Sea by Oil and Other Hazardous and Noxious Substances* (AMSA, 2010a).

B.18.2.2 State Legislation

The following state legislation has been identified as directly relevant to port operations and development of associated facilities:

- *Transport Operations (Marine Safety) Act 1994* and *Regulations 2004*
- *Transport Operations (Marine Pollution) Act 1995* and *Regulations 2008*
- *Transport Infrastructure Act 1994*
- *Sustainable Planning Act 2009* and *Regulations 2009*

- *Coastal Protection and Management Act 1995*
- *Environmental Protection Act 1994.*

B.18.2.3 Townsville Port Procedures

MSQ is the pre-eminent management authority for maritime and vessel safety in Queensland. MSQ publishes port procedures (*Port Procedures and Information for Shipping – Port of Townsville*) (DTMR, 2012) designed to complement the requirements of regulations, codes and the procedures of:

- Port of Townsville Limited
- Townsville City Council
- Australian Maritime Safety Authority
- Australian Customs Service
- Commonwealth Department of Agriculture, Fisheries and Forestry
- Royal Australian Navy.

The mandatory port procedures ensure marine safety as they relate to ship movements in the jurisdiction of the Townsville Regional Harbour Master, by whom they are regularly reviewed.

The *Transport Operations (Marine Safety) Act 1994* enables the Regional Harbour Master to give general directions to ship owners, ship masters, ships, other persons or matters for purposes of ensuring the safety, effectiveness and efficiency of the Queensland maritime industry.

B.18.2.4 Maritime Safety Queensland Guidelines for Major Development Proposals

To assist proponents of major development proposals to identify maritime related impacts and to define mitigation strategies, MSQ has developed guidelines for major development proposals. The guidelines specify the minimum information required by MSQ to evaluate significant development proposals. The preferred format for presentation of this information is through the development of management plans for:

- vessel traffic management
- aids to navigation
- ship-sourced pollution prevention.

These guidelines have been accounted for in the vessel management planning in this chapter, as well as the environmental management plans developed for the EIS.

MSQ and the Regional Harbour Master were consulted during the preparation of the EIS to discuss the specific requirements of these guidelines in relation to the PEP.

B.18.2.5 Other Regulations, Codes and Guidelines

The following are also applicable to the vessel operations:

- International Maritime Organisation regulations
- International Maritime Dangerous Goods Code
- AS3846-2005 Handling and transport of dangerous cargoes in port areas (Standards Australia, 2005a)
- International Ship and Port Facility Security Code
- PIANC guidelines for navigation
- International Association of Marine Aids to Navigation and Lighthouse Authorities guidelines (IALA-AISM, 2011)
- POTL emergency management plans (POTL, 2008b)
- Queensland Coastal Contingency Action Plan (DTMR, 2011b)
- First-strike Oil Spill Response Plan – Port of Townsville (A supplement to the Queensland Coastal Contingency Action Plan) (DTMR, 2011a)
- MSQ Standard Operating Procedures for Oil Spill Response (MSQ, 2011a)

- Oil Pollution First-strike Response Deed for the Port of Townsville (MSQ, 2011b).

B.18.3 Existing Values, Uses and Characteristics

This section discusses the existing features of the Port of Townsville operations and the key changes to the operations by the PEP.

B.18.3.1 Existing Navigational Arrangements

POTL and the Regional Harbour Master have the joint responsibility for managing the safe and efficient operation of the existing commercial port. The Regional Harbour Master is appointed by MSQ, a state government agency attached to Department of Transport and Main Roads. Shipping legislation in Queensland is controlled by MSQ.

Under the *Transport Operations (Maritime Safety) Act 1994*, the Regional Harbour Master is responsible for:

- improving maritime safety for shipping and small craft through regulation and education
- minimising vessel sourced waste and providing response to marine pollution
- providing essential maritime services such as pilots and aids to navigation
- encouraging and supporting innovation in the maritime industry

As such, the Regional Harbour Master is the key authority on navigation matters in the port. POTL supports the Regional Harbour Master in its function.

The *Port Procedures and Information for Shipping – Port of Townsville* provides important navigation information of the port and ship operations. It also describes the mandatory requirements for vessels operating in the port.

Ships using the port are typically up to Handymax (55,000 DWT (dead weight tonnes)) in size. The port can accept vessels of Panamax size (beam 32.3 m) subject to the vessel maintaining a minimum 1.3 m underkeel clearance. The channel depth varies according to maintenance dredging campaigns and a declared depth of –11.7 m CD (chart datum) is typically available.

Vessels berth in an enclosed breakwater protected harbour (other than Berth 11) and arrive via the Platypus and Sea channel system, which currently has an overall length of 13.9 km. There are currently no capacity issues with the operation of the existing channel system.

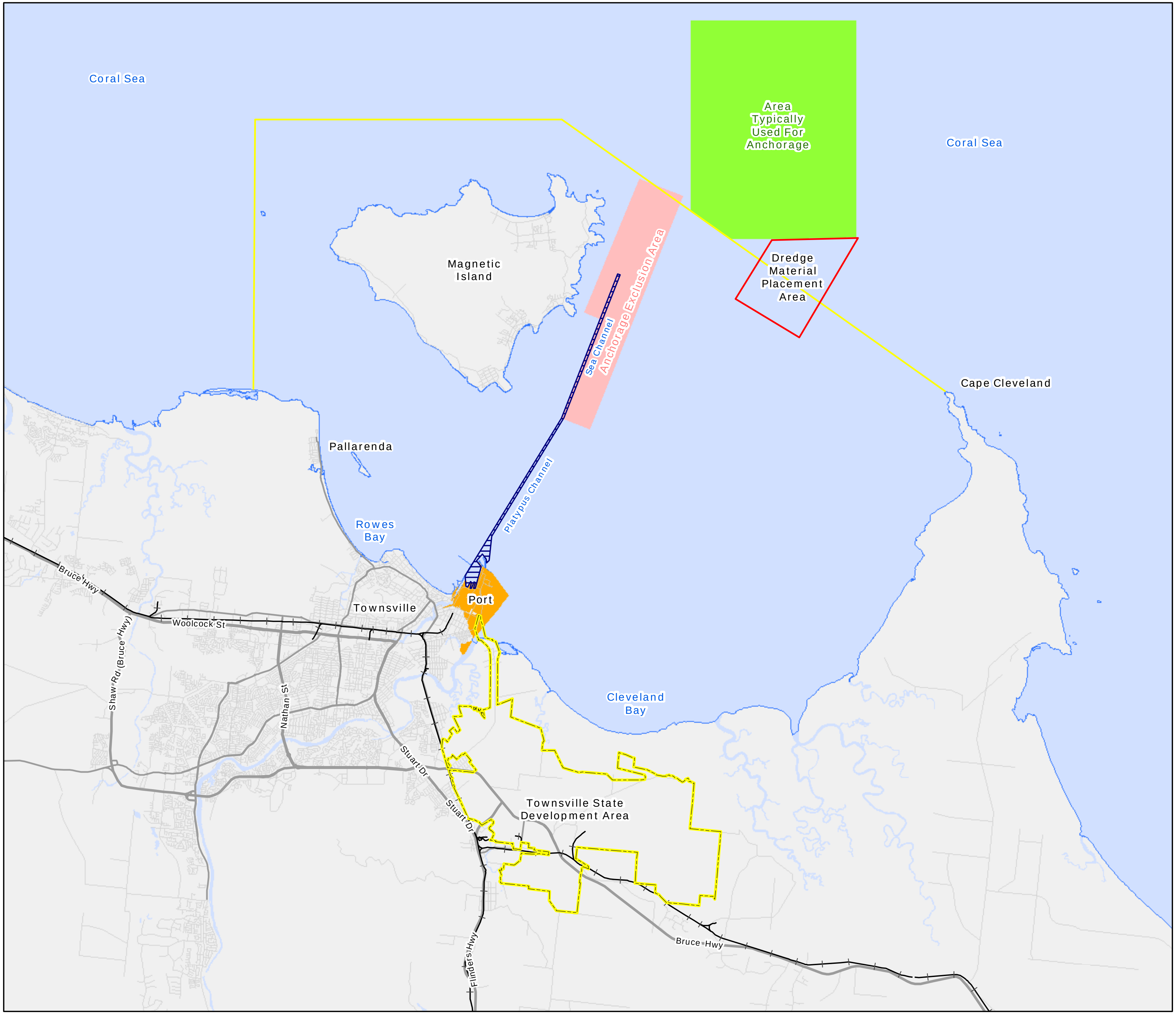
B.18.3.2 Existing Anchorage

Vessels waiting to enter the port generally do so well offshore, although there are some limited areas where vessels can anchor inside the port waters with depth constraints. There are presently no specific designated anchorage areas. Vessels are provided a general anchorage area determined by Townsville Vessel Traffic Service, which is managed by MSQ. Vessels are prohibited from anchoring in the channel and harbour basin, as well as a designated area east of Magnetic Island. Figure B.18.1 shows the typically used anchorage area and areas where anchoring is prohibited.

PORT EXPANSION PROJECT EIS

Typically Used and Prohibited Anchorage Areas

Figure B.18.1



Legend

- Highways
- Main Roads
- Local Roads
- Port Limits
- Channel
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Anchorage Exclusion Area
- Area Typically Used For Anchorage

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_028

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd

B.18.3.3 Shipping in Commonwealth Marine Waters

Ships calling at the Port of Townsville have to navigate through waters in the Great Barrier Reef Marine Park. The port infrastructure and the dredged channel are located in the Great Barrier Reef World Heritage Area. However, they are not within the bounds of the marine park apart from some minor areas of channel that overlap on the eastern side of Magnetic Island.

Australian Maritime Safety Authority, the Great Barrier Reef Marine Park Authority and MSQ administer measures under international treaty law, as well as other domestic sources of law to regulate ships and vessel activities in the region. These agencies share common goals of protection and sustainable use of the marine environment in relation to shipping operations and the safety of ships' crews, passengers and other users of the Great Barrier Reef and Torres Strait. Collectively, they oversee the adoption and implementation of measures for enhancing maritime safety and marine environment protection in the Great Barrier Reef region.

Shipping traffic is confined to Designated Shipping Areas in the Great Barrier Reef region. Measures to increase navigational safety and reduce the risk of ship groundings and collisions include:

- compulsory pilotage
- recommended pilotage
- mandatory vessel reporting and monitoring

The major channels shown in Figure B.18.2 and Figure B.18.3 that are available for shipping through the Great Barrier Reef are:

- Inner Route between the Great Barrier Reef and the Queensland coast (300 miles) from the Tropic of Capricorn to Torres Strait
- Great North-East Channel between the Great Barrier Reef and the Papua New Guinea coast (120 miles) from Bramble Cay to Torres Strait
- Hydrographers Passage across the Great Barrier Reef in Central Queensland, linking the coal port of Hay Point, (the Hay Point berth is adjacent to the Dalrymple Bay berth), with the Coral Sea.
- Palm Passage across the Great Barrier Reef off Townsville, linking the ports of Lucinda, Townsville and Abbott Point with the Coral Sea.
- Grafton Passage across the Great Barrier Reef off Cairns, linking the ports of Cape Flattery, Cairns and Mourilyan with the Coral Sea.

Compulsory pilotage (using a licensed pilot) is required for vessels of 70 m or more in overall length and for oil tankers, gas carriers and chemical tankers irrespective of length that transit:

- Inner Route between Cape York and Cairns
- Hydrographers Passage
- Torres Strait
- Great North-East Channel.

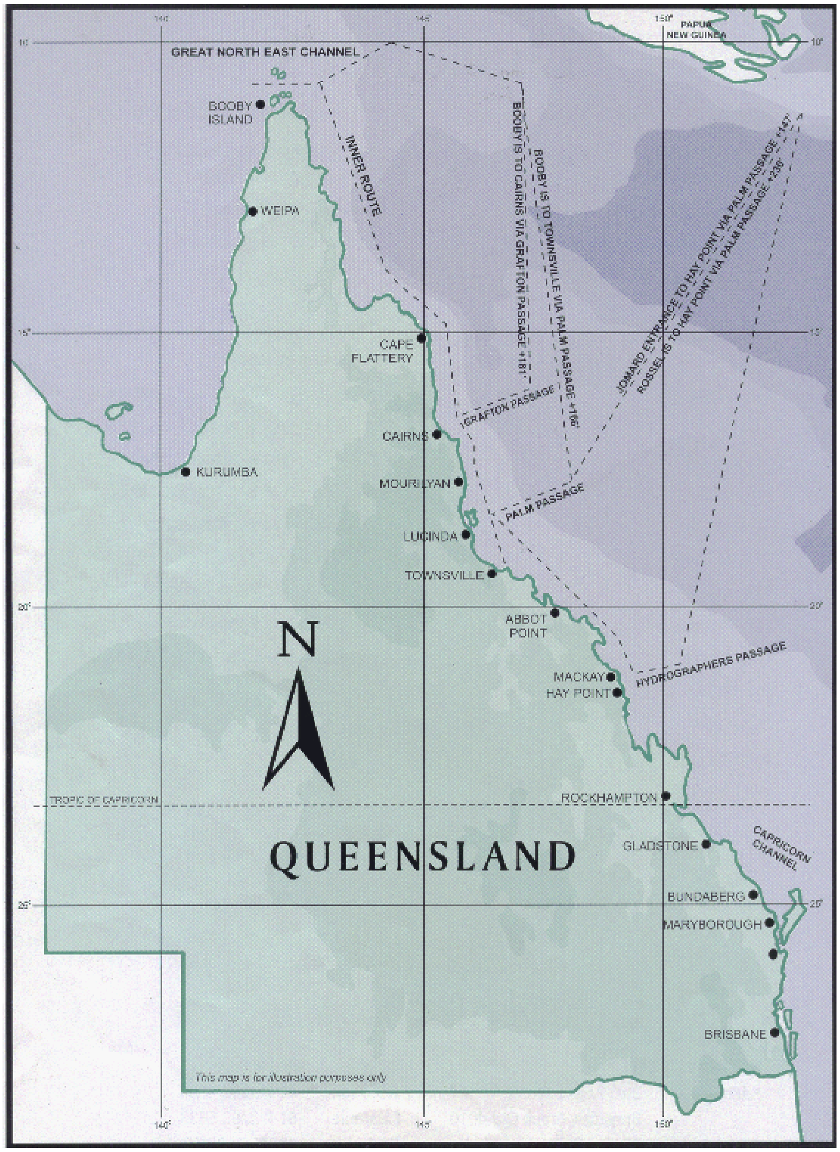
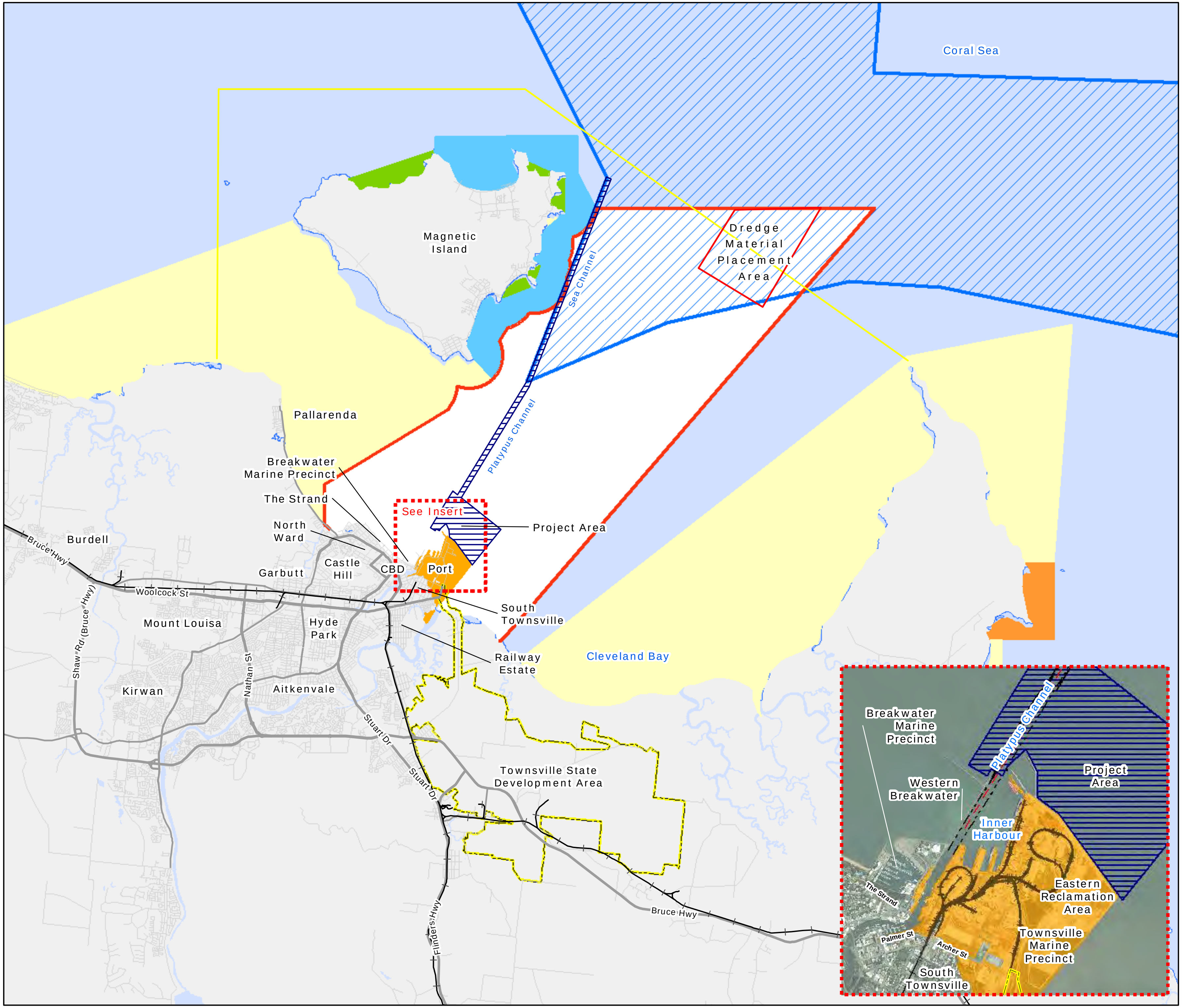


Figure B.18.2 Great Barrier Reef shipping channels (GBRMPA, 2012d)

PORT EXPANSION PROJECT EIS

Great Barrier Reef Shipping Channels

Figure B.18.3



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Channel Centre Line
- Existing Channel Limits
- Shipping Vessel Transit Area*
- Project Area
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area

GBRMPA - Zoning

- Conservation Park
- General Use
- Habitat Protection
- Marine National Park
- Scientific Research
- Marine Park Boundary

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 8-Feb-2013

FILE NAME 60161996_PLN_147

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Imagery (insert) - Port of Townsville 2011.

***Shipping Vessel Transit Area has been based on the Townsville Vessel Transit Data Map prepared by the Maritime Safety Queensland, 15 March 2012.**

Figure B.18.4 shows that the total number of ships is forecast to double by 2040 under a high growth scenario, at the same time the cargo throughput is expected to quadruple. This is due to the relatively high growth in bulk cargos that will use larger vessels. It is also generally expected that average parcel sizes will increase across many ship types.

The PEP design gives consideration to both larger vessels using Townsville and an increase in ship traffic. Dry bulk carriers, which generally represent the larger ship types that will visit the port, are expected to have the greatest contribution to the increase in traffic. This represents an efficient method of moving product through the port and coastal waters.

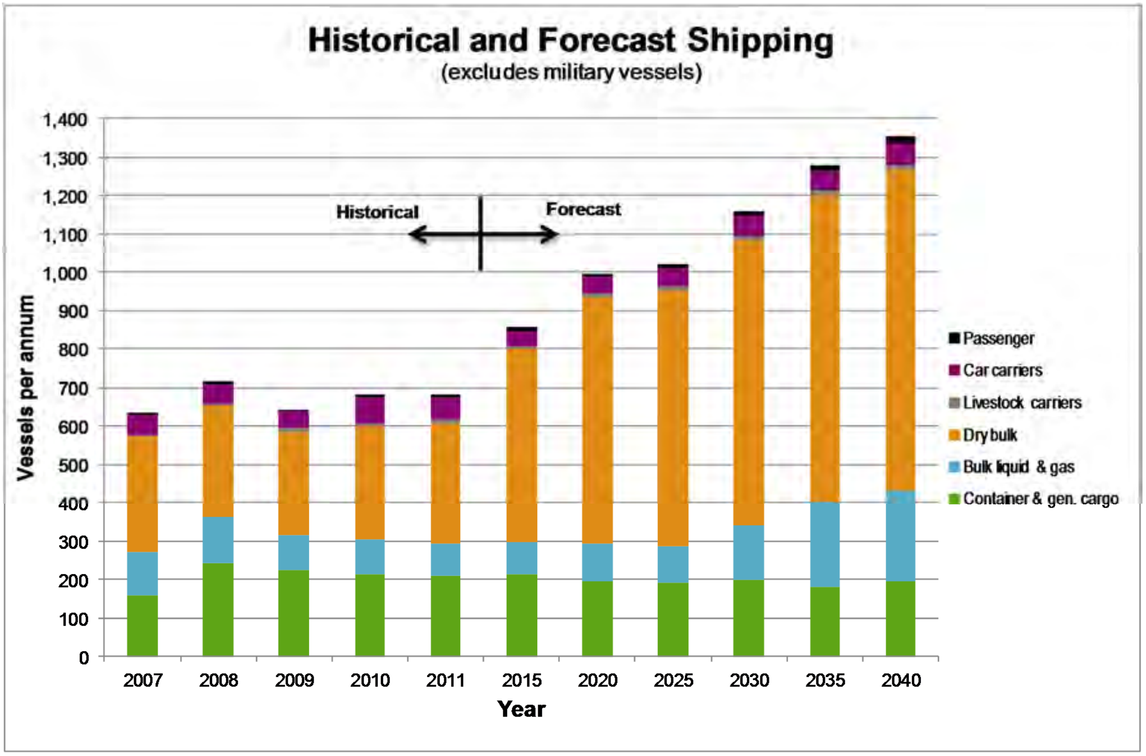


Figure B.18.4 Historical and Forecast Shipping for High Growth

Ships calling at the Port of Townsville share the navigation routes in the Great Barrier Reef Marine Park with other major ports. A reef-wide shipping study was undertaken to review the environmental implications of the cumulative shipping of the 11 major ports located within the GBRWHA. The *Great Barrier Reef Shipping: Review of Environmental Implications* (PGM Environment, 2012) study includes a shipping forecast of all the ports based a detailed forecast that was cooperatively prepared by the relevant Great Barrier Reef Queensland ports, government and industry organisations. The forecast ship traffic from the Port of Townsville and the PEP was provided as an input to the cumulative shipping study.

The cumulative shipping forecast over a 20 year timeframe from 2012 to 2032 for the ‘Probable Case’ is shown in Figure B.18.5. The contribution from the Port of Townsville ship calls is shown in the chart, the proportion of ships progressively declining from 19% to 11% of the total ship numbers.

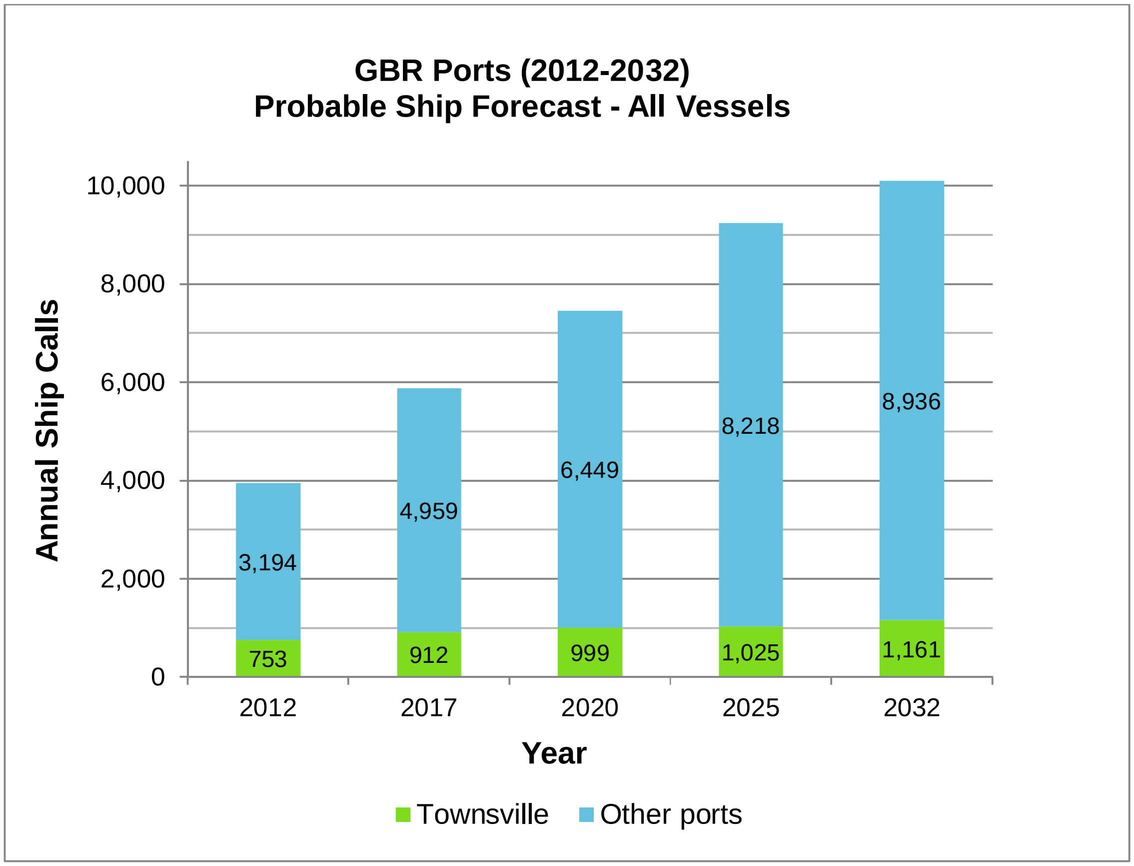


Figure B.18.5 'Probable Case' shipping forecast from Great Barrier Reef ports

(data sources Queensland Port Authorities / Corporations)

B.18.3.5 Vessel Size

The key element governing the layout and design of the PEP is the size of the largest ships likely to use the port both on a regular basis and on an exceptional basis. The economic ship size used is in turn dependent in the main on the volumes of cargo to be shipped (and other factors such as the size of the receival port, and global shipping economics). The aim of the port layout and design is to provide adequately sized port infrastructure to support the economic ship size.

At present, because of the depth constraints in the channel and basin areas for larger vessels the port is best suited to Handymax shipping up to 55,000 DWT (with draught up to 12 m). The PEP involves the creation of a new outer harbour for large dry bulk and possibly liquid bulk vessels initially up to 75,000 DWT Panamax size with 13 m maximum draught, but in the long term capable of berthing Panamax vessels up to 85,000 DWT with 14.6 m maximum draught, as shown in Table B.18.1.

Table B.18.1 Typical maximum ship attributes for regular shipping [1]

Development Stage	Existing Port	PEP Stage A	PEP Stage C
Typical Ship Category (regular ship calls)	Handymax (dry bulk carrier)	Panamax (dry bulk carrier)	Large Panamax (dry bulk carrier)
Draught (m)	12.0	13.0	14.6
Beam (m)	30.0	32.3	32.3
Length Overall [2] (m)	190	220	225
Typical DWT Range	45,000 to 55,000	60,000 to 75,000	80,000 to 85,000

1 The maximum allowable vessel sizes will be confirmed by POTL in conjunction with the Regional Harbour Master during the detailed design stages of the Project. Detailed navigation simulation may be necessary to confirm the vessel limitations for the navigation design depths and to assess manoeuvrability and bank effects for the larger vessels.

2 The outer harbour basin layout can accommodate future possible use by Post-Panamax vessels with an overall length of approximately 250 m. From the stage that Berth 16 is developed, there will be practically no limit to the length of vessel that can manoeuvre in the basin.

B.18.3.6 Vessel Speeds

Maritime Safety Queensland, through the authority of the Regional Harbour Master (RHM), has jurisdiction over the safe movement of all shipping within the pilotage area. Vessel operations in the Sea and Platypus channels and the inner harbour are conducted under the control of a port pilot for ships that have a length of 50 metres or more unless a current Pilotage Exemption Certificate (PEC) is held by the master of a ship. The majority of ships using the inner harbour berths fall into this category, smaller vessels not requiring a port pilot would typically use facilities in Ross Creek, Ross River or the Marine Precinct.

The *Transport Operations (Marine Safety) Regulation* applies to the Port of Townsville and stipulates that vessels may not operate at a speed of more than 6 knots when within 30 metres of any wharf, boat ramp or pontoon, a vessel at anchor, or moored or made fast to a jetty. An additional specific speed limit of 10 knots applies to the inner harbour from the breakwater to Ross Creek. No speed limits are specified in the channel or Cleveland Bay.

These speed limits effectively apply to vessels other than cargo ships using the inner harbour or Berth 11. The safe movement of cargo ships requires slower speeds while arriving and departing the inner harbour because of the manoeuvring requirements and the need to maintain a slow speed when under the control of tugs. The ship speed arriving and departing the inner and outer harbours is restricted because of the relative long distance required to stop and the relatively slow acceleration of these larger vessels.

The ship sizes calling at Townsville are typically in the Handysize and Handymax range, the largest vessels able to call being Panamax size. The same range of vessels is planned for the PEP; however a greater proportion of Handymax and Panamax vessels is expected. Ship speeds are presently less than 6 knots in the inner harbour and the Berth 11 basin, and will be similar in the new outer harbour.

The speed of ships transiting the Sea and Platypus channels is mainly dependent on the direction of sailing (inbound or outbound), location in channel, ship size, ship manoeuvrability, weather conditions, wave and water current conditions, and available underkeel clearance. Table B.18.2 shows the range of ship speeds for the various Port of Townsville ship navigation areas comprising of the channels and harbour basins. The speeds apply to the existing port and the PEP.

Table B.18.2 Typical vessel speeds for Handysize, Handymax and Panamax vessels – inbound and outbound

Navigation Area	Typical Speed Range (knots)
Sea Channel	7 - 13
Platypus Channel	3 - 12
Existing Inner Harbour and Berth 11 basin	0 < 5
New Outer Harbour	0 < 6

The development of the outer harbour will require small craft (recreational boating, work boats, research vessels, ferries and barges etc.) that access Ross Creek to travel at reduced speeds for the length of the channel adjacent to the outer harbour. The speed limit for this section of the channel will be determined by Maritime Safety Queensland, it is expected to be similar to the existing speed limit for the inner harbour.

B.18.3.7 Cargo Handling

The conveyance, storage, loading and unloading of cargo is not part of the EIS, which covers infrastructure provided by POTL up to an elevation of the top of reclamation and wharves. As with cargo handling arrangements in the existing port, cargo handling within the PEP will be undertaken by the tenants who will be responsible for complying with statutory requirements, mandated as part of the lease agreement.

The Project Description (Part A3.0) outlines how cargo handling will generally be undertaken for the PEP for:

- ship loading/unloading
- transfer of cargo between terminals and berths
- cargo storage
- landside transport (road, rail, conveyor and pipeline options).

B.18.4 Assessment of Potential Impacts

In its existing port operations POTL has incorporated a comprehensive range of measures to manage efficiency, safety and the risk of potential impacts to the surrounding environment. The existing port infrastructure and management systems have the capability of handling increased traffic, with the possibility of increasing capacity.

Townsville is not a busy port system in comparison to other major ports in Australia and globally. With further development of infrastructure such as the PEP, additional traffic and larger ships will be accommodated. In addition to the infrastructure requirements, it is also necessary to review management of operations to ensure that risk to safety is not compromised.

Ship management in Townsville is subject to ongoing review and upgrades to maintain and improve safety. POTL as the port authority, and MSQ as the state government authority responsible for marine safety, have responsibilities under a range of international, Commonwealth and state legislation.

This section identifies the main potential effects of the PEP on vessel operations and the management measures that will need to be reviewed to maintain existing standards for shipping.

B.18.4.1 Overview of PEP Infrastructure

The PEP responds to forecast growth in trade, which is expected to result in increased shipping and a trend for an increasing number of Panamax size vessels using the port (Sections B.18.3.4 and B.18.3.5). To accommodate the future shipping demand, the marine infrastructure to be developed comprises:

- a new breakwater protected outer harbour with six additional berths to be developed in stages
- land reclamation for landside operations
- deepening of the channel in two stages to provide access for deeper draught vessels.

Further detail of this infrastructure is presented in the Project Description of the EIS (Section A3.0).

The forecast ships will be using the same Platypus and Sea channels as used by the existing fleet, but the channels will be deepened (with minor widening of the channel near the entrance to the outer harbour) to accommodate the forecast increase in ship size.

The deepening of the Sea Channel will also extend it seawards. Panamax ships in the channel will be required to maintain a minimum underkeel clearance as shown in Table B.18.3.

Table B.18.3 Key navigation parameters

Navigation Parameter	Existing	PEP Stage A	PEP Stage C
Approximate length of dredged Platypus and Sea channels (m)	13,870	14,900	16,480
General channel width (m)	92	92	92
Channel width between markers P11/P12 and P13/P14 (m)	92	130	130
Navigation design depth (m CD)	–11.7[1]	–12.8	–13.7
Minimum underkeel clearance (m)[2]			
▪ Platypus Channel Ch1000 to Ch7500	1.3	1.7	1.7
▪ Sea Channel Ch7500 to end	1.3	1.4	1.4
▪ Protected harbour	0.9 (inner harbour)	0.9	0.9

1 Approximate declared depth varies
2 The underkeel clearance adopted for the PEP will be reviewed by POTL and the Regional Harbour Master as part of detailed design.

B.18.4.2 Future Anchorages

In order to improve efficiency and safety for current ship operations, POTL and the Regional Harbour Master were, at the time of preparing the EIS, considering the introduction of designated anchorages. Although not assessed in detail, it was expected that there may also be environmental benefits associated with this vessel management strategy.

POTL does not have any jurisdiction over offshore anchoring of vessels, but is able to influence the strategy if it is supported by the maritime industry, MSQ and the Great Barrier Reef Marine Park Authority and other approval authorities.

The concept layout of designated anchorages being considered is shown in Figure B.18.6. These are located in the general area where ships presently anchor and comprise:

- Twelve designated anchorages located outside of port limits in the Great Barrier Reef Marine Park. These anchorages are 1 nm (nautical mile) in diameter and would be suitable for use by ships up to approximately 300 m in length.
- Three designated anchorages within port limits suitable for vessels with a lesser draught requirement e.g. passenger vessels. These berths are 1 nm in diameter and would be suitable for use of ships up to approximately 300 m in length.

The safety benefits from a navigation perspective are:

- Vessels will be anchored in a more orderly manner providing better safety and confidence that the next vessel will not anchor too close. Some ship masters tend to anchor too close to other vessels causing concern of vessel interactions.
- The designated circular berths, which would be shown on nautical charts, would allow vessels to better monitor whether position is being maintained - both their own and vessels at adjacent anchorage berths.
- Vessel Traffic Service (part of MSQ) monitoring of vessels at anchor will be more efficient and dragging will be immediately identified.
- Ship masters would nominate the preferred anchorage and obtain Vessel Traffic Service confirmation of availability well in advance, allowing adequate time to finalise the passage plan.
- During cyclone evacuations, the departure of vessels from anchorage can be managed in a more organised and systematic fashion.

It is not possible to predict if the increased shipping activity over the timeframe of the PEP will result in a greater requirement for vessel anchorage for the existing port facilities and new outer harbour. The number of ships anchoring will still be dependent on a number of factors such as:

- number of berths and use measured by the berth occupancy by vessels
- ship waiting time due to depth constraints and channel traffic

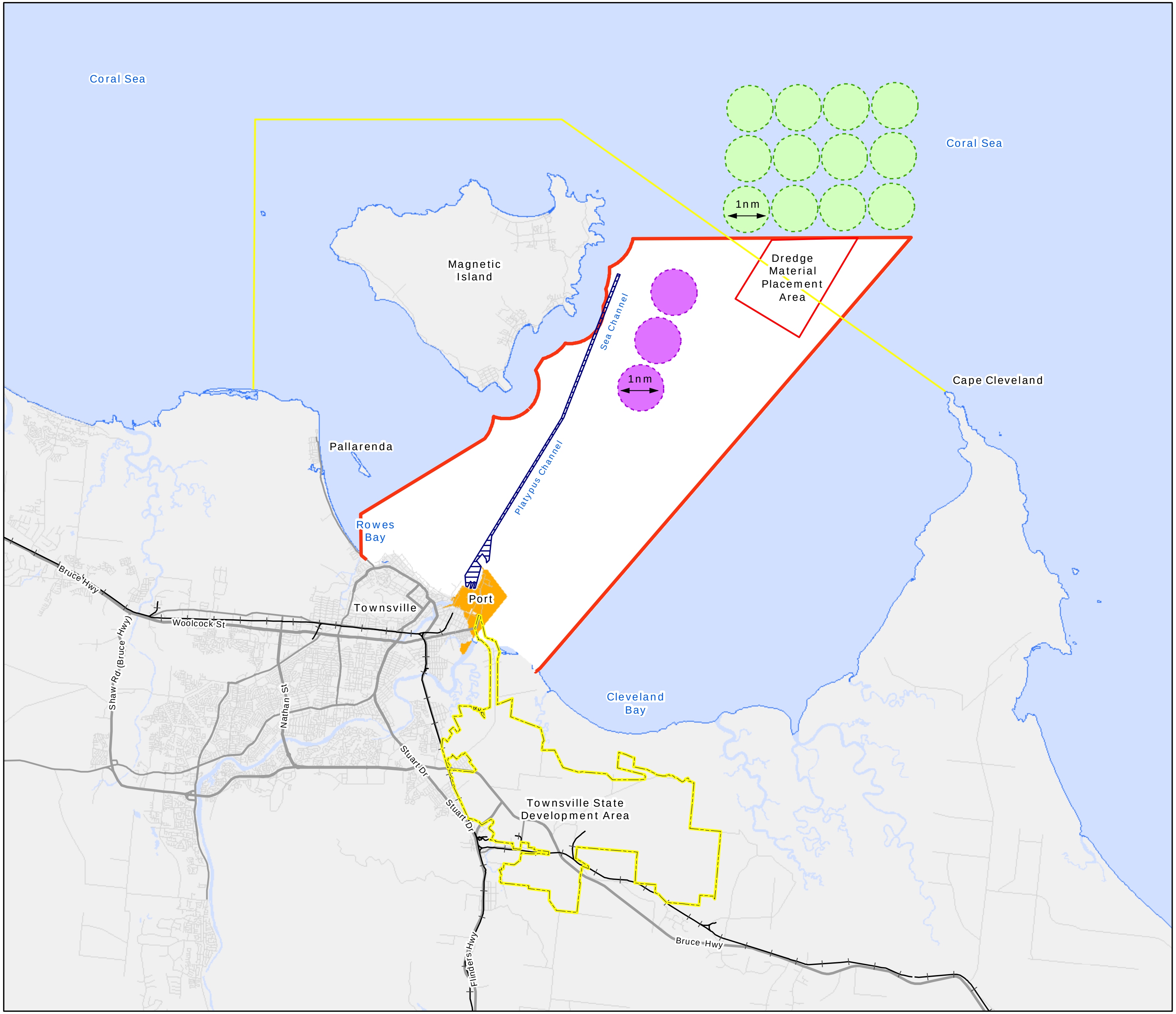
- extent that ships can be scheduled for each berth
- disruption to shipping and landside operations due to extreme weather events and cyclones

There is no apparent constraint to available deep water area for anchoring of vessels for the Port of Townsville. Should designated anchorages be introduced, the number of anchorages can be extended further north, north-east or east if required in future.

PORT EXPANSION PROJECT
EIS

Designated Anchorage
Layout Concept

Figure B.18.6



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Channel
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary
- Deep Draught Anchorage
- Shallow Draught Anchorage

N

Scale:1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_094

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012

B.18.4.3 Future Navigational Arrangements

The increase in vessel size and ship traffic will change the ship operations and navigation arrangements in Townsville requiring a range of measures to be implemented. Prior to the development of each stage of the PEP, navigation arrangements will be reviewed and changed as necessary to maintain efficiency and safety for shipping. The adopted development parameters and navigation design are detailed in the Project Description (Section A3.0).

The key management measures for the PEP, in response to expected changes to navigational arrangements, are summarised in Table B.18.4. These measures will be implemented as and when needed as part of ongoing collaborative management of shipping by POTL and Regional Harbour Master. They will be reviewed as part of the detailed design of each stage of development as well as part of the ongoing review of operations on the port. A more comprehensive discussion of measures including potential impacts on the marine environment is included in the Maritime Operations Management Plan (Section C2.4).

Table B.18.4 Measures to Manage Shipping Risk due to Increased Vessel Size and Ship Traffic

Topic	Description
Minimum ship underkeel clearance	Increase the current minimum underkeel clearance requirements to accommodate future vessel requirements and to maintain safe navigation. The minimum underkeel clearance adopted for the PEP would be reviewed by POTL and the Regional Harbour Master as part of detailed design.
Channel and basin depth	Deepen the Platypus and Sea channels in stages to allow access by larger vessels and to increase the available sailing windows.
Channel width	The PEP includes widening the Platypus Channel in the approaches to the outer harbour to increase the manoeuvring width for the slower vessel speeds while navigating the harbour approaches. Should there be a need in future to consider a wider channel system, the alignment of the channel and layout of the new outer harbour can accommodate channel widening.
Aids to navigation	The existing port and channels are well provided with aids to navigation. While the new outer harbour will use the same channel and harbour entrance, changes to the aids to navigation are: ▪ new paired channel markers to be placed at the start of the extended channel for each deepening stage ▪ installation of buoys to mark the extent of the dredged harbour basin, as it expands stage by stage ▪ lights to mark the new breakwaters and the extent of the new reclamation.
Marine management systems	Ongoing review of marine management systems prior to development of each stage to ensure that systems and resourcing are appropriate for port expansion and the incremental growth in shipping. Key areas to address in this regard are: ▪ Vessel Traffic Service managed by MSQ ▪ staffing requirements of POTL and MSQ to manage systems for safe and efficient marine operations ▪ information systems for real time and predictive weather and tide information ▪ requirements for electronic navigation aids such as Portable Pilot Units.
Tug fleet	Ongoing review of the tug fleet (number and capacity) in relation to ship sizes and ship traffic.
Pilots and pilot launches	Review the number of available port pilot personnel and launches to cater for the increasing ship traffic and the construction phase vessel requirements.
Channel capacity	In the long term, the increase in the number of vessels using the channel may introduce channel capacity issues. Detailed consideration to the appropriate measures will be given when the issue arises. Several options are available to alleviate capacity issues such as: ▪ scheduling large vessel transits as convoys of vessels at high tide ▪ providing layby berths in the outer harbour.
Ship anchorage	POTL and the Regional Harbour Master were, at the time of preparing the EIS, considering the introduction of designated anchorages to improve safety and efficiency. In collaboration with MSQ and other agencies (such as the Great Barrier Reef Marine Park Authority), POTL will undertake ongoing review of anchorage procedures and

Topic	Description
	requirements as a result of increased shipping due to the development of the PEP and other planned projects for the port.
Emergency management	Review emergency management procedures for cyclones and extreme weather events to cater for a greater number of vessels that could be present in the port. The additional requirements during construction periods are to be addressed in the Vessel Management Plan (Construction). Review emergency response equipment and personnel resources.
Recreational craft	Lighting on breakwaters and seawalls to show extents for visibility by recreational craft at night. Vessel Management Plans for Construction are a necessary at each stage of development and are required to address recreational boating safety. Particular consideration will be given to: ▪ temporary aids to navigation for construction areas ▪ notices to mariners ▪ consultation with the recreational boating community.

B.18.4.4 Shipping in Commonwealth Marine Waters

Generally it can be expected that an increase in ship traffic would increase ship risk with regard to the probability of groundings or vessel co-occurrences. The increase in risk profile can be mitigated by a number of measures such as:

- improved vessel traffic management and tracking systems
- improved aids to navigation infrastructure
- regulation that supports safer shipping operations
- improved emergency response

This is evident in the analysis of shipping records for the Great Barrier Reef, which has seen a decline in vessel incidents even though ship traffic has significantly increased. Figure B.18.7 shows the correlation between the incidences of ship groundings and the implementation of the Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS).

Over time, improvements in ship design and advances in technology for navigation have also resulted in significant improvements in shipping safety on a global scale.

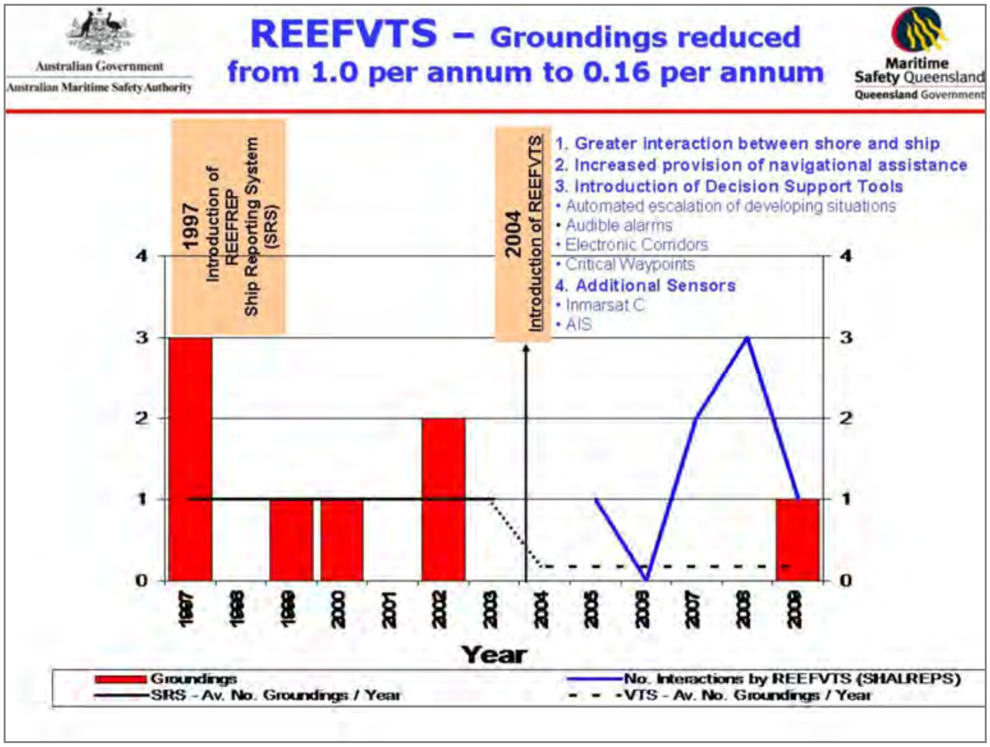


Figure B.18.7 Incidence of Groundings since the Introduction of REEFVTS (AMSA, 2010b)

Great Barrier Reef Marine Park Authority has identified the main potential shipping impacts that can damage the Great Barrier Reef as collisions, groundings, introduction of invasive marine pests, oil and chemical spills, introduction of anti-fouling paints, waste disposal and anchor damage.

A summary of key findings regarding ship management in the *Great Barrier Reef Outlook Report 2009* (GBRMPA, 2009) were:

- Shipping rules are uniform nationally and there is high-level coordination of everyday activities and incident response.
- Most routine shipping activities have negligible consequences on the Great Barrier Reef Marine Park and almost all ships travel safely along the designated shipping routes of the Great Barrier Reef with little, if any, impact.
- Due to comprehensive management arrangements there have been few incidents threatening Great Barrier Reef values relative to the large number of shipping movements in and through the region. Port management appears to have protected natural values, but the independence of the individual port corporations makes consistency across jurisdictions a challenge.
- Although subject to careful environmental impact management, further development of ports in the Great Barrier Reef region (such as an increase in construction of new shipping berths and shipping channels or an increase in maintenance or dredging activities) are likely to have local impacts on the marine environment.

Townsville is one of 11 major ports located on the Great Barrier Reef coast. The potential increase in the risk of ship groundings and vessel collisions in the Marine Park, and associated impacts, due to the Townsville PEP cannot be assessed in isolation. The assessment of shipping risks needs to consider the cumulative shipping from traffic generated from all ports and how these risks will be managed by the agencies on a reef-wide basis.

Substantial development of coal handling port facilities were being planned at the time of preparing the PEP EIS. The Port of Abbot Point had been identified by the Queensland government as a preferred port to undertake a Cumulative Environmental Impact Assessment to support further development of the coal export industry; this included a cumulative shipping study. BHP Billiton and North Queensland Bulk Ports had carriage of a reef-wide cumulative shipping study to looking at current and potential shipping movements through the reef. In consultation with ports, maritime safety organisations, relevant regulatory authorities and agencies, and the shipping industry, it examined future management arrangements to ensure protection of the reef.

The aim of the reef-wide component of the study was to:

- outline the international, national and regional controls relating to shipping
- outline current shipping management arrangements in the Great Barrier Reef
- analyse current and future shipping activities in the Great Barrier Reef
- identify potential environmental implications at a reef-wide level
- determine and articulate likely shipping environmental risks
- analyse likelihood and consequence of ship groundings and collisions
- identify risk management measures.

The report *Great Barrier Reef Shipping: Review of Environmental Implications* (PGM Environment, 2012) considered the forecast growth in shipping (approximately 2.5 times greater than the current ship traffic levels) over a 20 year timeframe. The review conducted as part of the study concluded that:

- In general terms, existing routine shipping presents no substantial risk of lasting damage to the environmental values of the Great Barrier Reef.
- Future increased shipping presents a minimal change to this substantive risk if managed accordingly.
- Overall the impacts and the risks to the Great Barrier Reef had been well managed and had improved over time to address increased ship traffic and related risks. Management of shipping in the Great Barrier Reef Marine Park compared favourably to the highest standards applied in other parts of the world with Particularly Sensitive Sea Areas. It also identified that there were plans to adopt further measures to improve the management approaches.
- With ongoing risk assessment and implementation of international best practice standards in navigation and shipping standards, along with regional and local management, the current and forecast shipping activities were not seen to pose an unmanageable or unacceptable risk to the reef or its natural and World Heritage values.

The study identified that there were some aspects where increased shipping activity presents a changed risk in terms of:

- The statistically increased likelihood of stochastic events such as collisions, groundings and successful invasive marine species transfers.
- The capacity of existing ship control procedures, facilities and contingency arrangements to cope with the additional ship traffic.

The report recommended ongoing active management associated with the current and forecast shipping to address key emergent and existing environmental risks. Risk management measures were identified in a workshop which included key Great Barrier Reef Commonwealth and state government regulatory authorities and agencies, Queensland port authorities, coal shipping terminal operators and coal exporters. Thirty suggested action measures, together with nominated lead organisations, were identified to address the existing and emergent risks in a collaborative manner.

B.18.5 Mitigation Measures

Management plans will be used as the mechanism for monitoring and managing the implementation of mitigation measures for the PEP. The Maritime Operations Management Plan (Section C2.4) contains details of a range of mitigation measures to maintain safe, efficient and effective vessel operations in the port. As it is a small subset of long-term port operations, a Vessel Management Plan (Construction) details additional measures specifically for the marine construction works.

Table B.18.6 to Table B.18.10 outline the mitigation measures to be addressed in the design and construction of PEP as well for the management of vessel operations.

Table B.18.5 Channel and Outer Harbour Development – Construction Phase

Topic	Channel and Outer Harbour Development
Management objective	To provide and maintain navigation waterways over the PEP planning horizon for the safe and efficient navigation in the Platypus and Sea channels and new outer harbour basin.
Performance criteria	▪ Navigation design depth of channels and outer harbour basin to be sufficiently deep to support efficient port operations (measured by waiting time for vessels to transit the channel). ▪ Design of channels and outer harbour basin to achieve safe vessel navigation. ▪ Dredging works to achieve minimum navigation design depth. ▪ Navigation design depths preserved by ongoing maintenance dredging.
Applicability	Design, development and maintenance of navigation areas for PEP development stages and operations.
Implementation strategy	▪ Review minimum ship underkeel clearance requirements for design vessels in each stage of channel deepening. ▪ Detailed navigation design to be undertaken in consultation with Regional Harbour Master (if necessary. undertake detailed navigation simulation). ▪ Undertake dredging works to deepen the channels and widen the Platypus Channel approaches to the outer harbour to suit shipping requirements for each stage of PEP development. ▪ Undertake harbour basin dredging works to suit shipping requirements for each stage of PEP development. ▪ Completed dredging works to be surveyed in accordance with MSQ *Standards for Hydrographic Surveys in Queensland Waters* (MSQ, 2007). ▪ Undertake regular hydrographic survey of the seabed in navigation areas and after extreme weather events. ▪ Undertake ongoing maintenance dredging of navigation areas to preserve the navigation design depths. ▪ Detailed design is to be undertaken prior to the development of each stage of the Project. ▪ Ongoing review of the suitability of the channel and harbour to support efficient vessel operations and safety, as well as regular maintenance.
Responsibility	▪ POTL will be responsible for the design, development and maintenance of the channels and harbour basin. ▪ The Regional Harbour Master is to be consulted during the design, construction and operation phases.

Table B.18.6 Aids to Navigation

Topic	Aids to Navigation
Management objective	To design, install, maintain and manage aids to navigation to support safe and efficient navigation in the Platypus and Sea channels and the outer harbour basin.
Applicability	Design, development and maintenance of aids to navigation for PEP development stages and operation.
Performance criteria	▪ Safe navigation for shipping. ▪ Safe navigation for recreational boating.
Implementation strategy	▪ Detailed design of aids to navigation for PEP development stages to be undertaken in consultation with Regional Harbour Master. ▪ Install additional channel markers (fixed piled channel markers similar to the existing Sea Channel beacons) to demarcate the dredged extents Sea Channel at each stage of channel deepening. ▪ Relocate outer harbour basin buoys at each stage of PEP development to mark dredged extent. ▪ Remove the existing Berth 11 leads (turning) when the outer basin is enlarged for Berth 16. ▪ Provide lighting on reclamation edge structures and breakwaters as appropriate to assist with visibility for recreation boating. ▪ Provide detailed drawings with coordinates of new, relocated and removed markers to MSQ to support the revision of nautical charts and Notice to Mariners for each stage of

	PEP development. ▪ Seek agreement with MSQ for the provision, maintenance and management of existing and new aids to navigation for the port.
Responsibility[1]	▪ POTL is to undertake the detailed design of aids to navigation in consultation with Regional Harbour Master prior to the development of each PEP stage. POTL is to ensure that specific construction stage requirements are addressed as part of the Vessel Management Plan - Construction (Section C2.4).

Table B.18.7 Ship Anchorage

Topic	Ship Anchorage
Management objective	To ensure that anchorage arrangements for vessels calling at Port of Townsville address safety, efficiency and environmental objectives.
Applicability	Anchorage procedures for vessels awaiting entry to the Port of Townsville.
Performance criteria	▪ Safe vessel anchorage for shipping operations and construction vessels. ▪ Achieve best practice environmental outcomes.
Implementation strategy	▪ Work collaboratively with MSQ, Regional Harbour Master and other agencies (e.g. Great Barrier Reef Marine Park Authority) to assess the concept of a designated anchorage area for current shipping operations. ▪ Review procedures for vessel anchorage at each stage of the PEP development.
Responsibility	▪ POTL will work with MSQ, Regional Harbour Master and other agencies such as Great Barrier Reef Marine Park Authority. ▪ Other regulatory agencies according to jurisdiction.

Table B.18.8 Maritime Operations Management Systems

Topic	Maritime Operations Management Systems
Management objective	Align and review the adequacy of marine management systems for the PEP development to provide safe and efficient navigation in the Platypus and Sea channels and outer harbour.
Applicability	Systems for the management of marine operations.
Performance criteria	▪ Safe vessel operations. ▪ Efficient and effective marine operations.
Implementation strategy	Ongoing review of marine management systems over the PEP timeframe to ensure that systems and resourcing are appropriate for the port expansion and the incremental growth in shipping. Key areas to address in this regard are: ▪ Provide Regional Harbour Master with relevant information in relation to the PEP as an input to the ongoing review and update of the *Port Procedures and Information for Shipping (Port of Townsville)* ▪ Adequacy of Vessel Traffic Service systems and resources for increased shipping and construction vessel operations ▪ Requirements for information systems for real time and predictive weather and tide information ▪ Review future channel operation procedures to include ship convoys during high tides when ship traffic reaches levels when delays to transit the channel are incurred ▪ Supply drawings and information to MSQ so that vessel management systems can be updated with the development of the PEP ▪ Provide information as an input to *Cumulative Shipping Study for Great Barrier Reef* ▪ Adapt maritime operations management based on the findings of *Cumulative Shipping Study for Great Barrier Reef*.
Responsibility	▪ POTL in conjunction with MSQ. ▪ Other regulatory agencies according to jurisdiction.

Table B.18.9 Maritime Operational Resources

[1] The responsibilities with regard to the provision, maintenance and management of existing and new aids to navigation in the Port of Townsville were an ongoing matter of discussion between POTL and MSQ at the time of preparing this EIS.

Topic	Maritime Operational Resources
Management objective	Plan resources for services to support safe and efficient and effective navigation operations in the Port of Townsville.
Applicability	Resources for the management of marine operations.
Performance criteria	▪ Adequate resources for marine services available to support safe vessel navigation. ▪ Achieve acceptable marine operations service levels for vessel operations.

Implementation strategy	▪ Undertake forward planning and monitoring of shipping requirements to identify future resource requirements for:
	  ▪ tug fleet number and capacity
	  ▪ number of pilots and pilot launches
	  ▪ navigation aids e.g. Portable Pilot Units
	  ▪ staffing requirements of POTL and MSQ to manage systems for safe and efficient marine operations
	  ▪ MSQ Vessel Traffic Services Centre.
	▪ Undertake detailed assessment of PEP shipping and construction traffic at each stage of development and ensure that adequate maritime operational resources are available to manage ship and marine construction operations.

Responsibility	▪ POTL to execute work in conjunction with MSQ. ▪ POTL to ensure that specific construction stage requirements are addressed as part of the Vessel Management Plan - Construction. ▪ MSQ to apply its jurisdiction against approved plan.

Table B.18.10 Emergency Management

Topic	Emergency Management
Management objective	To identify, assess, prevent and manage emergencies including the subsequent recovery after an emergency/disaster that may occur in the port. This also includes the managed, planned and safe evacuation of vessels and personnel.
Applicability	Procedures and resources for emergency management.
Performance criteria	▪ Prevention of emergency situations through proactive measures. ▪ Early detection of potential or actual emergency situations through effective processes, communication and monitoring. ▪ Quick and effective response to emergency situations and recovery from events. ▪ Availability of first-strike response equipment.

Implementation strategy	▪ Ongoing review of emergency management plans, resource levels and equipment with the development of infrastructure, additional vessel berths, increased ship traffic, construction vessels and equipment.
	▪ The emergency management plans to ensure that there are appropriate preventative, detection, response and recovery measures to protect safety and the environment.
	▪ Emergency plans for review:
	  ▪ POTL Emergency Response Plan
	  ▪ POTL Cyclone Emergency Response Procedure
	  ▪ First-strike Oil Spill Response Plan – Port of Townsville
	▪ Review minimum requirements for first-strike response equipment.

Responsibility	▪ POTL will generally be responsible for the ongoing review of the impact of the PEP development on emergency management in the Port of Townsville in conjunction with relevant authorities and agencies. ▪ Other regulatory agencies according to established roles and jurisdictions.

B.18.6 Assessment Summary

The PEP will be developed as a progressive expansion of the existing port with the operations conducted under the existing management framework by POTL and other relevant maritime authorities. The operations that will result from the PEP will be conducted using the same road, rail networks and shipping channels as the existing port and other separate developments that are underway. The measures to manage potential impacts on the environment, vessel safety and operational efficiency of the port do not involve major changes to those already in existence.

The mitigation and management measures will be reviewed during the detailed design prior to each development stage of the Project. These measures will be addressed by POTL, relevant stakeholders and port users. The port operations most relevant to the PEP EIS are those relating to shipping, road and rail, since the above-wharf development of cargo handling facilities will be by the port's as yet unidentified tenants, who would lease POTL's land and berth facilities. They will construct their own operating infrastructure as and when they take up their lease and the approvals would be independently undertaken by those tenants at the appropriate time.

POTL, as the port authority, will be responsible for developing and managing the PEP. This will be done in conjunction with other key port stakeholders, in particular:

- port tenants who will develop and conduct cargo handling operations
- MSQ and the Regional Harbour Master who are responsible for navigation in the Port of Townsville
- Queensland Rail as the authority responsible for the rail network and managing rail operations

Management plans form part of the Environmental Impact Statement to outline the requirements during construction and operation that are necessary to meet the conditions of environmental legislation, to achieve best practice environmental management and to aid in achieving the requirements of the proponent and the relevant authorities. They describe the measures to be implemented to help achieve and maintain acceptable levels of environmental impact.

Specifically, the Maritime Operations Management Plan (Section C2.4) provides mitigation measures to address the potential impacts of increased shipping volumes associated with growth from existing facilities, upgrades to facilities being implemented at the time of the EIS, other planned upgrades/expansion projects, and the PEP. It details a range of management measures for maintaining safe, efficient and effective vessel operations in the Port of Townsville in relation to:

- design, development and maintenance of marine infrastructure and navigation areas
- anchorage arrangements
- Vessel Management Plan - Construction
- marine operations management systems
- marine operations resources (tug fleet, pilotage resources and pilot launches)
- emergency management
- aids to navigation

Port Expansion Project EIS

Part B

Section B19 – Economic Development

B.19 Economic Development

B.19.1 Relevance of the Project to the Economic Environment

B.19.1.1 Summary

The main competitive advantage of this region, and particularly Townsville as the main urban centre in the Northern Economic Triangle (NET), lies in its skilled population, diversified and growing economy and existing infrastructure linking major resource centres in North West Queensland. Townsville is the major centre in the NET (Figure B.19.2).

The economy of Townsville performs well, shows strong population growth and enjoys incomes on par with the rest of Queensland. It also has a well-diversified economy. In contrast, the NET as a whole shows low population growth, is much less urbanised, and has low wage and salary incomes compared with Townsville and with Queensland as a whole. Its economy is less diversified, with highly localised concentrations of employment in agriculture, mining, construction and public sector services.

The NET has potential for further expansion in the resources sector. While this will not diversify the economy, it will enable growth to take place in a sector that pays high wages and that will attract additional working population. Local expenditure by individuals and companies in the resources sector will create positive income and employment multiplier impacts in Townsville and the rest of the NET, enabling a degree of downstream diversification and higher employment levels. Expansion in the resources sector will be directly supported by the Port Expansion Project (PEP).

B.19.1.2 Demand for Port Capacity

Port of Townsville Limited (POTL) has prepared trade forecasts to the 2039/40 fiscal year (Appendix T1), which underpin the need for the PEP. A review has been conducted of the forecasts maintained by POTL, focusing on the economic factors and global economic outlook supporting the forecasts.

The forecasts are based on a detailed assessment of individual resource projects, particularly in nickel, magnetite, copper, coal, and fertiliser, being developed by several major resource companies. The forecasts summarised are supported by a detailed mine-by-mine analysis of port capacity needs.

The export of magnetite is a trade that has recently been introduced to Townsville following several magnetite mine developments. Coal is currently exported through Townsville in very small quantities, however this may change with increased outputs from the North Galilee Basin. Nickel, copper and fertiliser are existing trades whose volumes might also change as the economy develops towards 2040.The result is that the port’s current trade of 11 Mtpa (million tonnes per annum) in 2010/11 is expected to more than double to nearly 25 Mtpa within 5 years once proposed mines become operational and commence exporting.

This additional volume will exceed the current capacity of the port, which is approximately 23 Mtpa in the base case. The base case includes some capacity for projects currently underway (such as Berth 12 and a dual conveyor for Berth 11), but excludes the additional capacity that would be created by the PEP. Figure B.19.1 summarises POTL trade forecasts, base case capacity and PEP capacity, which would be delivered in several stages over the next three decades.

The timings shown in the figure, of each stage of the PEP capacity expansions and the commencement of new trades, are indicative for the purposes of illustrating the potential development of the port. The exact timing of when new trades will commence and when future new capacity will come on line will depend on a range of factors, such as the approval, development and operational output of new mines in the NET.

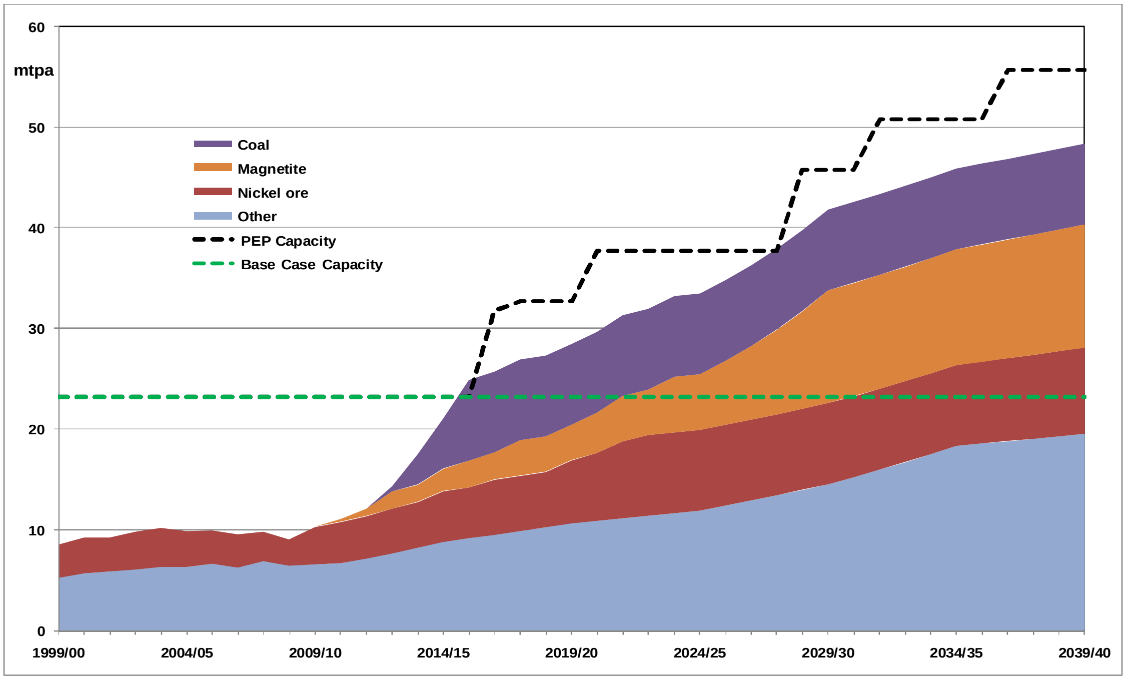


Figure B.19.1 POTL Trade Forecasts (Deloitte, 2012)

Trade is expected to be around 33.4 Mtpa by 2024/25, which is three times the current volume. By the time trade reaches this level the components of total port trade are expected to be:

- coal exports 24%
- nickel ore imports 24%
- magnetite exports 16.5%
- fertiliser exports and fertiliser component imports 10.5%
- other mineral concentrate exports (e.g. copper, lead, zinc, cobalt) 9.5%
- other imports and exports (e.g. general cargo, agricultural, general trade, etc.) 15.5%.

Sugar and molasses, which currently comprise 13% of total trade, are expected to decline to a 4% share. The absolute export tonnage of sugar and molasses is not expected to decline, but the share in total exports is expected to shrink as other trades grow in volume. The growth in resource trade volumes will dilute the share of agricultural products passing through the port as a percent of the port total. General cargo is expected to only account for 1.5% of the total tonnage passing through the port in 2024/25.

The Port of Townsville is well positioned to handle coal exports from the North Galilee Basin, as export through Townsville reduces both rail and ship travel distances to markets, compared with the nearest alternative port at Abbot Point.

A risk to the forecasts is the concentration of total trade in three commodities: nickel, coal and magnetite. By the time trade reaches 33.4 Mtpa in 2024/25, nearly two-thirds of total tonnage is expected to be in these three commodities. In the resources sector it is common to see ports handling large volumes of a small number of commodities (often only one commodity). In many respects POTL is more diversified and stable than most bulk ports as it has more commodities, plus it also handles trades such as motor vehicles and general cargo.

Other general risks, not specific to Townsville but relevant for all resource-driven projects, are a softening in the outlook for the Chinese economy and the impact of policies to address global warming. These risks could cause trade growth for key Townsville commodities to be lower than currently expected. Equally, it is also possible that continued economic strength in China could result in additional ore deposits in the region (not currently included in the forecasts) being developed, particularly magnetite, coal, and other ores. This would result in higher port throughput than currently expected.

Increasing interest from India and the (so far) modest impact on coal export growth from recent climate change policy announcements mitigates these risks. The ability to stage development to be in line with market demands is also a mitigation factor. The timing and staging of the PEP is intended to allow some flexibility in meeting future trade demand. Once the initial construction of the breakwater and revetments is complete, there is some flexibility in the timing of later stages, depending on when future resource projects commence. As such, POTL can adjust the timing of later stages of capital expenditure, if actual trade growth turns out to be more or less rapid than forecast.

In summary, the strong demand from China and India for North Queensland’s resource exports is driving the development of new mines along the Townsville-Mount Isa corridor, which in turn, are serviced by the Port of Townsville. Based on a review of POTL forecasts, economic factors and the global outlook, the forecasts are considered to be a reasonable basis for planning purposes and for the Environmental Impact Statement’s purpose of estimating impacts.

The PEP is planned to enable sufficient capacity to be delivered ahead of expected demand. This will avoid bottlenecks or capacity constraints at the port impacting on trade growth opportunities, and will provide sufficient flexibility to accommodate demand, if trade growth driven by the resource sector is more rapid than expected.

B.19.2 Assessment Framework and Statutory Policies

There is no formal assessment framework specifically for the economic element of a development proposal, and there are no statutory policies for economic development. However, there is a wider policy framework that needs to be recognised in impact assessment. The relevant policies are discussed below.

B.19.2.1 Queensland Government Policies

B.19.2.1.1 NET Infrastructure Plan 2007–2012

The *NET Infrastructure Plan 2007–2012* (DI, 2007b) outlines a vision for North West and North Queensland to foster sustainable economic, social and community development through the emergence of mineral processing and industrial development over the next half century. It is not a general economic strategy for the region, rather it provides a focus for the development of a priority sector of large-scale industry, particularly mining and minerals processing. The plan proposes strategies to support stronger regional linkages and the competitive advantages of individual economic centres and sustainable communities. The strategic objectives of the plan include:

- sustainable exploitation of the rich mineral resources of the North West Minerals Province
- broadening of the economic base of Townsville by building on its proximity to the mineral wealth of the interior
- strategic planning and the development of Bowen as an industrial precinct
- strong commitment at all levels of government, industry and the community.

Significant constraints to growth in the region are the provision of competitively-priced power, gas delivery, resource development, efficient transport systems, industrial land and corridors, reliable water supply and access to skills.

Strategies to mitigate the constraints to growth have been developed and the plan notes that all stakeholders need to work collaboratively to implement the actions and achieve the objectives of the plan.

B.19.2.1.2 Major Resource Projects Housing Policy

The state Coordinator-General released the *Major Resource Projects Housing Policy* (CG, 2011) in August 2011 as a policy foundation for better planning for housing in resource communities. The PEP project would fall under this policy. The policy encourages governments, industry and community to work in partnership on housing issues. The objective of the policy is to make clear the government’s expectations of the accommodation and housing issues that project proponents submitting an environmental impact statement will need to consider. To achieve this objective, the policy establishes:

- guiding principles on stakeholder engagement for use by proponents in undertaking social impact assessment
- principles that the Coordinator-General's Social Impact Assessment Unit will use to assess accommodation and housing market impacts of resource and resource-related projects that are subject to social impact assessment.

These principles are to be used by government, industry and communities each time a resource project is subject to environmental and social impact assessment. The principles, which are listed below, intend to guide the identification and assessment of accommodation and housing impacts, and the development of mitigation and management strategies.

- growth management and liveable resource communities
- environmental and social impact assessment
- stakeholder engagement
- housing, planning, infrastructure and environmental sustainability
- project workforce accommodation.

To assist with managing the social impacts over the life of a project, the Coordinator-General's Social Impact Assessment Unit has developed a *Guideline to preparing a social impact management plan* (DIP, 2010). A social impact management plan sets out the requirements for project proponents so that the roles and responsibilities of proponents, government, stakeholders and communities can be established throughout the life of the Project. A social impact plan for the PEP has not been required at this stage.

B.19.2.1.3 Queensland Regionalisation Strategy

The *Queensland Regionalisation Strategy* (DLPG, 2011) is an initiative to help manage future growth in Queensland. It uses a twofold approach to regionalisation; focusing on both economic development and liveability. One of the key objectives of the state government's regionalisation approach is to encourage population and economic growth outside the south-east corner. The PEP project aligns with this strategy. The *Queensland Regionalisation Strategy* contains 35 state-wide actions aimed at supporting growth across the state and is focused around the four priority areas of:

- infrastructure and services: ensuring regional Queensland emerges more resilient from natural disasters and anticipates future growth to improve productive capacity and sustain long-term growth
- people: promoting regional communities as centres offering residents the full range of opportunities in life through career and education, as well as the amenities that contribute to liveability
- business: supporting businesses to attract new investment to generate sustained employment opportunities and strengthen the economic base
- partnerships: fostering partnerships at the local, state and national levels to promote coordination and drive local leadership.

The actions in each priority area are supported by separate regional action plans that target different opportunities and priorities across the state. These plans seek to broaden the economic base; capitalise on growing industries and major investments; and retain and enhance lifestyle and character.

B.19.2.1.4 Queensland Skills Plan 2008

In 2006 the *Queensland Skills Plan* (DETE, 2008) identified strategies to address the state's skill shortages. Since its inception much has been achieved to reform the state's vocational education and training system and boost the skills of the state's workforce. The PEP project would fall under the auspices of this plan.

In 2008 the *Queensland Skills Plan* was updated to include a review of each action in the 2006 plan and provide an updated list of actions. The *Queensland Skills Plan* is a major investment to achieve the state government's vision of having a highly skilled, flexible workforce that underpins the state's continuing growth and prosperity and lays the foundations of an inclusive and socially cohesive society. The plan aims to achieve this vision through:

- boosting participation in vocational, education and training

- recognising the pivotal role of effective partnerships with industry, its workforce and providers
- harnessing synergies across the Department of Education, Training and Employment
- working alongside the Commonwealth government to address skill shortages.

A set of priorities with specific actions has been developed to ensure Queensland has the necessary skill set to sustain economic development. These priorities include:

- developing the skills of existing workers and apprentices
- engaging unemployed and under-employed people
- improving youth transitions to enhance education, training and employment outcomes
- building the capacity of the Queensland vocational employment and training sector
- building bridges to the professions.

The *Queensland Skills Plan* acknowledges that the challenge of addressing the state's skill needs cannot be met by the government alone. Accordingly, the plan seeks continued strong partnerships between government, business and industry, its workforce, and vocational and higher education providers in implementing the plan.

B.19.2.1.5 Townsville Community Plan 2011-2021

The *Townsville Community Plan 2011-2021* (TCC, 2011a) is a strategic plan for the future that the community, council, government, non-government organisations, businesses and stakeholders can work towards together.

The plan acknowledges that the large, transient workforce of Townsville, particularly due to the growing defence presence and the fly-in/fly-out workers from the mining industry, contributes to increased pressure on the affordable housing market. The plan notes that there is new development occurring on the urban fringes to cater for the growing population; however, there is increased pressure on human services such as health and education. Employment and training opportunities for youth have also been identified as challenges for the community.

Although the Townsville economy has experienced rapid growth over the past decade, which can largely be attributed to tourism, mining and defence, the remote location continues to present challenges for connectivity to other major regional centres. The community plan also notes that, as mines have a finite production life, Townsville's economic development will be impacted by the life-cycle of mining activities.

The plan organises the community visions into the following target areas:

- a strong, connected community – pride in culture and lifestyle
- environmentally sustainable future – impact reduction
- sustaining economic growth – balanced economic growth
- shaping Townsville – infrastructure and services.

The plan notes that it is critical for council to work in partnership with government agencies, community organisations and mining industry stakeholders to ensure the plan is effectively implemented to foster the local growth and development while maintaining social inclusion and environmental preservation.

B.19.3 Existing Values, Uses and Characteristics

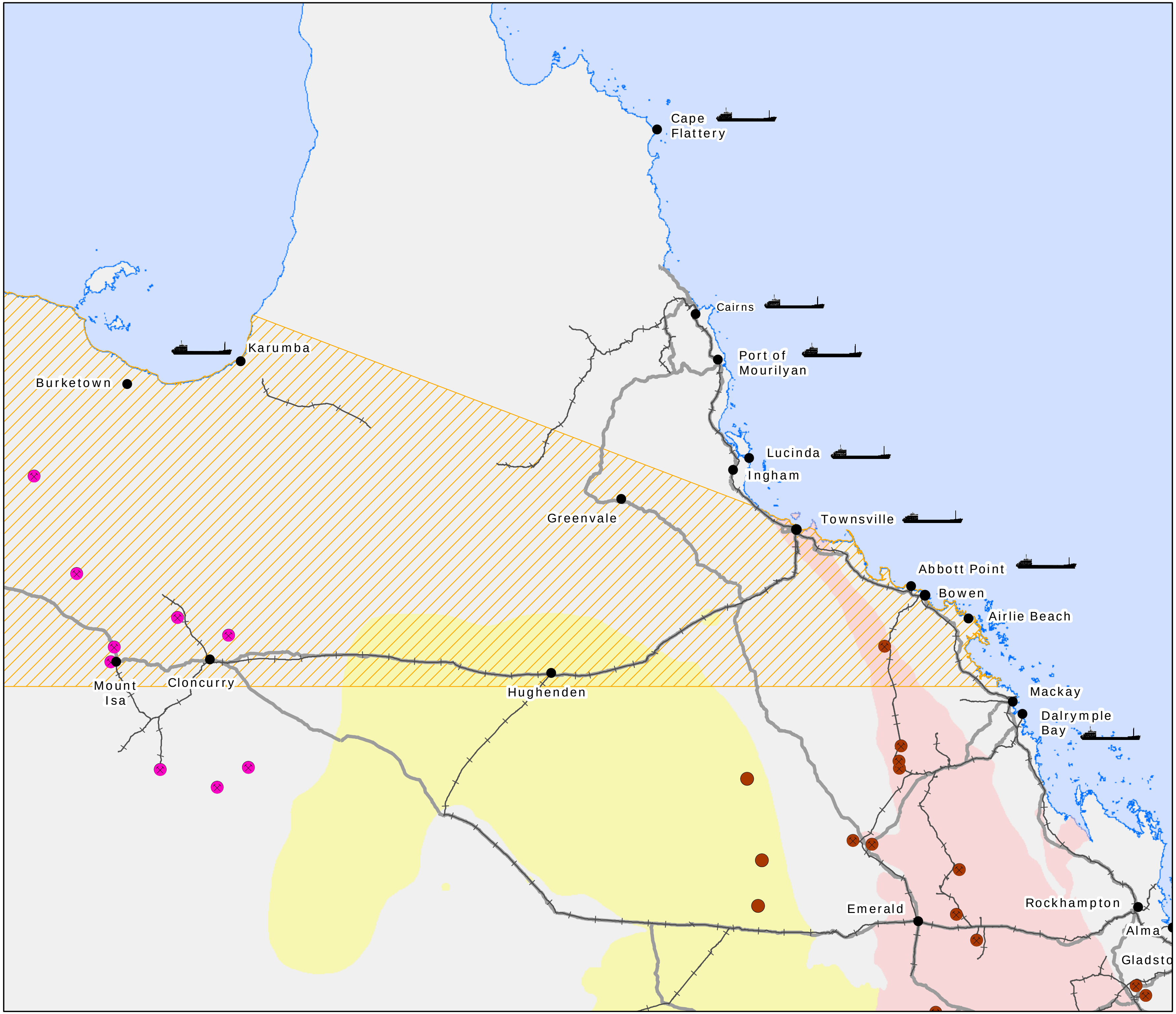
B.19.3.1 Geography of the Region

Townsville is located in the NET. The NET is shown in Figure B.19.2 and the relevant statistical boundaries are shown in Figure B.19.3.

PORT EXPANSION PROJECT
EIS

Northern Economic Triangle

Figure B.19.2



Legend

- Queensland Port
- Localities
- Mineral Mines
- Coal Mine
- Coal Deposit
- Highways
- Main Railway Lines
- Bowen Basin
- Galilee Basins
- Northern Economic Triangle (approx)

N

Scale: 1:6,000,000 (when printed at A4)

0 50 100 200

Kilometres

PROJECT ID	60161996
LAST MODIFIED	CFS 05-Oct-2012
FILE NAME	60161996_PLN_121

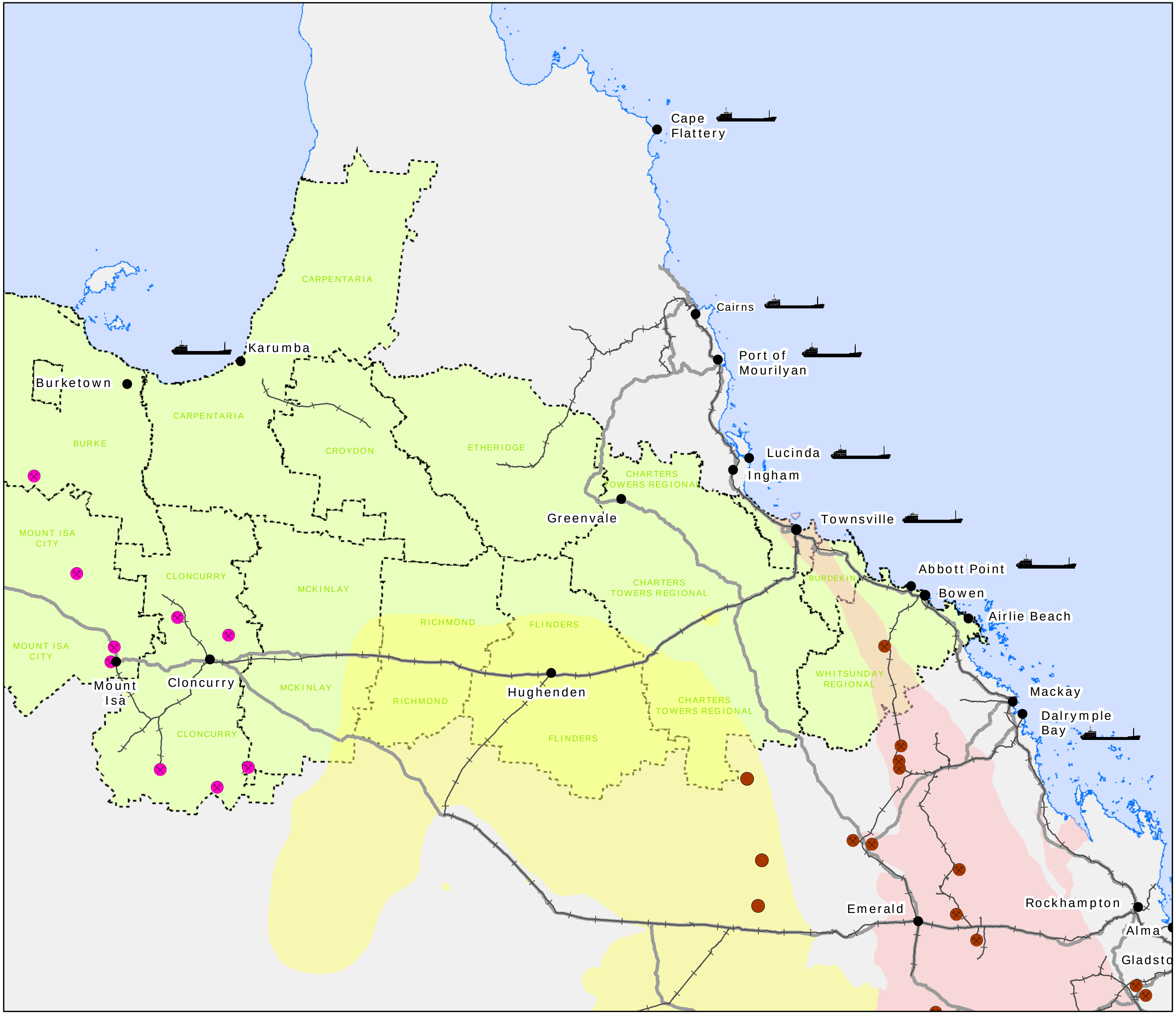
Data Source:

Northern Economic Triangle, derived from Northern Economic Triangle Map, Department of State Development, Infrastructure and Planning.

PORT EXPANSION PROJECT
EIS

Northern Economic Triangle
Statistical Boundaries

Figure B.19.3



Legend

- Queensland Port
- Localities
- Mineral Mines
- Coal Mine
- Coal Deposit
- Highways
- Main Railway Lines
- Bowen Basin
- Galilee Basins
- Northern Economic Triangle Statistical Boundaries Study Area

N

Scale: 1:6,000,000 (when printed at A4)

0 50 100 200

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_122

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Northern Economic Triangle Statistical Boundaries - NRW LGA 2009

The local government area (LGA) boundaries, as defined by the Australian Bureau of Statistics (ABS), do not exactly match the state government delineation of the region. The data compiled represent the boundaries that most closely align with ABS definition, while including all the main population centres of the region.

The Townsville City Council has included Thuringowa since the 2008 council mergers. Data from earlier years for Thuringowa has been included to ensure council boundaries are consistent with the post-merger data.

B.19.3.2 Population

Table B.19.1 shows the population of the NET by LGA. The NET has experienced a steady increase in population over the period 2006 to 2010, mainly driven by development in the Townsville and Whitsunday LGAs, which accounts for 77.1% of the population of the region.

In contrast, most of the smaller LGAs with less than 1,000 inhabitants, such as Croydon, McKinlay, Flinders and Richmond, exhibit a negative annual growth rate. The size of these areas is such that their decreasing population exerts little impact on the overall NET situation, which shows compound population growth of 2% per annum over the period 2006 to 2010. Table B.19.2 shows a summary population profile.

Table B.19.1 Population by LGA (ABS, 2012b)

LGA	Population		Compound annual growth rate	Share of NET 2010
	2006	2010		
Burdekin	18,085	18,531	0.49%	6.5%
Burke	531	554	0.87%	0.2%
Carpentaria	2,076	2,149	0.70%	0.8%
Cloncurry	3,366	3,384	0.11%	1.2%
Croydon	274	273	–0.07%	0.1%
Doomadgee	1,170	1,285	1.97%	0.5%
Charter Towers	12,155	12,837	1.12%	4.5%
Etheridge	900	925	0.56%	0.3%
Flinders	1,911	1,821	–0.94%	0.6%
McKinlay	955	944	–0.23%	0.3%
Mount Isa	21,114	21,994	0.83%	7.7%
Richmond	969	951	–0.37%	0.3%
Townsville	165,278	185,768	2.48%	64.9%
Whitsunday	31,355	34,765	2.18%	12.2%
Total NET	**260,139**	**286,181**	**2.00%[1]**	**100.0%**

1 This is the average value for the whole of the NET

Table B.19.2 Population Profile

Component	Townsville (%)		NET Median (%)		Queensland (%)		Australia (%)	
	2006	2010	2006	2010	2006	2010	2006	2010
Age distribution								
0 to 14 years	21.4	20.7	23.9	24.9	20.4	20.0	19.6	18.9
15 to 24 years	16.7	16.8	12.9	15.0	14.1	14.3	13.9	14.1
25 to 34 years	15.4	15.8	14.0	14.2	13.9	14.1	14.0	14.3
35 to 44 years	14.8	14.2	14.3	13.0	14.7	14.2	14.8	14.2
45 to 54 years	13.2	13.1	13.7	13.0	13.7	13.5	13.8	13.6
55 to 64 years	9.4	9.9	12.1	11.8	11.1	11.3	10.9	11.4
65+ years	9.0	10.6	8.9	11.5	12.1	14.1	13.0	15.3

Component	Townsville (%)		NET Median (%)		Queensland (%)		Australia (%)	
	2006	2010	2006	2010	2006	2010	2006	2010
15 to 64 years	69.5	69.8	67.0	67.0	67.5	67.4	67.4	67.6
Household type								
Lone person	21.3		22.6		22.8		24.4	
Group	5.3		4.8		4.5		3.9	
Family	73.4		72.6		72.7		71.7	
couple with children	44.5		44.0		43.3		45.3	
couple without children	37.2		38.6		39.1		37.2	
lone with children	16.6		15.8		15.9		15.8	

Source: (ABS, 2012b),
Note: 2010 Household type not presently available

Apart from the small increase in the share of people aged 65 and over, the age distribution in Townsville did not change substantially from 2006 to 2010. The increase in the over 65 age group is in line with the trends observed in the region and in the country generally. In both years the total proportion of people in the age group 55 and upwards in Townsville was actually smaller than in the NET, Queensland and Australia.

Townsville also has a lower proportion of people younger than 24 years compared with the NET, but a higher proportion than the state and Australia. The median age in Townsville is 32 to 33 years, while the median age in Queensland is 36 years.

In 2006, families comprising a couple with children are the most common household type in Townsville (44.5%), followed by couples without children (37.2%) and lone parents with children (16.6%). There is little difference between household profiles in Townsville, the NET, Queensland or Australia. Overall, Townsville has a slightly younger and more rapidly growing population than the state and national averages.

Table B.19.3 Population Growth, Migration and Location (ABS, 2012b)

Component	Townsville (%)	NET median (%)	Queensland (%)	Australia (%)
Population growth (2006 to 2010)	2.5	0.6	2.1	1.6
Fertility rate (2009)	2.0	2.2	2.1	1.9
Standardised-death rate (2009)	6.5	7.1	6.1	5.9
Net migration [1]	7.0	5.6	6.1	5.6
Population background 2006				
Indigenous population	5.9	7.9	3.5	2.5
Overseas born	12.5	12.0	19.2	23.8
Mobility (over 5 years) [2]	64.0	58.9	59.8	52.5
Population by section of state 2006				
Major urban (>100,000)	83.3	52.9	64.0	66.6
Other urban (1,000 to 99,999)	9.2	32.5	21.4	21.6
Bounded locality (200 to 999)	2.3	3.3	2.6	2.5
Rural balance	5.2	11.2	12.0	9.4

1 Net migration is calculated as annual population growth subtracted from the natural growth rate, i.e. fertility rate minus death rate.
2 Mobility refers to the share of population that has not been living at the same address five years ago.

Table B.19.3 shows population growth and its components. The net migration rate into Townsville (7%) is higher than the rate in the NET, Queensland and Australia. According to the Queensland's Office of Economic and Statistical Research (OESR, 2012a), the fastest growing LGAs between 2011 and 2031 are projected to be Whitsunday and Townsville, with an average annual growth rate of 2.2%.

In terms of population composition, the 2006 census data show that there is 5.9% of Indigenous population and 12.5% overseas born residents in Townsville. These percentages are similar in the NET, but clearly differ at the state and national level, where there is only approximately half of this proportion of Indigenous population and almost double the proportion of the population was born overseas.

The rate of mobility is measured as the proportion of people that have not lived in the same address over the last five years. In Townsville this rate is 64%, among the highest in the NET, and higher than in Queensland and Australia. The data on population by section of the state indicates that the Townsville LGA covers a major urban centre where most people live (83.3%), and has only a minor part of rural population.

B.19.3.3 Townsville Futures Plan

The *Townsville Futures Plan* (TFPT, 2011) sets out a vision for Townsville to 2031, proposing the city as a future second capital for Queensland. It notes that Townsville is the largest and fastest growing regional centre outside the South East Queensland and it has been identified as a key centre with the potential for a bigger role supporting the state's capital. The *Townsville Futures Plan* is intended to assist in ‘making Townsville a destination of choice, by drawing on the region's strengths and opportunities to create a dynamic and globally engaged economy’. Table B.19.4 shows the population projections set out in the *Townsville Futures Plan*. The low projection shows growth of the 2010 population by 33.8%, while the medium and high projections represent growth of 45.6% and 62.6% respectively. While these are large changes, they are expected to take place over a long period, and the corresponding (compound) annual growth rates are modest, between 1.4% and 2.3%, as shown in the table.

Table B.19.4 Futures Plan Population Projections (TFPT, 2011)

Year	Low	Medium	High
2010	185,768	185,768	185,768
2011	187,441	191,329	196,145
2016	210,078	218,660	229,941
2021	226,401	239,619	257,722
2026	238,451	255,986	280,736
2031	248,487	270,500	302,044
Compound annual growth rate	1.4%	1.8%	2.3%

B.19.3.4 Regional Economic Performance

Economic performance is usually measured using three principal statistics, both at points in time and in terms of growth over time. The statistics are:

- gross regional product or gross state product
- gross regional product or gross state product per capita
- gross regional product or gross state product per worker.

Table B.19.5 shows that the gross regional product in Townsville is estimated to be $9.8 billion for 2008/09.

Table B.19.5 shows the increasing trends for gross regional product from 2005/06 to 2008/09 in nominal (money of the day) terms, which includes inflation. Gross regional product increased at a compound rate of 10.6% per annum (nominal gross regional product at factor cost), which is a marginally slower compound rate than that calculated for the whole of Queensland. The growth in the local economy is driven by population growth, major public sector investment and the strategic rail connection to the resources sector mining activities in North West Queensland.

Output per worker has been estimated by compounding forward the 2008/09 gross regional product/gross state product data and dividing by numbers employed in Townsville and Queensland, respectively. This shows that the state’s output per worker was 7% higher than in Townsville in 2010. Differences in output per worker reflect factors that include amounts of capital per worker and the sectoral composition of output.

Townsville City Council estimates that Townsville's CBD contributes more than 10% of the output for the North Queensland economy, or approximately $1 billion annually.

Table B.19.5 Output Data (ABS, 2011b)

Period	Townsville (Gross Regional Product)	Queensland (Gross State Product)
2005/06	$7,250M	$172,553M
2006/07	$7,548M	$191,811M
2007/08	$9,072M	$208,275M
2008/09	$9,800M	$235,328M
Annual growth rate (compound rate)	10.6%	10.9%
Output per worker (2010 estimate)	$107,363	$114,989

B.19.3.5 Labour Force

Table B.19.6 presents labour force data, including income data, workforce size, labour force participation and unemployment for Townsville and the NET in comparison with Queensland and Australia.

The workforce in Townsville has increased by 14.6% over the period 2006 to 2010. This increase is consistent with the trends in Queensland, and is higher than the Australian level of increase of approximately 10%. The NET has experienced an overall contraction of the workforce and at least 50% of the LGAs have also experienced a contraction. Labour force participation rates in both Townsville and the NET were over 70% in both 2006 and 2010. These rates were greater than those in Queensland and Australia.

Unemployment rates in both Townsville and the NET were below those of Queensland and Australia in 2010. This was an improvement on the 2006 position, when unemployment rates in both Townsville and the NET were above those of Queensland and Australia. Between 2006 and 2010 unemployment rates decreased in both Townsville and the NET (from 5.5% to 4.2% and 4.8% respectively), but at the same time rates slightly increased in Queensland (from 5.0 to 5.7%) and Australia (from 5.1 to 5.5%). This reduction in unemployment is largely as a result of the increasing industrial activity in the NET, particularly in the resources sector.

The income data indicate that wage and salary incomes in Townsville were very similar to those in Australia in 2010, but higher than those in the NET and in Queensland. This is somewhat at variance with the estimates of output per worker; the differences may reflect differences in the data sets, as output per worker includes profits as well as workers' incomes. Rewards to capital may be significantly higher in Townsville than in Queensland, relative to total output. Lower personal incomes and a greater leakage of output through profits accruing to external organisations and external residents would mean that less income is recycled in the Townsville economy than would be the case if the proportion of local wage and salary income in total output were higher. Wage and salary income in Townsville has increased at a faster rate than in the NET, Queensland and Australia, between 2006 and 2010. In contrast, the average investment income in Townsville ($4,463) is, along with the NET median ($5,527), relatively low compared with the Queensland and Australian averages ($7,155 and $8,092 respectively). The average total income in Townsville in 2010 was $46,922, which is approximately the same level of the Australian average $46,904, but greater than in the NET and in Queensland.

The nature of the industry expansion in the NET means that the occupations presently most in demand are technicians and trade workers. In Townsville, the 2006 census indicated that wage and salary earners were mostly professionals (16.2%) and technicians and trade workers (16.9%), followed by administrative workers (14.8%) and community and personal service (11.7%). Compared with Queensland and Australia, Townsville and the NET have proportionately fewer people with bachelor level degrees or higher, and have proportionately fewer people employed as managers and professionals, but have proportionately more people employed as technicians, trade workers and in community and personal service occupations. This is consistent with the data on wage and salary incomes.

Table B.19.6 Labour Force Data (ABS, 2012b)

Component	Townsville		NET		Queensland		Australia	
	2006	2010	2006	2010	2006	2010	2006	2010
Average personal finance								
Wage/salary income ($)	39,577	46,655	33,694	39,419	37,680	44,501	40,276	46,599
Taxable income ($)	44,946	54,328	43,080	50,366	44,306	54,126	47,064	57,208
Investment income ($)	4,559	4,463	4,926	5,527	6,546	7,155	7,025	8,092
Superannuation and annuity income ($)	19,675	21,471	18,578	19,655	22,383	21,411	23,503	23,214
Total income ($)		46,922		38,341		44,239		46,904
Labour market								
Workforce size	91,928	105,358	126,300	122,000	2,097,340	2,407,035	10,577,883	11,652,019
Total employment (%)	94.5	95.8	94.5	95.2	95.0	94.3	94.9	94.5
Unemployment rate (%)	5.5	4.2	5.5	4.8	5.0	5.7	5.1	5.5
Participation rate (%)	70.7	70.5	73.0	70.6	64.4	65.4	63.5	63.0
Qualifications (% total population)								
Postgraduate degree (%)	1.8		1.4		1.9		2.6	
Graduate diploma and graduate certificate (%)	1.0		0.8		1.2		1.4	
Bachelor degree (%)	9.7		8.3		10.0		11.6	
Others: advanced diploma, diploma, certificate (%)	37.6		38.1		37.3		36.9	
Total with qualifications (%)	50.0		48.6		50.4		52.5	
Occupations (wage and salary earners)								
Managers (%)	9.9		11.7		12.4		13.2	
Professionals (%)	16.2		14.3		17.1		19.8	
Technicians and trade workers (%)	16.9		16.7		15.4		14.4	
Community and personal service (%)	11.7		10.5		9.1		8.8	
Clerical and admin workers (%)	14.8		13.2		14.8		15.0	
Sales workers (%)	9.9		9.2		10.4		9.8	
Machinery operators and drivers (%)	8.0		9.6		7.2		6.6	
Labourers (%)	10.8		12.9		11.9		10.5	
Others (%)	1.7		1.9		1.8		1.8	

B.19.3.6 Key industries

Townsville has a highly diversified economy, in which no single sector dominates the local economy in terms of contribution to gross regional product. The largest contribution to gross regional product is that of the construction sector, followed by activities in relation to financial and insurance services, public administration and safety (including defence) and ownership of dwellings.

Figure B.19.4 and Figure B.19.5 present a comparison of the contribution of each industry sector to Townsville's gross regional product and the NET's gross value added[1] Figure B.19.5 shows the greater dominance of the mining sector in the NET.

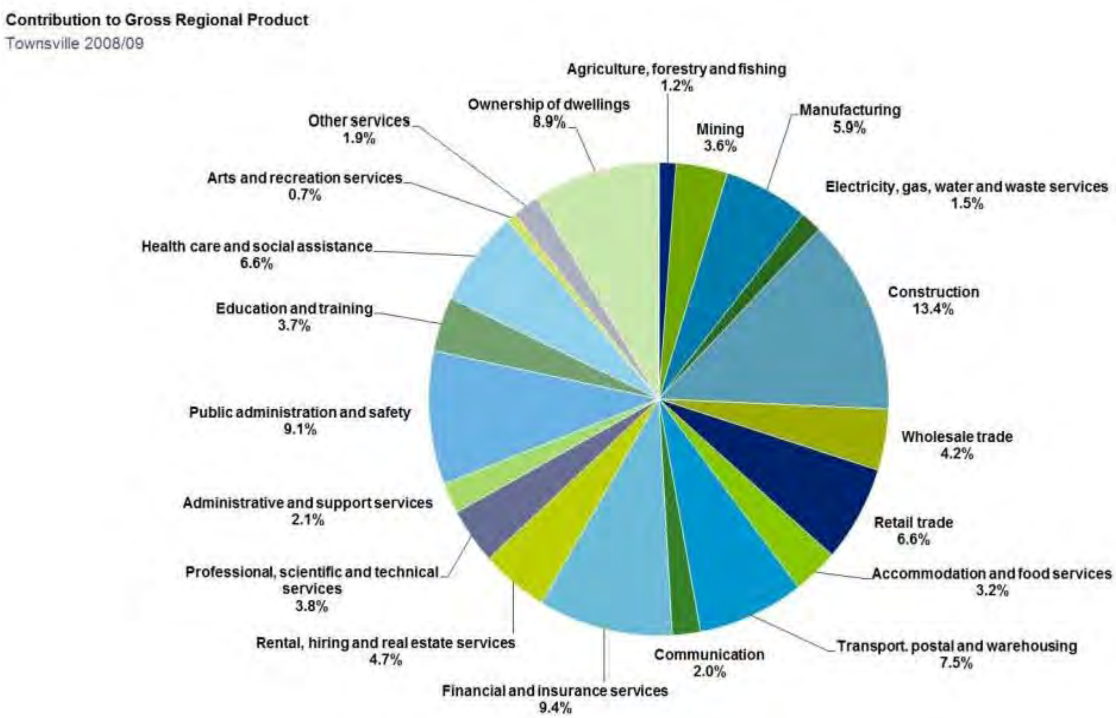


Figure B.19.4 Sector Contribution to Gross Regional Product: Townsville 2008/2009

[1] It was not possible to obtain gross regional product data by LGA. However, this comparison is appropriate after removing the share for taxes and subsidies and adjusting the gross regional produce shares accordingly.

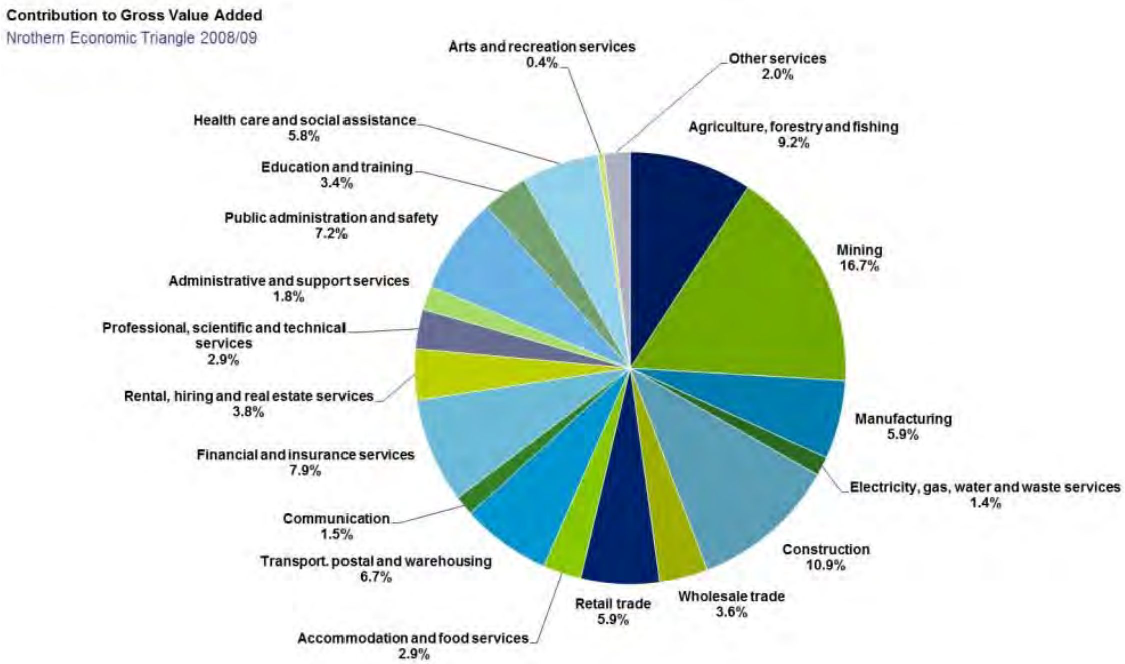


Figure B.19.5 Sector Contribution to Gross Regional Product (Value Added): NET

Figure B.19.6 shows the contribution by sector to Queensland's gross state product, which also shows the importance of the mining sector.

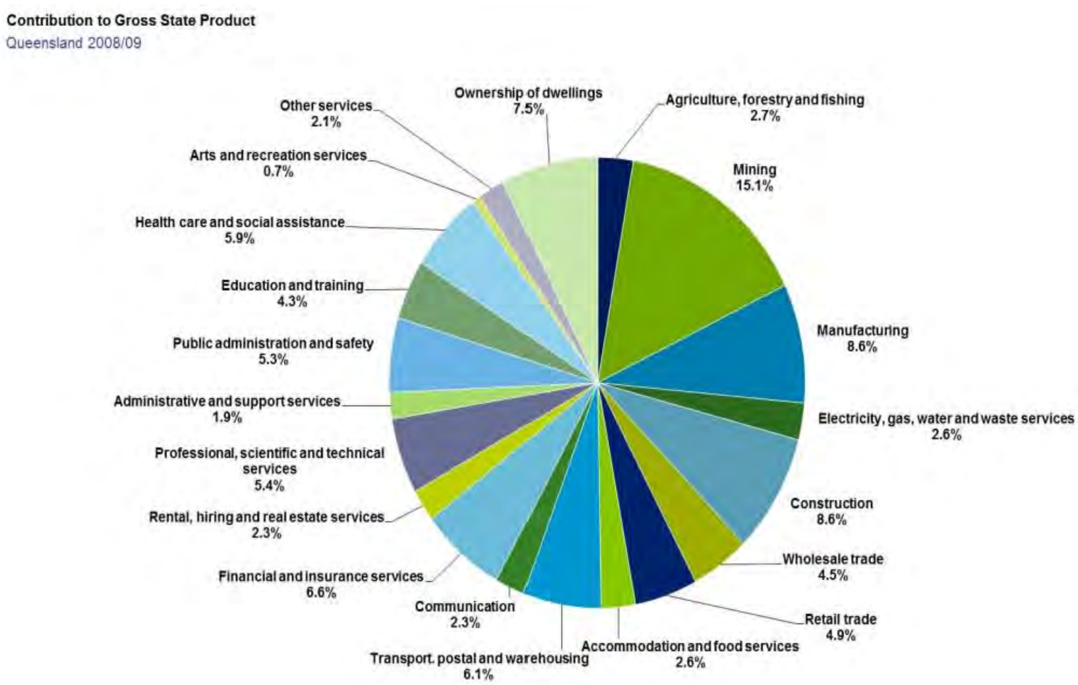


Figure B.19.6 Sector Contributions to Gross State Product: Queensland

Figure B.19.7 shows the employment shares by industry in Townsville and the NET, compared with Queensland and Australia. Labour intensive industries will receive a greater weight than they do in the gross regional product / gross state product analysis. In 2006, the sectors generating most employment in Townsville were the construction sector, retail trade, public administration and safety (including defence), and health care and social assistance. Townsville is a main defence centre in Australia, hosting the Royal Australian Air Force Base Townsville and Lavarack Barracks Army base including from late 2011 the third Battalion, Royal Australian Regiment..

The profile of employment by industry sector in Townsville broadly resembles the overall profile in Queensland and Australia, which indicates a well-diversified local economy. In contrast, the NET exhibits more concentrations of employment in a small number of sectors. The NET has its largest shares of the workforce engaged in agriculture and mining. Other sectors with a large share of employment in the NET are the transport, postal and warehousing sectors, as well as public administration and safety (including defence).

By way of contrast, the economic composition of most LGAs around Australia would tend to display activity that is more concentrated in only a few sectors. The main area of difference compared with state and national comparators is the relatively larger participation in the construction sector, as a result of emerging investments in infrastructure, and in community services such as health care, social assistance, public administration and defence, which are all centralised in Townsville, as the main city in North Queensland.

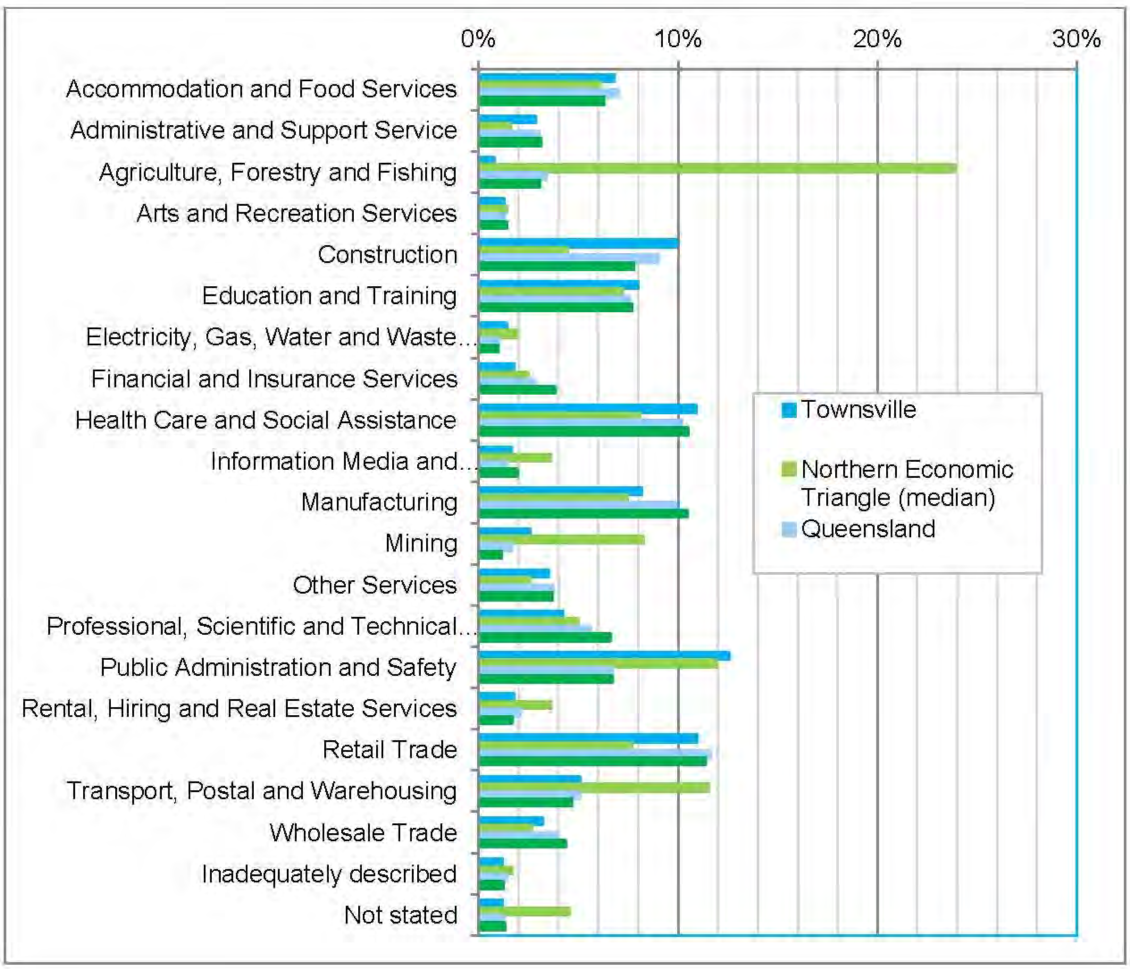


Figure B.19.7 Employment Shares by Sector (2006)

The *Townsville Futures Plan* observes that defence and tourism are important activities in Townsville. Defence is included in the category 'public administration and safety', which accounted for 12.6% of Townsville LGA employment in 2010. Defence is especially important as Townsville is home to a major Royal Australian Air Force base and to the Lavarack Barracks army base.

Tourism is an activity that cannot be identified directly from employment data. This is because tourism is not an industry or sector, but rather is a collection of activities that are supported partly by spending by leisure and business visitors. Visitors purchase services and goods such as accommodation, food and drink, car hire, fuel and other retail items, but local residents also purchase these items. Estimates of tourism impact requires data on visitor-spend by sector, and by how much sectors such as accommodation and food buy from other providers in a region (backwards linkages). Other public and private services are also required to support the population, for example health care, education, retailing and energy. The proportions of employment by sector are shown in Table B.19.7.

Table B.19.7 Employment by Sector (2006) (TFPT, 2011; ABS, 2012b)

Sector	Townsville LGA (%)	Queensland (%)
Public administration and safety	12.6	7.1
Wholesale trade	11.0	9.0
Heathcare and social assistance	10.9	4.0
Construction	9.9	14.3
Manufacturing	8.2	13.9
Education and training	8.0	4.1
Accommodation and food services	6.8	5.3
Transport port and warehousing	5.1	7.2
Professional, scientific and technical services	4.2	5.4
Other services	3.5	3.8
Retail trades	3.2	4.9
Administration and support services	2.8	2.7
Mining	2.6	2.7
Financial and insurance services	1.8	2.2
Rental, hiring and real estate	1.8	1.8
Information media and telecomms	1.6	1.5
Electricity, gas, water and waste	1.4	1.5
Arts and recreation	1.3	1.3
Agriculture, forestry and fishing	0.8	4.2
Inadequately described or not stated	2.4	3.0

This shows that the economy of Townsville is diversified, with a wide range of services including health, education, wholesale and retail trades. It also shows that in terms of employment, dependency on transport, manufacturing and construction were lower than in the state as a whole.

B.19.3.7 Other Relevant Activities: Commercial Fishing and Recreational Sailing

Cleveland Bay, in which the Project Area is located, is used for other purposes, including commercial fishing and recreational sailing. Additional infrastructure and facilities were provided for commercial marine users through the Townsville Marine Precinct project which cost approximately $110M and was completed in 2011. The project involved creation of new space through movement of 500,000 t of fill to provide an 18 ha site located at the mouth of Ross River. It is claimed that the project will protect 500 jobs in existing marine industries in Townsville. The precinct provides a safer and cleaner home for Townsville's commercial fishing fleet, marine fabrication and repair industries, marine research facilities and other marine operators. The precinct comprises an outer rock wall enclosing an inner harbour with fishing trawler jetties and reclaimed land for the construction of buildings and lift out facilities for marine support industries.

The Townsville Marine Precinct project will have no direct impact on the estimated 11,500 recreational sailors in the area. Relocating current upstream marine businesses to the new precinct has freed up prime locations and will allow for the creation of up to 16 new boat ramp lanes, two pontoons and more than 250 car trailer parks. The precinct is to be jointly funded by the Queensland Government and POTL.

This development is on the eastern side of the port and is some distance from the main port activities, which are located on the western and northern sides of the port land.

B.19.3.8 Input costs - labour

The costs of labour are largely determined by market forces in the regional labour market. Difficulties in recruiting staff and a lack of potential recruits compared with the requirement for labour to meet output targets will tend to bid up wage rates. Jobs that require specialist labour that is in short supply nationally, or jobs that are unpopular and difficult to attract recruits will generally have higher wage rates than jobs that tend to be easier to fill. Labour market data on wages provides information on current underlying supply and demand conditions.

Table B.19.8 and Figure B.19.8 illustrate the absolute values of average wages in Townsville, Queensland and Australia in 2006 to 2009, and wages growth respectively.

Figure B.19.8 uses index numbers, with wages in each geography set at 100 in 2006. These show that absolute values of wages in Townsville have increased at a faster rate than in Australia and that the overall rate of growth was very similar to that in Queensland as a whole. Townsville's wage remains around 5% higher than that of Queensland, but has increased slightly relative to wages in Australia.

Figure B.19.9 provides histograms showing weekly earnings for potentially relevant industries for the PEP. This figure shows that the construction, manufacturing and the financial and insurance services have a similar income distribution, with most people earning in the range $400 to $1,000 per week. Opposite to the high income figures in the mining sector (earning mostly above $1,000 per week), the large majority of workers in the retail sector earn less than $600 per week.

Table B.19.8 Weekly Wage Income (ABS, 2012b)

Area	2006	2007	2008	2009
Townsville	$760.7	$799.6	$837.0	$897.2
Townsville 2006 = 100	100.0	105.1	110.0	117.9
Townsville wage as % of Queensland wage	105.0	104.6	104.4	104.8
Townsville wage as % of Australia wage	98.2	98.8	99.1	100.1
Queensland	$724.6	$764.1	$801.7	$855.8
Queensland 2006 = 100	100.0	105.5	110.6	118.1
Australia	$774.5	$809.3	$844.7	$896.1
Australia 2006 = 100	100.0	104.5	109.1	115.7

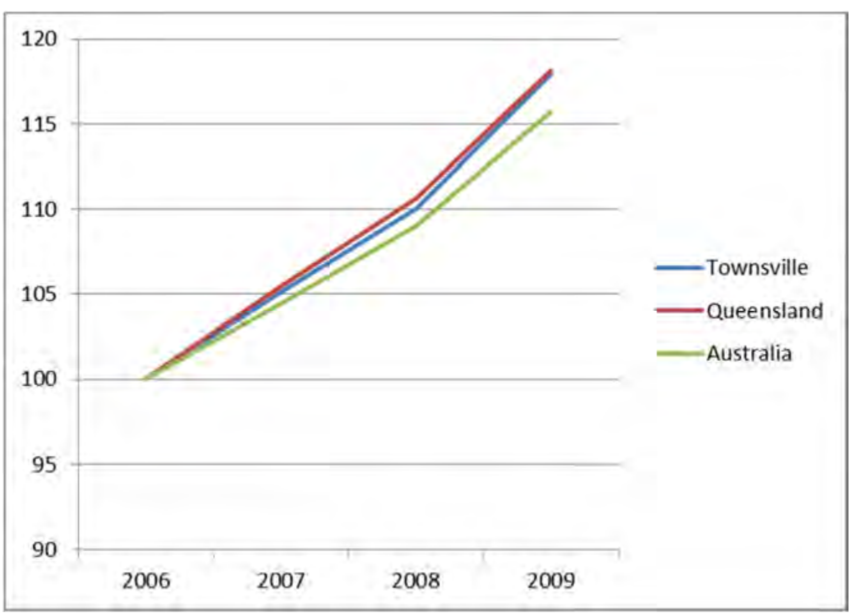


Figure B.19.8 Wages % Growth (2006 = 100)

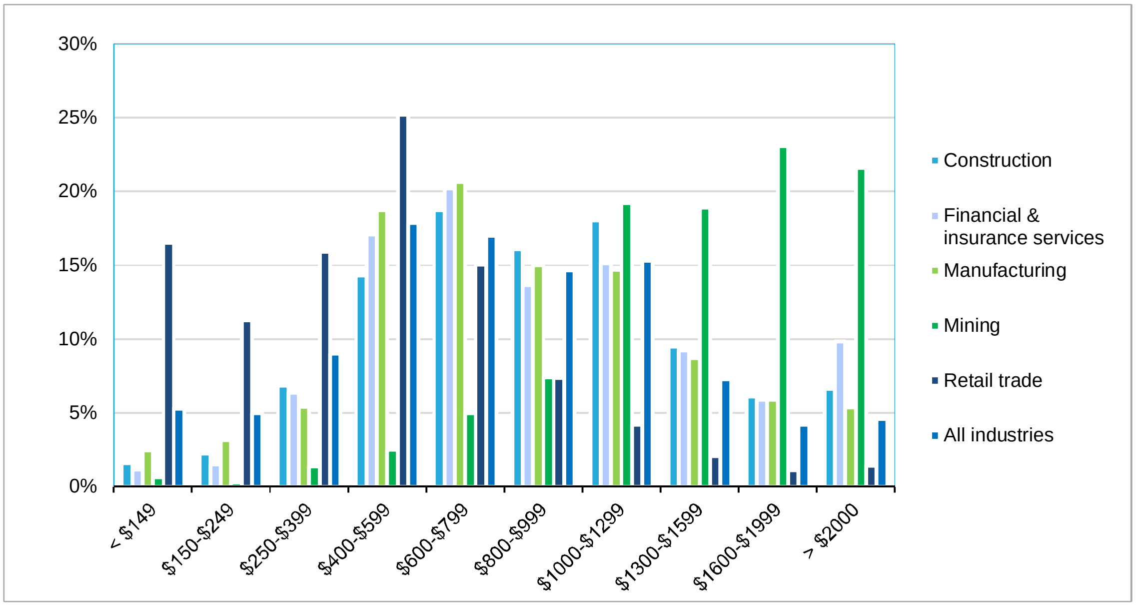


Figure B.19.9 Weekly Wage Levels inRelevant Economic Sectors

B.19.3.8.1 Input Costs – Land

The value of land in Townsville has increased significantly between 2002 and 2007, whereas the number of sales appears to have softened since 2008, possibly as a consequence of the global financial crisis. These patterns are shown in Figure B.19.10.

Townsville City Council has indicated that industrial land is available for new development, including the Townsville State Development Area, which covers approximately 4,900 ha and includes the Stuart Industrial Area and the Eastern Access Corridor (Townsville Port Access Road and rail corridor), which is currently under consideration. This facility was created in 2003 with the purpose of supporting development in the North West Minerals Province.

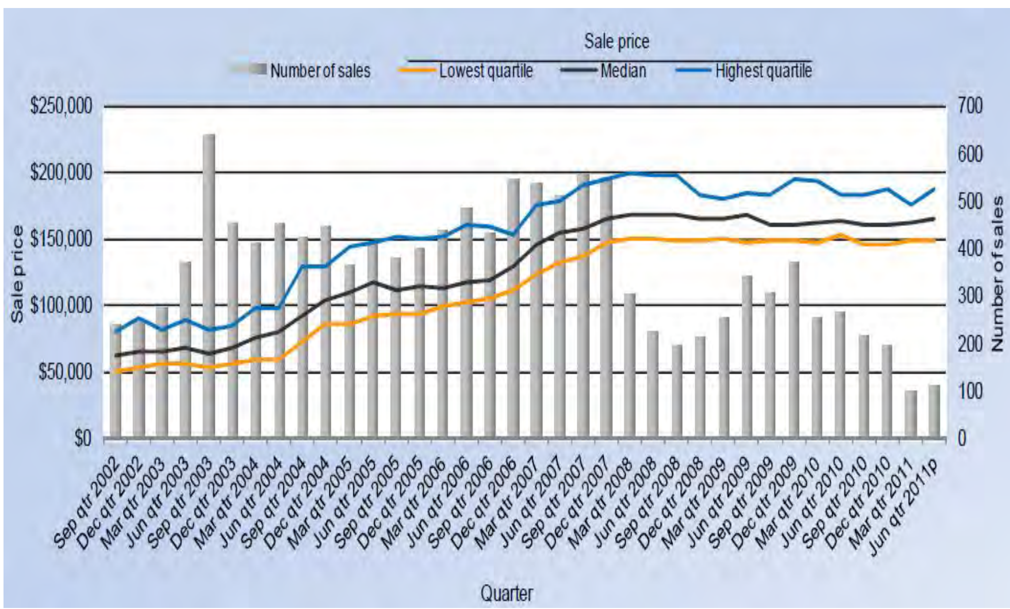


Figure B.19.10 Land Sale Values in Townsville City Council 2002 to 2011 (OESR & QTT, 2012)

p preliminary; subject to revision as a number of sale contracts may not have reached settlement at time of data collection.

Table B.19.9 provides the median value by market sector for Townsville City Council 2010 to 2011 as provided by the Department of Environment and Heritage Protection in the *2012 Valuation Report* (DERM, 2012). The median rural, commercial and industrial land valuations have seen a decrease between 2010 and 2011. The median value for multi-unit and rural residential remained constant over the same period. This data reflects the softening of the market demonstrated in the land value sales above.

Table B.19.9 Median Value 2010 to 2011 for Land Use Types for Townsville City Council (DERM, 2012)

Property Category	Median Value as at 1/10/2010 ($)	Median Value as at 1/10/2011 ($)	Overall Change in Median Value (%)
Multi-unit	210,000	210,000	0.0
Industrial	390,000	345,000	–11.5
Commercial	350.000	345,000	–1.4
Rural residential	190,000	190,000	0.0
Rural	390,000	385,000	–1.3

B.19.3.8.2 Housing

In a rapidly growing region with a transient population due to both defence activity and the growth of the mining sector, there is potential for the housing sector to encounter periods of excess supply or excess demand (bust and boom, in popular parlance). Unforeseen increases in demand can result in a period of increased construction, but by the time buildings are ready for use, the level of demand might have reduced, whether due to cycles in the national economy or to local circumstances.

The value of total building activity, including private sector houses and other dwellings, reflects recent trends of development in the construction market. The quantity of dwellings and aggregate value of total building are presented in Table B.19.10, while Figure B.19.11 (Deloitte, 2012) presents these measures as index numbers with 2005/06 as the reference year. The value of building work approved is calculated based on the value when completed and approved by the relevant authorities. The ABS further clarifies that these data should exclude the value of land and landscaping, but include site preparation costs associated with building activity.

The data show a remarkable peak in building value developed in 2007/08 and is clearly observed at the regional, state and national level. After this year there is a drop in total building value in Townsville, returning to similar levels observed in previous years, which is aligned with a decreasing trend in Queensland. The notable decline in this activity in the most recent financial year in Queensland may be explained by the natural disasters at that time. As can be seen in

Figure B.19.11 and Figure B.19.12, total value and numbers of houses approved have fluctuated considerably. In particular, housing numbers show an upward trend, while total values show a slight downward trend. Building numbers also appear to have risen substantially following a peak in total (and unit) values in 2007/08.

The 2011 Valuer-General's report (DERM, 2012) on the Townsville region (encompassing Townsville, south to the Burdekin, north to the tip of the Cape and west to the Queensland border and including the city of Mount Isa) noted that in general terms, only 'minor changes have been experienced in Townsville residential market since the last evaluation in 2010, with an overall increase of 1.3% in residential land values. This is partly because the Townsville property market is underpinned by a strong tertiary education, government and mining support sector'. The Valuer-General further noted that there had been a period of significant growth from 2004 to 2007 after which the market experienced a slow-down in sales volumes. Towards the end of 2009, 'market confidence had returned to the property sector and this continued through 2010, particularly in the residential sector'.

The national economy plays a role even at the local level through financial markets, and in particular through the lending practices and degree of risk aversion in financial markets. Lending for both construction and purchase of property has exerted a negative effect on the development market, with 'reductions in value being experienced in the residential subdivision land market'. As the economy improves and confidence returns the property sector is expected to benefit. As the Valuer-General's report notes, 'it is taking a long time for these improvements to filter through the property market in general'.

A 2012 commentary on the Townsville market noted the importance of first home buyers in the market. These accounted for 20% of total housing finance commitments taken out in November 2011, compared with 19.1% in October 2011. This market is influenced by both lending practices and government policy. The report notes that the number of first home buyers dropped off in early 2010 following the end of the Commonwealth government's First Home Owner Boost Scheme, which offered additional grants of up to $14,000. For most of 2011, first home buyers accounted for between 16 and 18% of total housing finance commitments. The greater proportion of these buyers in November 2011 helped drive a 1.4% rise in the number of housing finance commitments in the month. It was suggested that with more first home buyers in the market, home prices would stabilise in 2012. Compared with past market levels, sales volumes remain low; however, prices have not declined. The Valuer-General commented that residential land values have generally remained static with the exception of a few locations.

Figure B.19.11 shows sales values as index numbers with a base of 2005 = 100. This shows clearly the steeper downward trend in values in Townsville compared with Queensland and Australia.

Table B.19.10 Value of Construction Activity and Numbers of Dwellings (ABS, 2012a)

Year	Townsville		Queensland		Australia	
	Value ($)	Number of dwellings	Value ($)	Number of dwellings	Value ($)	Number of dwellings
2005/06	792,228	1,097	15,193,735	38,033	61,817,761	152,214
2006/07	873,427	1,716	17,410,559	41,516	67,907,493	153,415
2007/08	1,210,009	1,168	20,640,726	45,052	82,483,934	162,732
2008/09	836,769	2,695	15,769,879	28,954	68,713,621	133,088
2009/10	886,171	1,998	14,774,886	33,889	86,833,145	171,429
2010/11	616,888	1,888	13,842,917	27,470	76,146,694	164,140

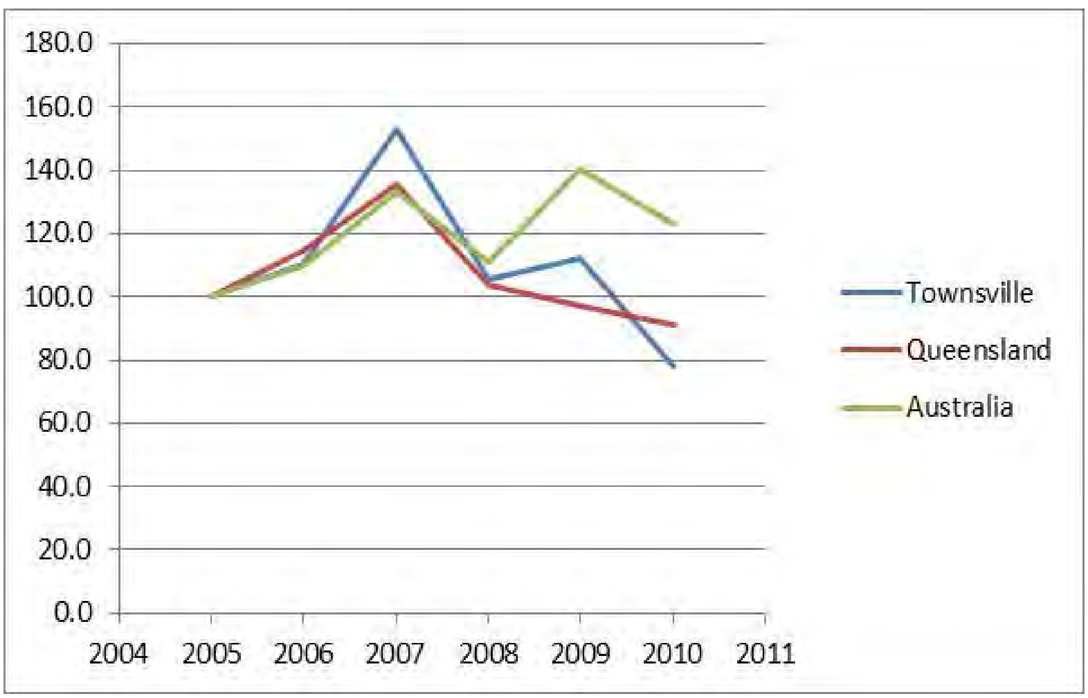


Figure B.19.11 Sales Values by Percentage (2005=100)

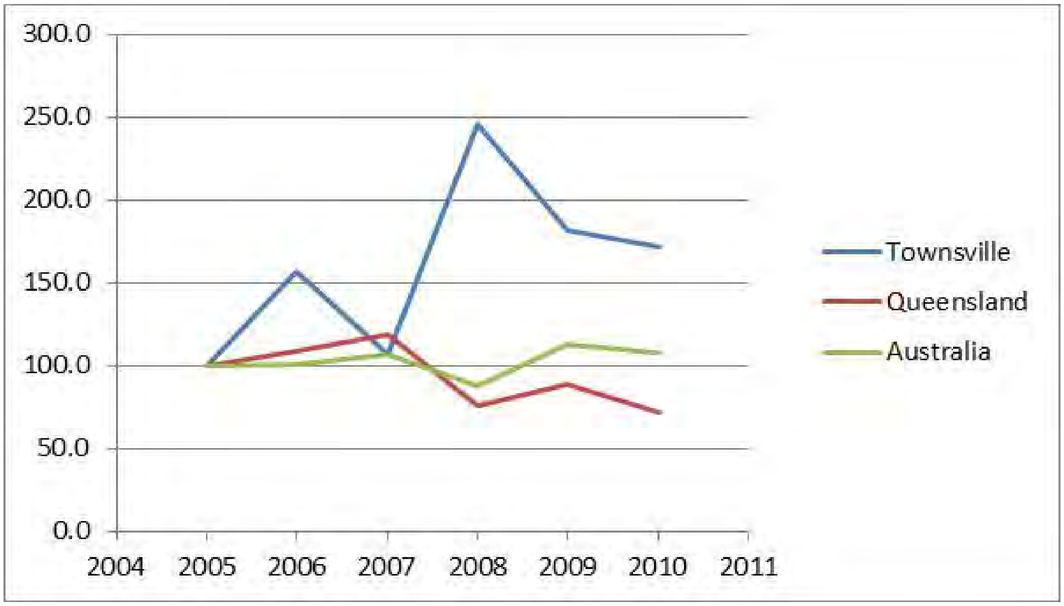


Figure B.19.12 Building Numbers by Percentage (2005=100)

The price of housing in the Townsville has changed significantly in the last six years. Table B.19.11 and Figure B.19.13 show the median house prices for Townsville City Council from March 2005 to March 2011. This figure demonstrates the steady increase in house prices between 2005 and 2008, then the softening of the housing market since 2008. In March 2011 the median house price was $368,000. A report by Herron Todd White (2012) on the Townsville housing market noted that the easing of prices has occurred across both good quality and generic properties alike.

Table B.19.11 Median House Prices and Year-on-Year Percentage Change (PDS, 2012)

Period (Oct to Sept)	South Townsville ($)	% Change	Railway Estate ($)	% Change	Townsville City ($)	% Change
2001 to 2002	120,000	-	120,000	-	142,000	-
2002 to 2003	146,000	21.7	145,000	20.8	160,000	12.7
2003 to 2004	204,000	39.7	205,000	41.4	200,000	25.0
2004 to 2005	245,000	20.1	256,000	24.9	250,000	25.0
2005 to 2006	280,000	14.3	275,000	7.4	281,000	12.4
2006 to 2007	380,000	35.7	329,000	19.6	345,000	22.8
2007 to 2008	342,000	–10.0	360,000	9.4	370,000	7.2
2008 to 2009	380,000	11.1	334,000	–7.2	365,000	–1.4
2009 to 2010	384,000	1.1	365,000	9.3	380,000	4.1
2010 to 2011	340,000	–11.5	330,000	–9.6	377,000	–0.8

Insufficient data available for Magnetic Island

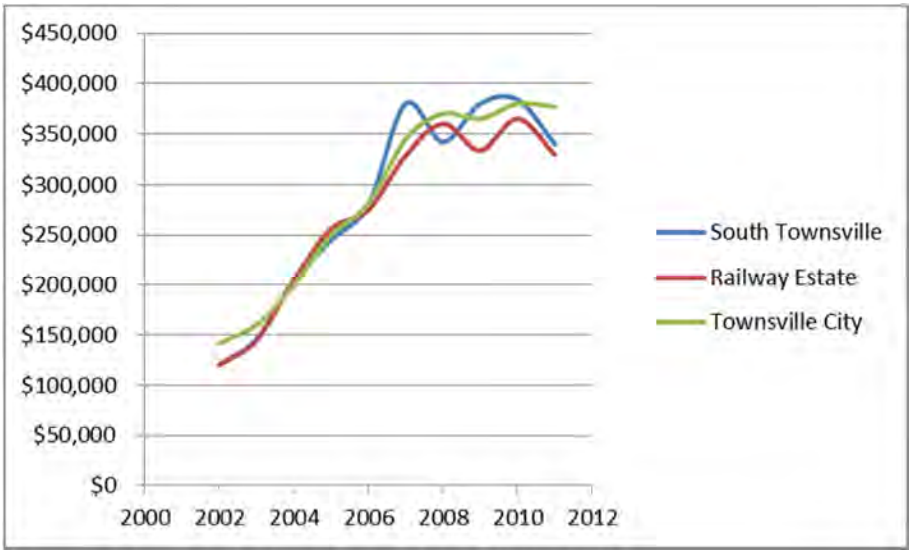


Figure B.19.13 Townsville Median House Prices

Figure B.19.14 show the median unit prices for two areas in Townsville and for the Townsville City Council area from March 2005 to March 2011. The median price for an established unit in March 2011 was $285,000, decreasing from $299,000 in September 2010. The price of new units decreased over the same period from the median price of $368,000 in September 2010 to $355,000 in March 2011. The volume of sales decreased over the same period in both new and established units.

The Herron Todd White report (HTW, 2012) attributed the especially pronounced decrease in sales of new units to the 'very slow demand for new apartments located in tourist oriented areas and/or higher priced CBD developments'. Table B.19.13 shows the median house and unit price for three suburbs and for Townsville LGA for 2011.

Table B.19.12 Median unit prices and year on year percentage change (PDS, 2012)

Period (Oct to Sept)	South Townsville ($)	% Change	Railway Estate ($)	% Change	Townsville City ($)	% Change
2001 to 2002	185,000	-	90,000	-	135,000	-
2002 to 2003	215,000	16.2	108,000	20.0	154,000	14.1
2003 to 2004	235,000	9.3	145,000	34.3	178,000	15.6
2004 to 2005	300,000	27.7	174,000	20.0	220,000	23.6
2005 to 2006	337,000	12.3	199,000	14.4	265,000	20.5
2006 to 2007	400,000	18.7	268,000	34.7	323,000	21.9
2007 to 2008	480,000	20.0	252,000	–6.0	331,000	2.5
2008 to 2009	365,000	–24.0	267,000	6.0	320,000	–3.3
2009 to 2010	500,000	37.0	256,000	–4.1	336,000	5.0
2010 to 2011	380,000	–24.0	268,000	4.7	317,000	–5.7

Insufficient data available for Magnetic Island
Note 2002 refers to the period October 2001 to September 2002

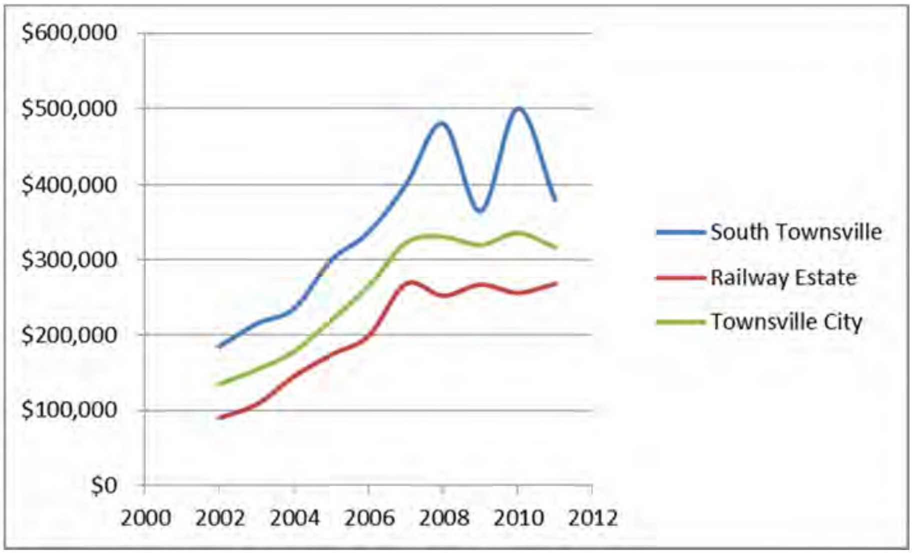


Figure B.19.14 Median Unit Prices

Table B.19.13 Median Dwelling Prices (2011) (APM, 2011)

Suburb	Median house price ($)	Median Unit Price ($)
South Townsville	352,000	380,000
Railway Estate	321,000	*
Magnetic Island	355,000	520,000
Townsville LGA	365,000	325,000

* No data available as numbers are too small to record; statistically not relevant

The tables and figures above illustrate that while the price of housing in each suburb differs, the property markets in each area exhibit the overall same trend of growth and decline as the Townsville LGA. This suggests that the primary impacts to property prices in the Townsville City Council, on aggregate, are driven by macroeconomic state or regional factors.

The *Townsville Residential Land Use Study* (Urbis, 2011) investigated the affordability of housing across Townsville. It concluded that housing affordability is a current and future concern for Townsville. The report identified Magnetic Island as a suburb that is considered unaffordable to the rental market. This is likely to be indicative of the island's tourist role and higher proportion of short-term, tourist-based accommodation, including serviced apartments and bed-and-breakfast accommodation. These types of accommodation generally have a higher rental rate due to the higher levels of service that are provided for this specialist market and are generally not targeted towards a more permanent, residential market.

The high levels of occupancy could suggest that people are prepared to pay a premium for other attributes that the area offers, which may include proximity to services and employment (e.g. CBD and employment from industry in South Townsville, Railway Estate and the port), access to and availability of public transport, and amenity considerations.

The median rents across the 14 LGAs in the wider Study Area are presented in Table B.19.14. The median rent across the wider Study Area differs widely across the LGAs. The highest median rent per week is in Whitsunday LGA at $200 per week. The lowest median rent per week is in Etheridge LGA at $19 per week (or less than 10% of the median rent in Whitsunday LGA). Across the NET the average median rent is $92 per week.

Table B.19.14 Median Rent and Housing Loan Repayments (2006) (ABS, 2006)

Local Government Area	Median Rent ($/weekly) 2006	Median Housing Loan Repayment ($/monthly) 2006
Burdekin	125	867
Burke	50	1,400
Carpentaria	85	802
Cloncurry	75	982
Croydon	95	347
Doomadgee	40	0
Charters Towers	130	867
Etheridge	19	566
Flinders	65	628
McKinlay	50	789
Mount Isa	150	1,083
Richmond	24	521
Townsville	180	1,200
Whitsunday	200	1,300
Average NET	92	873

In the 2006 ABS Census the Median housing loan repayment for Doomadgee LGA was given as $0. Tthis has been removed from the data to obtain an average housing loan repayment for the NET for statistical accuracy.

The median rents for Townsville have varied from between $325 and $350 for a house and $270 and $300 for units over the last four years. There has been a downward trend in rent between December 2009 and September 2010, but the median rent increased by an average of $10 per week for houses and $20 per week for units during the first quarter of 2011. The median rent in March 2011 was $355 per week for houses and $300 per week for units. The Herron Todd White report (2011) suggests that 'tightening vacancy rates means that rents may continue rising over the near term'.

B.19.3.8.3 Population forecasts and housing

Broad estimates of future housing need can be derived from population forecasts and assumptions about household size. Table B.19.15 illustrates possible levels of demand for housing in Townsville based on assumed average future household sizes. It is assumed here that a larger increase in the population is correlated with larger average household size. If average household sizes decline over the period, the demand for additional housing will be greater than shown. This analysis makes no allowance for the replacement of older housing.

Table B.19.15 Housing Demand Projections: Additional Annual Demand (2011 to 2031)

Forecast	Low	Medium	High
Household size (persons)	1.8	2.1	2.4
Additional housing demand			
Annual 2011 to 2016	2,515	2,603	2,816
Annual 2017 to 2021	1,814	1,996	2,315
Annual 2022 to 2026	1,339	1,559	1,918
Annual 2027 to 2031	1,115	1,382	1,776
Total 2011 to 2031	33,914	37,700	44,125
Average construction rate 2005/6 to 2010/11	n/a	1,760	n/a

B.19.4 Assessment of Potential Impacts - Economic Impacts

B.19.4.1 Approach

The approach adopted here complies with the requirements of the *Townsville Port Expansion Project: Terms of Reference for an Environmental Impact Statement*. It involves defining a base case and comparing a ‘with-PEP’ case with the base case. The impacts are the difference between the with-PEP case and the base case. The base case needs to be a realistic forward scenario.

B.19.4.2 Base Case for Appraisal

The current capacity of the port is 23 Mtpa. This capacity includes the inner harbour and the Berth 11 and Berth 12 projects that are part of the baseline.

The outer harbour of the PEP will allow the port to handle the expected growth in trade that arises principally due to development of mineral resources (coal and magnetite) in the hinterland. In total, by 2039/40, the PEP is expected to accommodate 25 Mtpa of additional trade, which would be unable to be accommodated through the baseline port facilities.

To estimate the economic impact of this lost trade (in the ‘do nothing’ or ‘business as usual’ scenario), it is necessary to determine what would happen to trade in the absence of the PEP. As is often the case when measuring economic impacts, the ‘do nothing’ scenario of what might happen in the absence of the PEP is as important as the scenario of what might happen if the PEP proceeds. There are several possible scenarios to be considered. These have different likelihoods of occurrence, as discussed below.

B.19.4.2.1 Do Nothing - Scenario 1

The most likely ‘do nothing’ scenario, that is, if the projected coal and magnetite trades cannot be handled through the Port of Townsville, is that these coal mines and magnetite mines will either not be developed at all or will be developed only in the long term, the latter depending on global prices. This is likely because of the substantial additional costs of transporting these trades to the next closest port (Abbot Point) adds approximately 200 km in travel. Abbot Point also has limited capacity to handle the volumes involved. With the added costs, these trades will become unviable in competition with other sources.

If these resources cannot be exported through Townsville, their development would move substantially up the cost curve of new mine development options. At expected future prices of the mines’ outputs, this would delay the development of mines in the Townsville-Mount Isa corridor by many years. At lower global prices, the resources might not be developed at all.

B.19.4.2.2 Alternative Do Nothing - Scenario 2

A less likely alternative scenario is that some of these trades will divert to Abbot Point, while the development of other sources is delayed, as in the above scenario. Use of Abbot Point involves adding considerable additional rail and sea distances to the export supply chain of resources in the Townsville-Mount Isa corridor. This would also add to transport emissions. Depending on volumes, this may require substantial additional port works at Abbot Point; the cost of which would be saved if the PEP proceeds. In cost-benefit terms, this is a benefit (resource costs avoided) that is attributable to the PEP.

For this scenario to be viable it requires commodity prices for coal and magnetite to remain strong, in order to overcome the additional transport requirements to Abbot Point. This scenario would also require additional facilities to be built at Abbot Point, which would require approvals. As both prices and the required investment and approvals are uncertain, this alternative scenario is not appropriate for assessing the economic benefit of the PEP.

B.19.4.2.3 Displacement of Current Trades at Townsville - Scenario 3

A third ‘do nothing’ scenario assumes that Townsville port capacity remains constrained, but assumes that the emerging magnetite or coal trades are able to outbid nickel ore imports to secure the limited port capacity available, resulting in the loss of nickel ore imports and the loss to the economy of the associated refinery operations at Yabulu.

This scenario is more complex, as it involves the crowding out of a domestic manufacturing facility (processing imported nickel ore at Yabulu) to free up capacity for resource exports. Essentially this is a ‘Dutch Disease’[2] scenario, where mining exports force up the price of the constrained port capacity, making it difficult for users of imported ore to compete and remain viable. An alternative would be for port capacity to be proposed for Halifax Bay. This would have potentially adverse environmental consequences and may add to overall shipping costs.

---

[2] In economics, the Dutch disease is a concept that explains the apparent relationship between the increase in exploitation of natural resources and a decline in the manufacturing sector.

Scenario 2 and 3 are worth noting, but due to their complexity they are less suitable than Scenario 1 for assessing the economic benefits of the PEP.

B.19.4.2.4 Selection of a Base Case

Scenario 1 is adopted as the most likely outcome against which to assess the economic impacts of the PEP. The other scenarios are both less likely and are much more problematic as a statement of the without-PEP outcome. This is because they require some strong assumptions to be made about developments at Yabulu or Abbot Point, which are beyond the control of the proponents of the PEP.

B.19.4.3 Port Investment - Costs and Timing of Port Development

The indicative timings for the PEP scenarios are shown in Table B.19.16[3].

Table B.19.16 PEP Construction Staging

Stage	Indicative Dates	Construction Works
Stage A	2014/15 to 2016/17	Breakwater, revetments, Berth 14 and 15, plus dredging and deepening the channel
Stage B	2018/19 to 2019/20	Berth 16, including dredging
Stage C	2026/27 to 2027/28	Berth 17, including deepening the channel and dredging for the berth
Stage D (i)	2029/30 to 2030/31	Berth 18
Stage D (ii)	2034/35 to 2035/36	Berth 19

The economic impacts have been modelled over these timeframes. The operating life of the mines and the coal export facilities at the port are likely to be very long, typically approximately 50 years. As such, the economic benefits from coal exports and employment opportunities at the port and mines are likely to extend many decades beyond the timeframe modelled here.

Furthermore, the later stages of construction present some modelling challenges, so the later stages are modelled as ongoing port development, rather than attempting to isolate the impact on a particular year (such as 2029/30).

The capital expenditure at the port required to handle the PEP trade forecasts is:

- $1.49 billion (2011/12 dollars) for the construction of port infrastructure in several stages. This includes the breakwater and revetments, berth pocket, shipping channel and associated port infrastructure.
- $1.35 billion (2011/12 dollars) for loading equipment, rail and storage areas needed to handle the trade. These works are necessary to transform the ‘raw’ port land (created from the above $1.49 billion of capital expenditure) into an operational port.
- capital expenditure required at the mine site (inland).

While the focus of the PEP is on the port infrastructure, that infrastructure does not occur in isolation. In order for the economic benefits of coal and magnetite exports to be realised, there needs to be loading facilities at the mine site, and other rail and mine investments. It is that package of investments that allows exports of resources to occur. Hence, to understand the economic importance of the PEP it is necessary to look at the entire envelope of economic activity facilitated or required by the PEP, which includes the mine, rail and loading investments.

The cost estimates exclude the costs of shipping, as this activity would be undertaken (most likely) by foreign flagged vessels. The impacts associated with the actual shipping of outputs are also excluded. This ensures that only the economic activity and employment occurring (in the first instance) in the Townsville LGA, and in the NET are included.

[3] The exact timelines will depend on demand and funding.

B.19.4.4 Impacts

The economic impacts can be described in two phases:

1. construction phase impacts; that is, the economic activity from building port infrastructure, plus storage and loading facilities
2. operational phase impacts (from operating the rail and loading facilities).

B.19.4.4.1 Port Construction

Because the construction occurs in several stages, there will be some overlap with the multiple construction phases and the operational phase. For modelling purposes, the initial phase of works, and the associated operational phases are included. The later stages of construction to the annual equivalent amount of ongoing capital works and growing levels of operations are smoothed out. This is necessary because overlapping multiple phases of construction and operations were not able to be represented in the general equilibrium modelling framework. This smoothing does not impact on the long run employment and economic benefits of the projects or the net present value (NPV) of these.

The localised impacts from the construction phases are likely to be significant and will include:

- breakwaters and revetments, reclaiming land and dredging berth pockets
- earthworks and site preparations
- internal roads and rail tracks around the port site
- loading facilities and prefabricated components
- services such as water, electrical, communications, sewerage and drainage.

Some of the design works, prefabricated components and dredging equipment are likely to come from outside the Townsville LGA. Nonetheless, based on the preliminary information available, the construction phase is likely to require a large amount of the construction work to be performed on site, due to the nature of earthworks, road, rail and other such civil construction methods requiring a substantial degree of on site work. Many of the construction inputs (such as crushed rock and fill) will also need to be sourced from local quarries, due to the bulky low-value nature of these inputs, which makes their transport over a long distance uneconomic.

As such, the local economy’s participation in the construction phase activity is likely to be of a similar proportion to other construction projects in the region. Further detail on the extent of local involvement in the construction work would be part of subsequent feasibility and contracting processes; at this stage, it is not possible to assess exactly which items will be sourced from which locations, as these can only be known with certainty once the location of the successful tender for each supply contract is known.

B.19.4.4.2 Port Operational Phase

During the operational phase, there will be locally employed labour to operate the ship loaders, conveyors, rail unloading and stockpiling operations.

The table B19.17 summarises the impacts on Townsville, the NET, Queensland and Australia. The results are cumulative, in the sense that the results for Queensland include the impact on the NET, which in turn includes the impact on Townsville. As such, the impacts on Townsville do not need to be added to those of those wider regional boundaries.

The impacts on Queensland include state royalties (and other state taxation) and the impact on Australia includes Commonwealth revenues such as the Minerals Resource Rent Tax, company tax and other revenues. The Queensland-wide and Australia-wide benefits also include the benefit from other sectors that supply inputs into the construction and operational phases. Due to the significant amounts of royalties and Minerals Resource Rent Tax likely to arise from the mining projects facilitated by the PEP, there are significant economic benefits spread across Queensland and Australia from the PEP. There are also significant localised benefits in the Townsville LGA (such as workers operating the loading equipment at the port and on the railway) and the NET (such as workers at the mine sites inland).

B.19.4.5 Economic Impact Results

B.19.4.5.1 Overview

The initial construction phase of the PEP involves a significant boost of around 6.78% above normal investment levels in the Townsville region over the period to 2025. This additional investment will impact on the employment levels and living standards of the region as follows.

On average, over the period to 2040, the Project creates an additional 616 full time equivalent (FTE) employees per annum in Townsville LGA[4], with a peak addition of just under 2,300 FTE at the height of the construction activity. Combining the associated mining developments in the NET with the PEP results in a combined employment generation of close to 8,400 person-years of employment in the initial phase of port and mine construction to the end of 2019.

The best measure of the impact on living standards is gross national income, which takes national production (gross domestic product, or gross regional product at the regional level) and adjusts for income flows overseas. On this measure, the total increase in Australian living standards from the PEP and associated mining developments is $12.6 billion in NPV terms at a discount rate of 7%. Of that boost to living standards, $8.1 billion remains in the NET, just over $10 billion accrues to all Queenslanders and the remainder benefits residents in other jurisdictions of Australia (mainly due to tax revenues flowing to the Commonwealth, then being redistributed to the other states and territories).

Table B.19.17 summarises the increase in economic activity as the changes in key macroeconomic variables, over two main stages (initial construction works to 2025, followed by mostly operation to 2040), as well as over the full evaluation period, and at the local, regional, state and national levels.

The key results of the economic impact in Table B.19.17 can be summarised as:

- In Townsville and the NET, most of the additional income is generated over the initial period, in which most of the construction works for the PEP are undertaken. Over this period to 2025, the PEP generates additional $1.6 and $3.0 billion gross regional product in Townsville and the NET, respectively. In terms of the gross national income (allowing for some income flows outside of the region), Townsville still receives a significant boost in income due to the large amount of construction and operational phase activity that is performed on site. The NET's product accrues another $1.8 billion from overseas income. This is due to the creation of highly paid positions at the mine sites in the NET. The NET benefits to a greater degree than Townsville from income from abroad.
- Substantial flow-on effects of the PEP are distributed evenly over the construction and operational phases across Queensland and, more notably, Australia. The total increase in gross regional product due to the PEP to 2040 is $6.6 and $9.4 billion for Queensland and Australia, respectively. Significant additional income leads to a large increase in the gross national income in Queensland, which amounts to $10.4 billion, while in Australia this is approximately $12.6 billion.
- In terms of employment, higher levels of additional labour force are generated in Townsville and the NET over the initial phase, while in Queensland and Australia a substantial increase in labour force is generated over the operational phase (twofold from the increase in the construction phase).
- The effect of the PEP on wages is more pronounced locally in Townsville and the NET, with expected increases of 1.6% and 2.0% in the construction phase, respectively, and of 0.8% and 1.5% in the operational phase, respectively. Labour force in the NET is likely to benefit the most from the PEP. In contrast, associated wage increases in Queensland are not expected to exceed 0.1% on average, while in Australia this effect is negligible.
- Most of the additional investment generated by the Project occurs mainly in Townsville and the NET, as expected. The additional investment over the first ten years is expected to increase by 6.8% in Townsville and 5.6% in the NET, while in the second phase this is 0.5% in Townsville and 0.3% in the NET. Across Queensland and Australia the relative contribution of the PEP in additional investment is small (< 0.4%).

---

[4] From 16,620 person years of employment.

Table B.19.17 Economic Impact of the PEP

Component	Unit	2014 to 2025 Stages A and B	2026 to 2040 Stages C and D	2014 to 2040 Overall
Townsville				
Gross regional product change	$billion NPV[1]	1.61	0.82	2.43
Gross national income change	$billion NPV	1.55	0.60	2.15
Employment change	average FTE	659	580	616
Wage change	average %	1.62	0.83	1.18
Investment change	average %	6.78	0.51	3.29
NET				
Gross regional product change	$billion NPV	3.02	1.93	4.95
Gross national income change	$billion NPV	4.77	3.34	8.10
Employment change	average FTE	922	775	840
Wage change	average %	2.00	1.50	1.72
Investment change	average %	5.56	0.33	2.65
Queensland				
Gross regional product change	$billion NPV	3.61	3.00	6.61
Gross national income change	$billion NPV	5.85	4.53	10.37
Employment change	average FTE	1,355	2,800	2,158
Wage change	average %	0.13	0.06	0.09
Investment change	average %	0.37	0.04	0.19
Australia				
Gross regional product change	$billion NPV	4.24	5.14	9.38
Gross national income change	$billion NPV	6.23	6.36	12.58
Employment change	average FTE	2,167	6,881	4,786
Wage change	average %	0.02	0.00	0.01
Investment change	average %	0.08	0.03	0.05

The aggregate direct and economy wide (or indirect) impacts of the PEP are presented in Table B.19.18. The direct contributions capture economic effects occurring immediately due to expenditure on the PEP, which includes increased payments to employees or purchases of input materials. The economy wide contribution of the PEP focuses on the effects derived from the additional upstream and downstream economic activities linked to the PEP in the national economy.

Table B.19.18 shows that, although the net revenues of the PEP are projected to increase more than twofold by 2040, the indirect impacts in other related sectors of the economy are substantially larger than the direct impacts generated by the Project. This result reflects the significant relationship between the PEP and the employment and investment generated in other related sectors in Queensland and Australia. Moreover, the general equilibrium modelling results indicate that the employment levels generated indirectly in Australia largely exceed the direct employment, based in Townsville and the NET.

Table B.19.18 Direct and Indirect Impacts of the PEP

Component	Unit	2014 to 2025 Stages A and B	2026 to 2040 Stages C and D	2014 to 2040
Direct impacts				
PEP capital investment	NVP $M	1,704	139	1,843
Direct PEP employment[1]	average FTE	116	158	139
PEP net revenues	NPV $M	128	156	284
Indirect and economy wide impacts				
Total employment	average FTE	2,167	6,881	4,786
Contribution to gross domestic product	NVP $billion	4.24	5.14	9.38

1 Direct employment relates only to the port itself, not the mines, and excludes offsite construction support (e.g. precast concrete fabrication; structural steel fabrication; equipment fabrication and supply; materials and equipment transport).

In the first five years, the PEP contributes to a peak increase in the gross regional product of 3.1% in Townsville and 2.9% in the NET. By 2025, this contribution declines to 1.3% and 1.8% in Townsville and the NET respectively and, then by 2040, the contribution diminishes further to approximately 0.7% and 1.2% respectively and the surrounding economy continues to grow in size relative to the PEP.

The contribution of the PEP to the Queensland economy reaches a maximum of 0.2% additional gross regional product (in line with the highest increase in the NET) and then stabilises at 0.14% additional gross regional product. The increase in Australia's gross domestic product is relatively small (<0.1%), due to the size of the Australian economy relative to the PEP.

The benefits to the Townsville economy arise more strongly in the first five years of the PEP, whereas the benefits to the NET economy are higher throughout the period to 2040. The large impact of the PEP on the NET economy reflects the large share of existing and potential projects in the resources sector, which will be further enabled by the developments of the PEP.

Compared with the base case for Townsville and the NET, Townsville sees an increase of $320 and $360 million in its gross regional product early in 2015 and 2016, which converges to an increase of approximately $225 million per year from 2017 onwards. By contrast, the additional gross regional product in the NET due to the PEP reaches $550 million per year in 2017. This additional output decreases marginally after this year, but tends to continue increasing from 2025 onwards, when the second stage of the capacity expansion is expected to be completed. The steady increase in Gross Regional Product of the NET is mainly due to future development of projects in the resources sector, which will derive more benefits from the PEP, as compared to the local economy in Townsville.

B.19.4.5.2 Fiscal impact analysis

This section provides an assessment of the direct fiscal benefits and costs in undertaking the $1.5 billion PEP. The assessment is undertaken in an accounting framework to inform Project stakeholders about the direct costs and benefits of the Project compared with the 'do nothing' scenario or reference case. The costs of the Project are in relation to the capital expenditure (net of terminal value at 30 June 2040), while direct Project benefits stem from additional cargo charges and revenue associated with increasing capacity and trade volume through the port. Removing capacity constraints at the port has important implications for the local economy; as existing constraints could prevent resource projects being developed. The analysis does not include benefits to port users, changes in transport costs and other impacts, which would be captured in a full social cost-benefit analysis.

The Project will entail major costs in constructing a breakwater and revetments, dredging to reclaim the land inside the revetments, and paving parts of it with concrete. This is particularly relevant during the Stage A of the Project, in which the total budget estimate is $826 million. Costs of the following stages of the PEP are $171 million each for Stages B and D, and $236 million for Stage C (in present values). These sum to a total of $1.49 billion in port infrastructure (excluding above-ground loading equipment, etc.).

Further benefits from removing the port's capacity constraints encompass the additional revenue for the state and Commonwealth through the mining royalties and the Mineral Resource Rent Tax regime, respectively. The Mineral Resource Rent Tax on coal and iron ore production is levied at a rate of 30% of the operating margin, i.e. revenue less operating and investment costs, less the extraction allowance. The extraction allowance is a 25% discount to the Mineral Resource Rent Tax liability to focus the tax on the value of the resource rather than the value added through mining expertise. Thus, the effective Mineral Resource Rent Tax is 22.5% of profit, based on coal revenue of $110/t and assuming coal operating costs of $70/t. State royalties are credited against the Mineral Resource Rent Tax liability to produce the net Mineral Resource Rent Tax liability.

In this context, it is reasonable to assume that these royalties and the Mineral Resource Rent Tax from new mining projects are enabled by the PEP, as an export supply chain for these projects would not exist otherwise; there is not a readily available alternative to handle these trades. The following assumptions have been used for the fiscal analysis of the expansion plan:

- trade forecasts with a 30-year horizon (provided by POTL, with 2010/11 as the start year)
- 4% social discount rate
- 2.5% consumer price index as the mid-point of estimates by the Reserve Bank of Australia
- high growth in resources trade of 5.5% from 2025/26 to 2029/30 (provided by POTL)
- high growth in resources trade of 3.0% from 2030/31 to 2039/40 (provided by POTL)
- growth in non-resource trade of 1.0%, beyond 2024/25, as estimated by POTL
- 50-year asset life for dredging and reclamation infrastructure
- 25-year asset life for transport/utilities/water infrastructure
- 25-year asset life for major buildings infrastructure
- construction and operational expenditure, with 30% contingency costs, are based on PEP capital costs estimates.

The Project costs have been distributed over time for the different stages of project development. The private benefits account for the revenue due to increased trade or, equivalently, the value of avoided lost revenue that would occur if the PEP is not undertaken.

The benefits of the PEP indicatively start to be realised from 2016/17, as the increased commodity trade through the PEP becomes possible. The benefits from cargo charges increase steadily from this year at a compound annual growth rate of 4.7%. Similarly, state royalties increase at an annual growth rate of 0.4% and are calculated as a function of the trading volume of magnetite, geothite, fertiliser, coal and mineral concentrates. Conversely, the revenue from the mining tax is a function of the operating margin on coal export volume, which remains constant at 8 Mtpa from 2015/16.

The summary of the analysis is presented by stages in Table B.19.19. The private costs of the PEP greatly vary across the different stages of the Project. There is a peak of investment of $330 M/a being required in Stage A, over 2014/15 and 2015/16. By contrast, annual costs in Stages B and C are estimated to reach $88 and $132M, respectively, which is approximately the same order of magnitude as the expected revenue during that period. Finally, costs are greatly reduced to approximately $61 M/a in both parts of Stage D.

The expected trade volumes of coal and magnetite are the main determinants of the state royalties providing annual revenue of $64 M in 2016/17 and reaching $71 M by 2040. The revenue from the Mineral Resource Rent Tax is assumed to remain constant over time, providing additional $8.0 M/a derived from coal exports. Under POTL high trade growth scenario, positive benefits from the PEP can be expected from 2016/17, but become significant, relative to the initial capital and operating expenditure, only from 2030/31.

Table B.19.19 Fiscal Impact Analysis

Period	Stage	Port Benefits ($M)	Mining Tax ($M)	State Royalties ($M)	Port Costs ($M)	Net Impact ($M)
2011/12		0.0		0.0	0.0	0.0
2012/13		0.0	0.0	0.0	0.0	0.0
2013/14	A	0.0	0.0	0.0	82.6	–82.59

Period	Stage	Port Benefits ($M)	Mining Tax ($M)	State Royalties ($M)	Port Costs ($M)	Net Impact ($M)
2014/15	A	0.0	0.0	0.0	330.4	–330.4
2015/16	A	0.0	0.0	0.0	330.4	–330.4
2016/17	A	26.6	8.0	64.0	85.1	13.5
2017/18		27.0	8.0	64.0	2.5	96.5
2018/19	B	27.3	8.0	64.0	88.0	11.3
2019/20	B	27.7	8.0	64.0	88.0	11.7
2020/21		28.1	8.0	64.0	2.5	97.6
2021/22		28.6	8.0	64.0	2.5	98.1
2022/23		29.9	8.0	64.2	2.5	99.5
2023/24		32.3	8.0	64.7	2.5	102.6
2024/25		35.0	8.0	65.3	2.5	105.8
2025/26		38.4	8.0	66.1	2.5	110.1
2026/27	C	42.3	8.0	67.0	131.9	–14.6
2027/28	C	46.6	8.0	68.0	131.9	–9.3
2028/29		51.5	8.0	68.9	2.5	126.0
2029/30	D1	57.1	8.0	69.9	61.4	73.6
2030/31	D1	57.3	8.0	70.0	61.4	73.8
2031/32		59.6	8.0	70.0	2.5	135.1
2032/33		61.7	8.0	70.0	2.5	137.2
2033/34	D2	64.4	8.0	70.1	2.5	140.0
2034/35	D2	69.1	8.0	70.1	61.4	85.8
2035/36		70.6	8.0	70.3	61.4	87.4
2036/37		72.1	8.0	70.4	2.5	148.1
2037/38		73.7	8.0	70.6	2.5	149.8
2038/39		75.3	8.0	70.8	2.5	151.5
2039/40		76.8	8.0	70.9	2.5	153.3
Terminal value		0.0	n/a	n/a	–700.9	700.9
Present value		556.36	104.27	837.58	865.91	628.35

The Project's impacts (in present values) are:

Total benefits $1,498.20 M

Total (private) costs $865.91 M

Benefit:cost ratio 1.73:1

Altogether, the PEP shows sizeable long-term direct net benefits to the NET,Queensland and Australia with a ratio of fiscal income to costs of 1.73. The extent of the benefits is mainly due to the impact of royalties, which largely exceed (more than doubling) the total value of trade volume through the port and additional revenue from the mining tax. Conversely, the private benefit:cost ratio, i.e. the costs and revenues directly accruing to the port excluding royalties and Mineral Resource Rent Tax, remains below one (0.64). This implies that without any adjustments to the service fee structure (or cargo charges) of the port, the costs incurred in the capacity expansion will largely outweigh POTL's revenues attained from it.

These results demonstrate that the PEP is of strategic importance for Queensland, Australia and for the development of the NET resources sector, rather than an isolated initiative of direct benefit to the port alone.

B.19.4.6 Other Impacts

B.19.4.6.1 Commercial Fishing

The PEP developments will take place on the northern side of the existing port area, while the fishing fleet and other small scale marine users occupy space on the eastern side. These users do not share either land or water areas with the commercial shipping for which the PEP has been developed. The design of the Project ensures there are no conflicts between users in the port area and port channels.

B.19.4.6.2 Housing

The analysis presented in B.19.3.8.2 indicates that the property sales market in Townsville performs normally in economic terms, even if it is subject to wide variations in numbers of developments and sales. Property markets typically display cyclical behaviour with suppliers frequently finding it difficult to predict changes in demand and in the behaviour of other suppliers. As a consequence there are periods of excess supply when values are static or decline[5] and periods of excess demand when prices are rising and developers accelerate construction activity. There is no evidence that the Townsville market suffers exceptionally from these problems, beyond what might be expected in a relatively small market that is subject to population growth and a transient population.

Table B.19.15 shows an estimate of additional housing demand based on forecast population growth (from the *Townsville Futures Plan*) and assumptions about average household size. This table shows that there could be a high level of demand for new housing development in the period 2011 to 2016, with total demand of between 12,500 and 14,000 houses; this excludes demand from PEP temporary construction workers. The council is aware of the potential for population growth and has been developing the *Townsville Land Use Proposal* (TCC, 2010c), which sets out future plans for land use. The plan notes that land that has already been allocated (prior to the development of the new plan) for development will provide for 65,000 new houses, which is estimated to represent around 25 years' supply of sites for new housing[6].

There are two issues for housing in the period to 2016, which is a major period for port construction:

- whether the development sector is aware of and geared up to produce some 2,500 to 2,800 houses annually in this period, when the average output in 2005/06 to 2010/11 was 1,760 houses; this involves an increase in output of up to 59%
- whether in the development of new housing there will be sufficient purchasing of investment or buy-to-let properties to meet the demands from the temporary/transient population, including people working on the PEP.

For members of the transient population, the availability of properties for rental will generally be more important than the availability or cost of property to purchase. The rental market appears to be subject to an annual cycle, but also influenced by the for sale market, as some purchases are made in order to supply the rental market.

A slow rental sector will tend to deter buy-to-rent purchase, as will high property prices in the owner-occupier market. In September 2011, a market survey of the residential rental market found that the low number of investors in the property market had contributed to the tightening of vacancy rates between June and September. A survey in March 2012 reported a rental property 'drought', with vacancies in the market at 'dangerously low levels'. March 2012 figures released by Real Estate Institute Queensland (REIQ, 2012) showed a vacancy rate of 2% for Townsville, a decrease from 2.3% in December. The problems were attributed to the supply side with a lack of investors putting new properties on the market. The market in Townsville is also impacted by defence personnel who add to the normal demand that arises from single people and young families.

The Commonwealth government has established an initiative to help increase numbers of properties for rental to low income tenants. The National Rental Affordability Scheme aims to stimulate the construction of 50,000 affordable, high quality rental dwellings across Australia. Up to 35,000 will be supported up to 2014/15, with a further 15,000 dwellings to be supported beyond 2014/15. The scheme is not a social

---

[5] When values are static in money (nominal) terms, general inflation implies a decline in real values.

[6] This exceeds the estimates based on population growth, but the difference could be due to (A) different assumptions on the sizes of new households and (B) an allowance for replacements for demolished properties.

housing program; it offers an annual tax free incentive to investors to purchase new affordable homes and rent these at 20% below market rents to eligible low and moderate income households. There is an annual income-tax free incentive that is currently $9,524 per dwelling and is indexed annually to the rental component of the consumer price index. The Commonwealth government has defined income eligibility requirements for prospective tenants of the scheme, which are reflected in the Queensland eligibility criteria for National Rental Affordability Scheme clients. There are several real estate intermediaries offering advice to investors to find properties and tenants in Townsville.

It is unclear whether Townsville suffers from more significant supply side problems than other locations in Queensland, some of which are due to wider property market conditions, including interest rates. Townsville might have an added problem on the demand side, which is attributed to the large numbers of defence personnel seeking rental property in the city. It is also unclear whether the turnaround of defence personnel is cyclical.

The property industry literature has not identified mining personnel as a factor either on the supply side or the demand side.

The operational phase of the PEP is unlikely to do more than add marginally to market demand, principally for property for purchase. The scale of the change in demand is also more predictable than demand changes due to movements of transient population. The property market should be able to anticipate the effects of the PEP on demand and respond accordingly by increasing supply. The population impacts, working through the labour market[7], are very small in the context of future population projections such as the *Townsville Futures Plan*. The port construction phase could conceivably add to demand for rental property in a situation where there are cycles of low and high vacancy levels. Impacts on the rental sector are intended to be mitigated through the National Rental Affordability Scheme. This is not limited to specific areas, and the scheme has a finite budget for which developments in different areas compete.

Townsville City Council has been consulted in advance of development so that there is shared awareness of the increase in demand that will arise from the PEP. By taking a long-term view the council can ensure land use and other plans do not constrain the positive impacts of the PEP, through strategic planning for infrastructure and for housing development. The employment impact of the PEP is small compared with background growth in population. Local resources are not expected to be overloaded due to Project requirements.

B.19.4.6.3 Employment

Labour Market

A major increase in labour demand can impose stress on the labour market and upward pressures on wages and shortages of workers in unpopular occupations. On the other hand, insufficient growth in employment opportunities can lead to unemployment and an outward migration of people, which frequently includes young people who do not return to their home region. The direct effects of the PEP are very unlikely to lead to stress in the Townsville labour market. Any impacts in Townsville are also unlikely to add to stress in the NET labour market.

Most additional employment in the NET and Townsville is projected to be generated during the initial construction phase of the PEP, increasing 1.9% and 2.6% from the employment in the reference case in the NET and Townsville respectively (this accounts for approximately 0.1% increase in Queensland). From 2021 onwards, the new requirement of FTE employees in both Townsville and the NET remain constant at approximately 0.35% per annum. In Queensland and Australia the relative effect is marginal, but appears to increase steadily over time.

The effects of the PEP on the absolute increase in FTE employees are markedly stronger in Townsville, where another 2,295 and 1,840 FTE employees will be required in 2015 and 2016 respectively. This requirement drops in the following two years. From 2021, new employment requirements are created again, as a result of the additional capacity expansion and ongoing operations of the port, reaching a level of approximately 640 additional employees (FTE) by 2040.

---

[7] That is, if all of the jobs created by the PEP had to be filled by additional people moving to the area; as discussed in B.19.4.6.3, this is unlikely, unless port and related occupations are unpopular within the Townsville population.

This indicates that there will be a peak in labour demand in 2015 and 2016 due to construction work, and this is likely to require some temporary workers locating in the area. Overall the employment impact on Townsville is small in relation to the scale of growth in the workforce due to population growth, which is partly natural growth and partly due to net in-migration.

In the period to 2026, the *Townsville Futures Plan* predicts the population to grow by 64,657 people (medium estimate). Table B.19.20 shows estimates for the workforce to 2031. This is based upon:

- an estimated workforce to population ratio based on 2010 figures
- alternative future scenarios for this ratio (ie the ratio remains constant or declines over time due, for example, to an ageing population, increased desire for leisure time etc)
- the *Townsville Futures Plan* population forecasts (low, mid and high).

Table B.19.20 Workforce growth

Year	Low Population Growth		Mid Population Growth		High Population Growth	
	Q	Constant Participation	Declining Participation	Constant Participation	Declining Participation	Constant Participation
2010	105,297	105,297	105,297	105,297	105,297	105,297
2016	115,548	119,076	120,269	123,941	126,474	130,335
2021	121,444	128,329	128,535	135,821	138,245	146,082
2026	124,742	135,159	133,915	145,098	146,863	159,127
2031	126,775	140,847	138,006	153,325	154,099	171,205
Change from 2010						
2016	10,251	13,779	14,972	18,644	21,177	25,038
2021	16,147	23,032	23,238	30,524	32,948	40,785
2026	19,445	29,862	28,618	39,801	41,566	53,830
2031	21,478	35,550	32,709	48,028	48,802	65,908

The additional long-term jobs created by the PEP are best seen as part of a much larger increase in employment supply that will be required to provide jobs for the expected growth in the population and growth in the workforce.

Construction work

Table B.19.21 and

Table B.19.22 show estimates of port construction employment based on detailed engineering-based analysis of the works involved in implementing the stages of the expansion plan. The estimates are for on site construction and do not include offsite construction support, such as precast concrete fabrication, structural steel fabrication, equipment fabrication and supply, materials and equipment transport and supply and quarry operations.

Table B.19.21 Port Construction Workers (per Construction Stage)

Construction Activity	Peak number of workers				Duration of Activity (months)				FTE (workers/month)			
	A	B	C	DS	A	B	C	D	A	B	C	D
Infrastructure Construction (on site)												
Contractor's head office and site office	5	5	5	5	36	18	18	15	5.0	5.0	5.0	5.0
Dredge crew including surveyor, barges and work boats												
Grab dredge	8	0	0	0	4.5	0	0	0	1.0	0.0	0.0	0.0
CSD	10	10	10	0	7.5	4.5	4.5	0	2.1	2.5	2.5	0.0
TSHD	10	0	10	0	9	0	9	0	2.5	0.0	5.0	0.0

Construction Activity	Peak number of workers				Duration of Activity (months)				FTE (workers/month)			
	A	B	C	DS	A	B	C	D	A	B	C	D
Bund and breakwater construction	10	0	0	10	18	0	0	4	5.0	0.0	0.0	2.7
Reclamation fill placement	5	5	5	0	7.5	6	6	0	1.0	1.7	1.7	0.0
Capping layer placement and ground treatment	5	5	5	5	9	6	6	6	1.3	1.7	1.7	2.0
Materials transport operators	45	10	10	10	36	18	18	15	45.0	10.0	10.0	10.0
Piling crew	5	5	5	5	12	7	7	12	1.7	1.9	1.9	4.0
Berth construction	10	10	10	10	12	8	8	12	3.3	4.4	4.4	8.0
Road and rail access	20	20	20	10	6	6	6	4.5	3.3	6.7	6.7	3.0
Services and utilities construction	20	10	10	15	6	6	6	6	3.3	3.3	3.3	6.0
Port and marine operations												
Head office and vessel control	3	2	3	1	36	18	18	15	3.0	2.0	3.0	1.0
Tug crew and pilots, pilot boat crew, linesmen	10	7	10	2	36	18	18	15	10.0	7.0	10.0	2.0
Security staff	3	3	3	3	36	18	18	15	3.0	3.0	3.0	3.0
Maintenance and repair crew	5	3	5	1	36	18	18	15	5.0	3.0	5.0	1.0

Table B.19.22 Total FTE and Duration

Total	Stage A	Stage B	Stage C	Stage D
FTE Workers	96	52	63	48
Duration (months)	36	18	18	15

Strategies for Local Participation and Employment

Legislation requires the preparation of a *Local Industry Participation Plan* (LIPP). This Project will be subject to the Queensland government's *Local Industry Policy* (DEEDI, 2010b), but POTL recognises that the legislation might change between 2012 and the time of Project implementation. The following is written in the context of the existing legislation.

In complying with current legislation and policies, POTL will develop a LIPP as part of the process of tendering for a managing contractor for the construction works described in the Environmental Impact Statement. POTL will:

- consult with the Industry Capability Network Queensland in order to prepare the LIPP, which will form part of the tender process
- work with Industry Capability Network Queensland to identify tenderers for the role of managing contractor and will provide full and detailed information of the Project requirements in its tender documents
- decide on the weight that will be attached to local content and will make tenderers aware of that weighting.
- advise tenderers of the capabilities of Industry Capability Network Queensland to assist contractors in meeting the goals and reporting arrangements required by the LIPP
- prior to the tender process, use Industry Capability Network Queensland to assist in identifying companies that will be asked to pre-qualify as potential tenderers for the PEP.

As part of the construction tendering requirements, all tenderers will be required to submit a draft LIPP for consideration by POTL. The draft LIPP will be required to clearly set out how the managing contractor will provide full, fair, and reasonable opportunity to local suppliers and specialist sub-contractors when tendering the various trade packages for the provision of materials, equipment, and/or services for the Project. The managing contractor will be required to follow the guidance set out in the *Local Industry Policy Guidelines* (DEEDI, 2010b) htm and the LIPP template.

It will be a contractual obligation on the managing contractor during construction to comply with POTL's LIPP. All tenderers must produce an outline LIPP, which will form part of the tender response. The successful tenderer for the role of managing contractor must develop a full and compliant LIPP with 30 days of appointment and must subsequently comply with that LIPP. The managing contractor and its supply chain are required to fulfil the requirements of the managing contractor's LIPP. The managing contractor will be responsible for the compliance of members of its supply chain with its LIPP.

POTL will monitor compliance with the LIPP by the managing Contractor. The managing contractor will be required to keep accurate records of work sourced from South East Queensland, regional Queensland, other Australian states and territories, and overseas, separately. The value of work shall include goods supplied, manufactured, and the services provided. These details shall be presented as an integral part of the managing contractor's monthly progress reports.

POTL recognises the importance of early dissemination of information on the Project and on supply opportunities to local industry and will look to Industry Capability Network Queensland to help to organise information sessions for local industry on Project-related opportunities. POTL will provide early notice of, and general information on, forthcoming supply opportunities through media advertising and by hosting one or more briefing events. The managing contractor will be responsible for providing more specific information when seeking to enter into contracts with companies that will form its supply chain. The managing contractor will be expected to use Industry Capability Network Queensland to assist in identifying potential tenderers for the supply of goods and services to the managing contractor.

POTL will expect the managing contractor to undertake measures such as advertising and holding industry briefings that will provide timely information to the regional business and industry on the services, material supplies, skills, and commercial support requirements of the Project in its planning, construction, and operational phases. POTL will also expect the managing contractor to work with Townsville Enterprise and other regional economic development bodies to facilitate the communication of the procurement and logistics requirements for goods, services and commercial support for the Project. It will be a matter for the managing contractor to determine which measures it will employ. POTL will assess the proposed measures and their likelihood of success in securing local industry participation when assessing tenders for the Project.

It will be a matter for the managing contractor to undertake measures to maximise the use of local business as sub-contractors when contracts are awarded outside the region. POTL will agree to targets for local industry participation with the managing contractor and will require the managing contractor to meet these targets. POTL will consider the use of penalty provisions and/or financial incentives in order to ensure that the managing contractor meets the agreed targets.

POTL recognises that it is an objective of the LIPP to develop local industry's long-term international competitiveness and flexibility in responding to changing global markets, by giving local industry a fair opportunity to compete against foreign suppliers of goods and services. POTL expects that it will include foreign suppliers in its tender list for the role of managing contractor. In awarding this contract, POTL will give due weight to the extent to which each tenderer is likely to transfer technology and best practice working to local suppliers. POTL will require tenderers to provide evidence as to their track record in working with their supply chain to increase productivity, employ new techniques and materials and develop management practices. In developing its LIPP, POTL will consider how best to use the Department of Employment, Economic Development and Innovation manufacturing and business support programs to provide Queensland local industry with an understanding and opportunity to develop the capabilities needed to be tender-ready for the PEP.

POTL recognises that it is also an objective of the LIPP to achieve enhancements in training and skills development, and that long-term economic benefits can be sustained by using a project such as the PEP to provide a basis on which local industry can develop its skill base and enhance the level and quality of training undertaken. In its tendering process POTL will indicate the likely skill requirements for the delivery of the Project, including the construction works, equipment and services fabrication and supply, and for elements of maintenance and operations that POTL may in future offer to the market as supply contracts.

Tenderers for the role of managing contractor will be required to define their specific skill requirements and how these will be met, including measures to address identified requirements for skill enhancements both in its own organisation and in providers in its supply chain. The managing contractor will be expected to set out specific proposals to address training and qualification arrangements in its own business to meet the needs of skills development to support all phases of the Project. The managing contractor must also consider skills training requirements and skill availability in its supply chain, and where appropriate set out plans to address any issues relating to the supply or quality of training in its supply chain. The managing contractor will also be responsible for ensuring that training and qualification systems meet the requirements of the National Standards Framework both in its own business and those of its sub-contractors.

Measures that are successful in achieving a high proportion of local industry participation will also create and sustain local employment generated by the Project, both directly and through supply chain linkages. Employment is also an element of project cost, and POTL will give consideration to maximising local industry participation while achieving an appropriate balance between Project costs and local employment.

Indigenous employment, labour market and training policies.

There are two further policies that relate specifically to employment:

- *Indigenous Employment Policy for Queensland Government: Building and civil construction projects* (IEP 20% Policy) (DEEDI, 2008): the IEP 20% Policy applies to all government-funded civil construction contracts with no minimum threshold and building construction projects exceeding $250,000 (GST inclusive) in value. This policy requires a 20% minimum benchmark of total labour hours, with half of the deemed labour hours required to involve accredited training. The Indigenous workforce is to be recruited from the local Aboriginal and Torres Strait Islander community/ies.
- *Government Building and Construction Contracts Structured Training Policy* (10% Training Policy) (Skills Queensland, 2008): the policy requires that a minimum of 10% of the total labour hours on any Queensland government building or civil construction project (valued over $250,000 for building or $500,000 for civil construction) must be undertaken by Indigenous workers, apprentices, trainees or cadets or used for the up-skilling of existing employees (to a maximum of 25% of the deemed hours).

The target of 20% Indigenous employment applies to projects in locations where there are significant Indigenous populations. Townsville is not deemed to be an affected area and the policy does not apply to the Port of Townsville. The 10% policy does apply to government owned companies and applies to the Port of Townsville.

While the IEP 20% Policy does not formally apply, POTL has sought to employ local Indigenous people and has been very successful so far in the employment of local Indigenous people on the Townsville Port Inner Harbour Expansion project. POTL plans to implement a similar approach for the PEP. In addition, POTL will include requirements with regard to Indigenous employment and training in the tendering process for the role of managing contractor. In the tendering process, POTL may require candidate for the role of managing contractor to develop an outline plan for the recruitment, training and employment of Indigenous people as part of the selection process. Alternatively, POTL may develop its own policy that complies with government policies on Indigenous employment and on training (noted above), and will require the managing contractor to comply with that policy as part of contractual obligations. It will be the responsibility of the managing contractor to ensure compliance with these policies by providers in the supply chain that are located in areas with significant Indigenous populations.

Approaching the implementation stage, POTL will establish an Indigenous advisory group to assist POTL in appointing a liaison officer, whose role will be to increase employment of local Indigenous people on the PEP. The appointed liaison officer will work with the employment manager for the managing contractor to develop measures to recruit, train and employ Indigenous people in the PEP.

Working through the Indigenous advisory group, the liaison officer will encourage and assist interested Indigenous people to prepare and lodge CVs, initially for applications for jobs on a nominated list of contract jobs required early in the construction process. It will be for the managing contractor to receive and assess CV's, hold interviews and make employee appointments.

The liaison officer will seek to establish an ongoing working relationship with the managing contractor's employment manager, in order to ascertain the types of jobs that will be offered as the PEP progresses, including the later stages of the Project as shown in Table B.19.19. The liaison officer will continue to assist interested Indigenous people in preparing and submitting CVs.

The liaison officer will also work with the managing contractor to establish skill needs, including skills in short supply in Townsville. The liaison officer will contract with one or more external training and mentoring companies; these companies will be employed to assist potential employees who wish to undertake training to obtain additional skills that are relevant to the Project's implementation and delivery. These companies will also provide mentoring where/if required to those Indigenous people that are already employed. This part of the strategy is aimed at up-skilling the 'not quite skilled enough' and at keeping employed those who may be experiencing some cultural and/or other employment problems.

B.19.5 Mitigation Measures and Residual Impacts

B.19.5.1 Employment

The operational phase of the port is expected to create approximately 460 to 500 FTE jobs, which is a small proportion of the likely total increase in employment demand in Townsville and the NET. It is expected that this level of employment will easily be absorbed given the projected growth in population, which includes growth in working age population.

It is likely that some of the new permanent residents to Townsville will be attracted to live there because of the opportunities generated by the PEP. Townsville Enterprise monitors employment issues and would be expected to implement other measures should there be a need to mitigate lack of employment issues for Townsville residents.

The construction phases of the Project could potentially create positive impacts working through from the labour market to other sectors of the economy. Construction activity will generate demand for physical inputs such as precast concrete fabrication, structural steel fabrication, and equipment fabrication. This will generate offsite construction related employment, and peak employment associated with the Project is estimated at just under 2,300 FTE jobs.

B.19.5.2 Housing

The post-implementation employment impacts of the Project in Townsville and the NET are projected to be small compared with the wider context. This is characterised by strong population growth, which will have to be accompanied by, and will to a degree be driven by, growth in employment. Employment growth will be required to sustain the levels of population growth forecast in, for example, the *Townsville Futures Plan*. Population growth will generate demand for residential accommodation. Sites for residential development are available and the supply of residential properties will depend on how well the development sector delivers additional supply in response to demand.

The 'buy to use' (or owner-occupied) housing market appears to function normally and it is reasonable to expect that the market will be capable of providing housing for existing and new residents who wish to (and are able to) purchase a house. The council is aware of the potential for population growth and has been developing the *Townsville Land Use Proposal* (TCC, 2010c), which sets out future plans for land use. This complies with the *Sustainable Planning Act 2009*. The plan outlines how the city will provide land for development, which includes housing land. The plan notes that land that has already been allocated (prior to the development of the new plan) for development will provide for 65,000 new houses, which is estimated to represent around 25-years' supply of sites for new housing.

The rental market presents more challenges, because demand is variable depending on numbers of temporary workers and the scale of the transient population related to, among other things, movements of personnel in the defence sector. The construction phases of the Project will add to that transient demand, as some of the workers are expected to be non-permanent residents of Townsville.

The National Rental Affordability Scheme provides a stimulus to the rental supply side nationally, but there is no specific local provision at present for any form of additional financial assistance or other measures to mitigate problems in the rental housing sector. While problems are not expected due to housing needs of people working in port operations, the construction of the PEP could impose strains on the rental sector, as some construction workers will be temporary residents and are likely to seek temporary (rented) accommodation. This potential problem is best mitigated through securing as much local employment for permanent residents of Townsville.

B.19.5.3 Other Port Users

The other principal port users are commercial fishing and recreational fishing. POTL has expanded the space available for commercial fishing functions on the eastern side of the port in the Townsville Marine Precinct, while the new berths for large cargo vessels are to be developed on the northern side of the port. The two functions are, and with the PEP will remain, physically separated with separate harbours. No additional mitigation is considered to be required during the operational phase

B.19.6 .Cumulative Impacts

The only identified downside effect of the PEP arises in the initial period of construction, which is likely to be between 2014 and 2016. In this period there is a small spike in labour demand, which is likely to be met in part by bringing in temporary workers. This in turn will have an impact on the rental housing market, in a context in which movements of defence personnel also impact upon the rental housing market.

The impacts due to the port quickly and significantly diminish after this period due to growth in population and in the local workforce as a consequence of population growth. While population growth will require a matching response from the housing sector, the contribution of port related employment to this process is extremely small. The longer term impact of a small amount of additional labour demand from the port and related activities is more likely to be a small increase in the workforce participation rate and/or a lowering in the level of unemployment.

The Project frees up space in the inner harbour, which could enable some further development of port-related activities.

The other significant and cumulative impact of the PEP arises through the increase in revenues to Queensland through royalties and to the Commonwealth through the Mineral Resource Rent Tax. These provide governments with additional resources with which to finance infrastructure and other projects or to support other public sector services.

B.19.7 Assessment Summary

The economic impacts of the PEP are summarised as:

- In Townsville and the NET, most of the additional income is generated over the initial period, during which most of the construction works for the PEP are undertaken. Over this period to 2025, the PEP generates additional $1.6 and $3.0 billion gross regional product in Townsville and the NET respectively.
- In terms of the gross national income (allowing for some income flows outside of the region), Townsville will receive a significant boost in income due to the large amount of construction and operational phase activity that will be performed on site. The NET's product will accrue another $1.8 billion from overseas income. This is due to the creation of highly paid mining jobs at the mine sites in the NET.
- Substantial flow-on effects of the PEP are distributed evenly over the construction and operation periods across Queensland and, more notably, Australia. The total increase in gross product due to the PEP to 2040 is $6.6 and $9.4 billion for Queensland and Australia, respectively. Significant additional income leads to a large increase in the gross national income in Queensland, which amounts to $10.4 billion, while in Australia this is approximately $12.6 billion.
- In terms of employment, higher levels of additional labour force are generated in Townsville and the NET over the initial phase, while in Queensland and Australia a substantial increase in labour force is generated over the operation phase (twofold from the increase in the construction phase).
- The effect of the PEP on wages is more pronounced locally in Townsville and the NET, with expected increases of 1.6% and 2.0% in the construction phase, respectively, and 0.8% and 1.5% in the operation phase, respectively. The labour force in the NET is likely to benefit the most from the PEP.

In contrast, associated wage increases in Queensland are not expected to exceed 0.1% on average, while in Australia this effect is negligible.

- Most of the additional investment generated by the Project occurs mainly in Townsville and the NET, as expected. The additional investment over the first ten years is expected to increase by 6.8% in Townsville and 5.6% in the NET, while in the second phase this is 0.5% in Townsville and 0.3% in the NET. Across Queensland and Australia the relative contribution of the PEP in additional investment is small (<0.4%).

The PEP is likely to create a short-lived peak in labour demand during the initial construction period, which might also place the rental housing sector under a degree of strain. The actual outcome will also depend on the (often large) movements of defence-related personnel who require rental housing. The more and earlier the development industry is aware of these future demands, the better it will be able to respond ahead of demand.

In the longer term any adverse impacts of the PEP on the housing and labour markets will be minimal, given the background growth in employment in the area and the consequent needs for housing.

Port Expansion Project EIS

Part B

Chapter B20 – Health and Safety

AECOM BMT WBM

B.20 Health and Safety

B.20.1 Relevance of the Project to Health and Safety Values

The purpose of this chapter is to assess the implications of the Port Expansion Project (PEP) on the existing health and safety values of the broader community, onsite workforce and transient occupants, suppliers, visitors and other stakeholders. Potential for injuries and fatalities to workers and to people in general may arise in construction, operational and decommissioning phases of the PEP and this chapter provides information about the risks and the proposed risk treatments to eliminate or reduce the impacts to acceptable levels.

The scope covers the identification of work related health and safety hazards, assessment and treatment of risk extending to workers and other people at work or affected by the hazards beyond the workplace in terms of human health, public safety and community amenity.

These hazards and risks may be associated with design or may arise because of potential accidents, spills and abnormal events that may occur during construction, operations or decommissioning. Potential causes may also include work factors and environmental factors associated with these phases, which can affect human health, public safety and quality of life, such as air pollutants, odour, lighting and amenity, dust, noise, vibration and water quality.

A preliminary health and safety risk assessment has been undertaken to assess the impacts and cumulative effects on public health values and occupational health and safety impacts on the community and workforce from Project operations and emissions. Mitigation measures and safeguards are identified aimed at protecting or enhancing health and safety community values, appropriate to each phase of the Project.

B.20.2 Assessment Framework and Statutory Policies

The following legislation and policies are relevant to the assessment and management of health and safety associated with the Project.

B.20.2.1 Queensland Work Health and Safety Legislation

The Queensland *Work Health and Safety Act 2011* (WHS Act) provides a framework to protect the health, safety and welfare of all workers at work and other persons who might be affected by work. *Work Health and Safety Regulation 2011* are subsidiary to the WHS Act and relate to the protection of the construction and operation workforces, as well as members of the public, including community receptors that may be affected by work related hazards.

The WHS Act aims to:

- protect the health and safety of workers and other people by eliminating or reducing workplace risks
- ensure effective representation, consultation and cooperation to address health and safety issues in the workplace
- encourage unions and employers to take a constructive role in improving health and safety practices
- promote information, education and training on health and safety
- provide effective compliance and enforcement measures
- deliver continuous improvement and progressively higher standards of health and safety.

Work health and safety legislation applies to all project phases through design, construct, operation and eventual decommissioning, demolition and disposal, and is relevant to the PEP.

B.20.2.2 Commonwealth Legislation

The Commonwealth of Australia operates its own legislative framework for health and safety at work. The *Work Health and Safety Act 2011* (Cth) and the *Work Health and Safety Regulations 2011* (Cth) are supported by a set of codes of practice. A listing of applicable codes of practice is provided in Appendix U1.

Generally, the application of the Commonwealth work health and safety legislation may be limited to Commonwealth jurisdiction, whether it is defined by designation of Commonwealth property or service. The Commonwealth and Queensland legislative frameworks are functionally similar and will not impact the undertaking of Commonwealth works at the Port of Townsville.

Commonwealth organisations have an obligation to provide safe and healthy conditions for workers and other persons. As such, the Commonwealth's governance processes must be sufficient to manage issues arising from work undertaken with both jurisdiction and applicability of the legislation. In the event that clarity on this matter is required, then the Queensland work health and safety regulator may be engaged to determine the applicability of any part of the Queensland work health and safety legislation to the identified issue in the Commonwealth work health and safety legislation.

B.20.2.3 Australian and International Standards

Australian and international standards are considered essential references for determining practicability, obtaining advice on acceptable and recommended practice, and informing decision-making.

The following Australian standards and guidelines apply to this assessment. A list of further relevant Australian standards appears in Appendix U2.

- *AS/NZS ISO 31000:2009 Risk management – principles and guidelines* (Standards Australia, 2009)
- *AS 3846:2005 The handling and transport of dangerous cargoes in port areas* (Standards Australia, 2005a)
- *AS/NZS 3833:2007 The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers* (Standards Australia, 2007)
- *HB 203:2006 Handbook - Environmental risk management – principles and processes*
- *HB 76:2010 Handbook – Dangerous goods - initial emergency response guide*.

B.20.2.4 Port of Townsville Limited Policies

Port of Townsville Limited (POTL) maintains its own *Risk Management Policy*, Occupational Health and Safety Management System (OHSMS) and Environmental Management System (EMS), providing organisational governance and stewardship on plans and procedures to manage risks and meet its statutory obligations.

B.20.3 Existing Values, Uses and Characteristics

This section summarises the existing health and safety values of the port operations in relation to the health and safety of port workers and all other persons on the port, and in the interaction with surrounding land uses and port stakeholders.

POTL is committed to:

- providing a safe port
- preventing all workplace injuries and illnesses
- ensuring all employees and others on port land are safe
- conducting safety inductions for employees and other interested parties
- promoting safe work practices
- implementing the safe walkways initiative
- promoting use of safety equipment
- integrating environmental considerations into decision making and work practices related to POTL's core functions

POTL's commitment to providing and maintaining the best possible standard of occupational health and safety for everyone at the port is supported by its *Safety Policy*. The policy sets out the occupational health and safety standards necessary for achieving the objectives of POTL's OHSMS, which is certified to the *AS/NZS 4801:2001 Occupational health and safety management systems - Specification with guidance for use*. The OHSMS establishes a framework for:

- consideration of, and compliance with, relevant legislative, regulatory and statutory obligations
- hazard identification, risk assessment and risk control requirements for routine and non-routine activities
- reduction of workplace injury and illness
- accident and incident prevention initiatives
- training, awareness, communication and consultation requirements.

Health and safety standards and conditions in the port are reinforced through the Port *Risk Management Policy* and procedures, and procedures on chemicals management and managing workplace hazards.

Serious events such as cyclones, storms, explosions, major chemical spills, or acts of vandalism or terrorism can place the port and the safety of port workers and the broader communities at risk. Planning for prevention, preparation, response and recovery of such events are managed through the port's security and emergency plans and procedures, and port tenants' plans. These are further discussed in Chapters 21 and 22.

Public safety and community amenity is further protected through the management of environmental factors associated with port operations, such as air pollutants, odour, lighting and amenity, dust, noise and water quality, extending impacts beyond port boundaries. POTL has established an EMS and management plans for reducing the risk of environmental impacts through the identification, reporting, assessment, monitoring and control of environmental risks.

B.20.4 Assessment of Potential Impacts

B.20.4.1 Risk Assessment

The aim of the risk assessment is to identify, prioritise and mitigate potential property and people risks that may occur during construction, operation and decommissioning phases of the PEP. This was carried out by undertaking a preliminary risk assessment following the principles of AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines (Standards Australia, 2009). This standard aligns with the basis of POTL's *Risk Management Policy* and procedures.

The risk management process applied in the preliminary risk assessment is described in Appendix U3. The preliminary risk assessment includes

- the identification of work related risks to workers, property and operations
- an analysis of the consequences of each identified risk
- proposed safeguards to reduce the likelihood and severity of each issue.

The risk process involves five dependent elements and is summarised as:

- stakeholder consultation and communication
- determination of risk context
- undertaking of risk assessment (incorporating risk identification, analysis and evaluation)
- application of risk treatment
- risk monitoring and review.

Each of these elements was undertaken to identify and manage health and safety risks associated with each phase of the Project. This analysis forms part of the larger risk management process to continue throughout the Project life and linked to POTL's corporate risk management process. Other contexts such as environmental management, security, property and infrastructure; and emergency management are addressed separately in Chapters B21 and B22.

B.20.4.2 Stakeholder Consultation and Communication

The risk assessment process was initiated through a risk identification and assessment workshop conducted with the project and environmental impact assessment technical discipline leaders and designers.

B.20.4.3 Determination of Risk Context

The risk assessment process seeks to achieve objectives in both the external and internal risk context. In the external context, the risk assessment aims to satisfy regulatory requirements, including but not limited to Queensland work health and safety legislation. In the internal context, POTL sets out to maintain the standards of hazard and risk management through its health and safety, and environmental policies and objectives, governed through *Risk Management Policy* and procedures.

B.20.4.4 Undertaking of Risk Assessment

This involved the identification of risk stemming from hazards associated with the construction, operation and (notional) decommissioning of the PEP. The risk identification, analysis and evaluation were informed by inputs from the risk workshop and review of the possible impacts associated with similar works.

Risk analysis incorporates the potential consequence of a hazard impact and the probability of occurrence. The consequence and probability estimates for impacts are applied through a risk matrix to evaluate the risk in accordance with AS/NZS ISO 31000. The criteria applied for health and safety hazard and risk is provided in the risk process description in Appendix U3. In summary:

- consequence criteria has been rated from negligible (no injury, an injury not sufficiently serious to require first aid treatment) to very high (a single or multiple fatalities or significant irreversible injury to more than 10 people)
- probability criteria assess the likelihood of occurrence, which has been rated from highly unlikely/rare (has not happened and is highly unlikely but theoretically possible to occur) to almost certain (is expected to occur and could possibly occur multiple times during the life of the Project)
- the risk matrix has been defined as a 5 x 5 matrix, characterising the significance of risk in terms of the five levels of consequences and likelihoods, rating the risk from negligible to critical
- risks are evaluated for three stages
    - inherent risk (i.e. pre-risk treatment)
    - interim risk (i.e. forecast risk treatment to compliance standard)
    - residual risk (i.e. achievable post-treatment risk).

Table B.20.1 Risk Matrix

		Magnitude (Consequence)				
		Negligible	Minor	Moderate	High	Very High
Likelihood	Highly unlikely/rare	Negligible	Negligible	Low	Medium	High
	Unlikely	Negligible	Low	Low	Medium	High
	Possible	Negligible	Low	Medium	Medium	High
	Likely	Low	Medium	Medium	High	Critical
	Almost certain	Low	Medium	High	Critical	Critical

B.20.4.5 Application of Risk Treatment

Risk treatment involves the implementation of a change process to modify the assessed risk. AS/NZS 31000:2009 provides a list of broad risk treatment options:

- avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk
- taking or increasing the risk in order to pursue an opportunity
- removing the risk source
- changing the likelihood or the consequences
- sharing the risk with another party or parties (including contracts and risk financing)
- retaining the risk by informed decision.

The *Work Health and Safety Regulation 2011* further provides a hierarchy of control measures:

- elimination of risk to health and safety
- substituting identified hazard with an alternative of lessor risk
- isolating the hazard from persons exposed to it
- implementing engineering controls
- failing the practicability to apply the above controls, implementing administrative controls
- failing the practicability to apply the above controls, supplying and using personal protective equipment.

Risk treatment options can be compared, considering the cost of implementation and use against the benefit to be gained. The benefit may be estimated as the 'residual risk', i.e. the calculated risk expected after the control measure is implemented.

B.20.4.6 Risk Monitoring and Review

The implementation of an individual risk treatment or a more comprehensive risk treatment plan will have some expectations or requirements around performance of the selected control/s. Monitoring and review processes may be incorporated associated with:

- obtaining information to improve an initial risk assessment
- ensuring control measure effectiveness
- detecting change impacting on either the risk or the control
- identifying new or emerging risk
- extending risk knowledge through experience.

B.20.4.7 Safety in Design

'Safety in Design' principles are applicable to the PEP and these principles are also underpinned by statutory obligations imposed through the Queensland WHS Act on designers and 'persons conducting business or undertakings' which include POTL, port operators, port tenants and port contractors (e.g. construction and maintenance).

The Queensland WHS Act imposes statutory duties on designers of plant, substances and structures to be used or expected to be used at a workplace. In general, the designer must ensure that plant, substances and structures are designed to be without risk to the health and safety of persons. Designers must also test and analyse the risk associated with their designs and provide sufficient information to end users. The designer may also be requested to provide current information about the design and relevant risks associated with its use.

The Australian Safety and Compensation Council (ASCC, 2006) defines safe design as:

> *The integration of hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life of the product being designed. It encompasses all design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout, and configuration.*

The national *Guidance on the Principles of Safe Design for Work* (ASCC, 2006) advises that safe design incorporates five principles:

- Principle 1: Persons with Control – persons who make decisions affecting the design of products, facilities or processes are able to promote health and safety at the source.
- Principle 2: Product Lifecycle – safe design applies to every phase in the lifecycle from conception through to disposal. It involves eliminating hazards or reducing risks as early in the lifecycle as possible.
- Principle 3: Systematic Risk Management – the application of hazard identification, risk assessment and risk control processes to achieve safe design.
- Principle 4: Safe Design Knowledge and Capability – should be either demonstrated or acquired by persons with control over design.

- Principle 5: Information Transfer – effective communication and documentation of design and risk control information between all persons involved in the phases of the lifecycle is essential for the safe design approach.

B.20.4.8 Health and Safety Risk Assessment Findings

Risk consolidated into four general phases for the PEP:

- design: concept development, design
- construction: construction, supply, install
- operations: commission, use, maintain, modify
- disposal: decommission, disposal.

Risk sources (encompassing hazards and aspects) were identified in relation to these four phases of the Project lifecycle. Consideration was given to areas of potential impact (receptors), potential events (including failure or change of circumstances) and potential, resultant consequences.

Findings of the risk assessment are presented in the Risk Register provided in Appendix U4. The Risk Register identifies the potentially hazardous activities or events that may present a health and safety risk to people and impact property assets, which may occur as outcomes of design or during the construction, operation and decommissioning of the PEP.

B.20.4.9 Design Phase Risks

Risk sources associated with the design phase are largely intangible elements (failure to recognise, failure to plan and failure to act) having long-term consequences and often costly retrofit solution requirements. Risk groups are mainly predicted (i.e. the actual group is not necessarily known). Design risk considerations included:

- understanding and providing description of the Project lifecycle
- designing for safe build
- designing for safe operation
- identifying and managing receptor interface and interaction (people, environment, society and organisation)
- consideration of intended use and unintended misuse of design
- designing for safe maintenance, modification and change
- applying foresight to decommissioning and disposal
- meeting statutory obligations and duties
- meeting commercial and legal requirements
- ensuring adequate risk information transfer

Cumulative risk impacts on the workforce and community can stem from the inadequacy of the application of safety in design principles. Such omissions may not be apparent during the transition from design to construction, but could create health and safety and environmental or public health impacts during construction, operational and decommissioning phases of the Project. Table B.20.2 summarises the work health and safety impacts associated with the Design Phase.

Table B.20.2 Safety in Design Risk Impact Analysis

Risk Source	Risk Group	Impact
Failure to understand and describe the Project lifecycle.	Designer POTL	Design inadequacy.
Failure to consider health and safety implications during construction phase.	Designer POTL Construction contractor	Design inadequacy resulting in downstream inefficiency, increased construction costs, injury, damage, loss and penalty.
Failure to consider environment, health and safety implications	Designer POTL Construction contractor	Design inadequacies resulting in downstream inefficiency, increased operate costs, retrofit

Risk Source	Risk Group	Impact
during operational phase.	Port operator Port tenants	costs, injury, damage, loss and penalty.
Failure to recognise risk groups associated with all phases of project lifecycle.	Designer POTL Construction contractor Port operator Port tenants	Inadequate risk assessment decisions informing design. Unrecognised consequences and unplanned mitigation.
Failure to recognise use/misuse associated with all phases of project lifecycle.	Designer POTL Construction contractor Port operator Port tenants	Inadequate risk assessment decisions informing design. Unrecognised consequences and unplanned mitigation.
Failure to incorporate safety in design (e.g. low energy usage, fail to safe measures)	Designer POTL Construction contractor	Design inadequacy resulting in downstream inefficiency, increased construction costs, injury, damage, loss and penalty.
Failure to design for safe maintenance, modification or change.	Designer POTL Construction contractor Port operator Port tenants	Design inadequacy resulting in downstream inefficiency, increased construction costs, injury, damage, loss and penalty.
Failure to recognise needs of decommissioning and disposal.	Designer POTL Construction contractor Port operator Port tenants	Inadequate risk assessment decisions informing design. Unrecognised consequences and unplanned mitigation.
Lack of understanding of statutory obligations and duties.	Designer POTL Construction contractor Port operator Port tenants	Inherent inefficiency, increased construction costs, injury, damage, loss and penalty.
Lack of understanding of commercial and legal requirements.	Designer POTL Construction contractor Port operator Port tenants	Inherent inefficiency, increased construction costs, injury, damage, loss and penalty.
Failure to embed risk information transfer from design phase.	Designer POTL Construction contractor Port operator Port tenants	Inherent inefficiency, increased construction costs, injury, damage, loss and penalty.

B.20.4.10 Construction, Operational and Decommissioning Phase Risks

Risk sources associated with the construction phase range from intangible to tangible impacts and may involve many variables in a short to medium term timeframe. For example, construction contractor work processes and the use of substances and equipment tend to be more variable during this phase and commonly carry greater health and safety risks.

During the operational phase of the PEP, risk sources are largely tangible impacts linked to a smaller and defined risk group (e.g. port operator, tenants and POTL) with medium to long-term association with the PEP. The relatively consistent nature of the operational phase permits stability through the establishment of permanent personnel, work processes and work schedules. During the operational phase, variation to risks is likely to accompany change. Change may be in two forms; variation of the degree of the hazardous property of existing hazards (e.g. a chemical is made more concentrated and becomes more hazardous) or change of process resulting in addition or removal of hazards (e.g. a manual handling task is automated thus removing the hazard).

In the decommissioning phase, known hazards may be reduced through elimination by progressive de-energisation, removal and disposal. Latency of hazardous materials and substances may increase the risk and impact on the risk group (POTL, port operator and present/former tenants). As with the construction phase, the work environment and conditions during this phase may change with little or no notice. Due to the inherently variable nature of this phase, decommissioning works will require extensive planning, risk assessment and management to reduce the risk.

Risk considerations during the construction, operational and decommissioning phases include:

- meeting commercial and legal requirements (e.g. statutory obligations, duties, licences and permits conditions)
- understanding of Project lifecycle
- correct interpretation and translation of design to application
- managing physical risk sources: energy, equipment, processes and materials
- identifying and managing receptor interface and interaction (people, environment, society, organisation)
- ensuring design considers maintenance, modification, decommissioning and disposal requirements
- ensuring fit for purpose (as designed and built)
- providing processes for use, maintenance, modification, decommissioning and disposal
- managing latency attributes of physical risk sources: energy, equipment, processes and materials
- ensuring adequate risk information transfer.

Cumulative impacts can result from incremental changes caused through each of these phases of the PEP. Generally, work presents hazards capable of impacting workers either immediately as trauma (e.g. a cut) or cumulatively as exposure related conditions (e.g. deafness). Construction activities introduce multiple tradespersons, equipment and work processes, which together in an unplanned manner can cause risk to increase as a result of the interaction of impacts. Increased traffic (any form) provides a further example that may introduce a variety of cumulative impacts affecting the community.

Table B.20.3 provides a summary of the work health and safety related impacts associated with the construction, operational and decommissioning phases, describing the hazards, risk source, risk group and potential recipients.

The identified risks for these phases will be further influenced by:

- inadequacy or absence of process for transferring risk information between stakeholders of each phase
- absence of understanding of, and consultation with, receptors and end-users
- inadequacy or absence of applied risk management during the phase
- lack of knowledge and experience (including inability to acquire resources and advice) regarding work health and safety
- failure to know statutory obligations or failure to comply
- failure to establish and formalise hand-over process from construction to commissioning
- failure to contemplate or plan for decommissioning/disposal.

Table B.20.3 Construction, Operational, and Disposal Phase Risk Analysis

Project Phase	Hazard	Risk Source	Risk group/receptor	Impact
Construction Operational Disposal	Biomechanical	Associated with hazardous manual work (manual handling and ergonomics), fall of people striking objects or ground.	Workers Designer Construction contractor POTL Port operator and tenants	Injury, death Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Mechanical	Persons being struck by or contacting moving construction vehicles, plant and equipment. This also includes land and marine vehicle movement from sharing of roadways and shipping channels during construction phase.	Workers Non-worker (e.g. visitors) Designer Construction contractor POTL Port operator and tenants	Injury, death Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Electrical	Unprotected persons contacting live electrical conductors.	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Injury, death Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Chemical	Persons contacting hazardous chemicals and contaminated environment during use, handling, transport and storage. This also includes dust, fume and vapour associated with work processes (also includes odour and asbestos).	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Annoyance, injury, ill health, death Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Potential and stored energy	Persons exposed to release of pressure from a pressurised systems (e.g. release of compressed gas) or stored tension in a material (e.g. release of cable under load).	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Injury, death Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Noise and vibration	Associated with work processes from vibration or fluid turbulence resulting in people being exposed to excessive noise or vibration. Infrastructure damage by vibration.	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Injury, annoyance Community impact, annoyance Imprisonment, prosecution Improvement notice Work delay Financial Reputation

Project Phase	Hazard	Risk Source	Risk group/receptor	Impact
Construction Operational Disposal	Thermal	Persons contacting or exposed to heat/cold and thermal events such as fire or explosion. Property and plant exposed to fire or explosion.	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Injury, heat stress, ill health, death Community impact Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Radiation	Associated with work processes (e.g. UV in welding and lasers). Exposure to electromagnetic field or ionising radiation.	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Injury, ill health, death Contamination Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Biological	Largely related to management of waste and potential disease(s) generated during all phases.	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Injury, ill health, death Imprisonment, prosecution Improvement notice Work delay Financial Reputation
Construction Operational Disposal	Work stressor	Related to work arrangements and organisation (e.g. odour, stress, glare).	Workers Non-worker Designer Construction contractor POTL Port operator and tenants	Ill health, annoyance Improvement notice Work delay

B.20.5 Mitigation Measures and Residual Impacts

B.20.5.1 Mitigation of Hazards

The work health and safety legislation requires the effective management of work health and safety to reduce the risk of injury, disease and impact to workers and other persons. POTL has instigated a variety of corporate governances in response to meeting its statutory obligations. These include:

- risk management policy and procedures
- *Occupational Health and Safety Policy* and OHSMS
- health and safety related procedures including
  - biomechanical hazards
  - mechanical hazards
  - electrical hazards
  - chemical hazards
  - potential and stored energy hazards
  - noise and vibration hazards
  - thermal hazards
  - radiation hazards
  - biological hazards
  - work stressor hazards
- Emergency Management Plan
- Security Management Plan
- Environmental Policy and EMS

The risk register in Appendix U4 identifies a number of mitigation measures to manage each of the risks identified in the design, construction, operational and decommissioning phases.

The work health and safety regulations, supported by applicable codes of practice, provide references for managing the identified hazards. Adoption of and/or compliance with the listed legislation and statutory support materials is expected to provide sufficient mitigation to manage health and safety risks to acceptable levels. Risk treatment of the identified physical hazards is also expected to provide cumulative mitigation of the associated environmental impacts. Table B.20.4 presents mitigation guidance for the identified hazards.

Table B.20.4 Practical and Statutory Mitigation Guidance by Hazard

Hazard	Reference for Hazard Group Mitigation Requirements

All or general hazards	▪ *Work Health and Safety Act 2011* (Qld)
	▪ *Work Health and Safety Regulations 2011* (Qld)
	  ▪ Chapter 12 – Public Health and Safety
	  ▪ Chapter 6 – Construction Work
	  ▪ Part 4.5 – High Risk Work
	  ▪ Schedule 3 – High Risk Work Licences and Classes of High Risk Work
	  ▪ Schedule 4 – High Risk Work Licences – Competency Requirements
	  ▪ Part 4.6 – Demolition Work
	▪ *Public Safety Preservation Act 1986*
	▪ *How to Manage Work Health and Safety Risks; Code of Practice 2011*
	▪ *Work Health and Safety Consultation, Co-operation and Co-ordination; Code of Practice 2011*
	▪ *Managing the Work Environment and Facilities; Code of Practice 2011*

Hazard	Reference for Hazard Group Mitigation Requirements
	▪ *Children and Young Workers; Code of Practice 2006* ▪ *Cash in Transit; Code of Practice 2011*

Biomechanical hazards	▪ *Work Health and Safety Regulations 2011*
	    ▪ Part 4.2 – Hazardous Manual Tasks
	    ▪ Part 4.4 – Falls
	▪ *Hazardous Manual Tasks; Code of Practice 2011*
	▪ *Managing the Risk of Falls at Workplaces; Code of Practice 2011*
	▪ *Scaffolding; Code of Practice 2009*
	▪ *Formwork; Code of Practice 2006*
	▪ *Manual Tasks Involving the Handling of People; Code of Practice 2001*

Mechanical hazards	▪ *Work Health and Safety Regulations 2011*
	    ▪ Chapter 5 - Plant and Structures
	    ▪ Schedule 5 - Registration of Plant and Plant Designs
	▪ *Plant; Code of Practice 2005*
	▪ *Traffic Management for Construction or Maintenance Work; Code of Practice 2008*
	▪ *Concrete Pumping; Code of Practice 2005*
	▪ *Tower Crane; Code of Practice 2006*
	▪ *Safe Design and Operation of Tractors; Code of Practice 2005*
	▪ *Transport Operations (Marine Safety) Act 1994* (Qld)
	▪ *Occupational Health and Safety (Maritime Industry) Act 1993* (Cth)
	▪ *Navigation Act 1912* (Cth)
	▪ *Navigation (Orders) Regulations 1980* (Cth)
	▪ *Transport Operations (Road Use Management) Act 1995* (Qld).

Chemical hazards	▪ *Work Health and Safety Regulations 2011*
	    ▪ Chapter 7 – Hazardous Chemicals
	    ▪ Chapter 8 – Asbestos
	    ▪ Part 4.8 – Diving Work
	▪ Confined Spaces; Code of Practice 2011
	▪ Hazardous Chemicals; Code of Practice 2003
	▪ How to Manage and Control Asbestos in the Workplace; Code of Practice 2011
	▪ How to Safely Remove Asbestos; Code of Practice 2011
	▪ Labelling of Workplace Hazardous Chemicals; Code of Practice 2011
	▪ Preparation of Safety Data Sheets for Hazardous Chemicals; Code of Practice 2011
	▪ Occupational Diving Work; Code of Practice 2005
	▪ Recreational Diving, Technical Diving and Snorkelling; Code of Practice 2011
	▪ Abrasive Blasting; Code of Practice 2004
	▪ *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth)

Potential and stored energy hazards	▪ Tilt-up and Pre-cast Construction; Code of Practice 2003 ▪ Steel Construction; Code of Practice 2004
Noise and vibration hazards	▪ *Work Health and Safety Regulations 2011* ▪ Part 4.1 – Noise ▪ *Managing Noise and Preventing Hearing Loss at Work; Code of Practice 2011*
Thermal hazards	▪ *Explosives Act 1999* (Qld)
Electrical hazards	▪ *Electrical Safety Act 2002* (Qld)
Radiation hazards	▪ *Radiation Safety Act 1999* (Qld)

Hazard	Reference for Hazard Group Mitigation Requirements
Biological hazards	▪ *Biological Control Act 1987* (Qld) ▪ *Environmental Protection Act 1994* (Qld) ▪ *Health Act 1937* (Qld) ▪ *Public Health Act 2005* (Qld) ▪ *Coastal Protection and Management Act 1995* (Qld)
Work stressor hazards	▪ *Prevention of Workplace Harassment; Code of Practice 2004*

Health and safety impacts may be incurred due to natural event hazard (e.g. cyclones) and socio/political event hazards (e.g. vandalism and terrorism). These risks are covered at length in Chapters 21 and 22.

B.20.5.2 Residual Hazard Impacts

The mitigation measures presented in the Risk Register and discussed above show that risk levels can be significantly reduced from extreme or high levels to medium or low across the identified health and safety risks. In addition, consideration of risk as part of safety in design as shown in the Risk Register can, in most cases, provide the opportunity to further reduce risks to low levels.

Findings described in the Risk Register will form part of a Risk Management Plan to provide ongoing review and assessment of risk throughout the phases of the PEP.

Both POTL's OHSMS and EMS include procedures for monitoring and measurement programs to assess occupational exposures or environmental emissions associated with the operation of the PEP. These monitoring programs are defined by occupational hazard or environmental impact and the results are reviewed against defined quantitative standards aimed to enhance health and safety and community standards.

The management systems also provide processes to accommodate change, such as that which is likely to occur for the PEP. These include the development (or in some cases modification) and implementation of a number of project-life management plans and programs including:

- communications plan
- risk registers
- hazard specific response plans (e.g. hazardous materials, infrastructure etc.)
- security management plan
- occupational health and environmental monitoring program
- contactor environmental management plans (contractor SOPs or work method statements)
- operating management plans
- demolition and disposal management plans
- emergency management plan.

B.20.6 Assessment Summary

B.20.6.1 Health and Safety

POTL has a *Risk Management Policy* and procedures that reference AS/NZS 31000:2009. This approach is consistent with current industry practice for the identification, assessment and management of health and safety risks to workers and broader communities. The preliminary risk assessment identified a number of risks across the design, construction, operational and decommissioning phases of the Project.

Health and safety impacts for the PEP covered ten work hazard categories:

- biomechanical (manual tasks)
- mechanical
- electrical
- chemical

- noise/vibration
- potential and stored energy
- thermal
- radiation
- biological
- work stressors.

A risk register covering health and safety risks was compiled, addressing the hazard, potential consequences of impact and an analysis of risk, taking into account the likelihood of occurrence. The inherent levels of risk were predominantly rated as high, with extreme risks relating to energy, equipment, processes and materials.

Identified risks can be reduced to medium or low risk levels by existing or planned mitigation measures. These issues are largely covered by work health and safety legislation (including supporting codes of practice). By meeting compliance requirements the hazards may be mitigated to avoid or reduce health and safety impacts.

Cumulative impacts are prominent with activities associated with change. In addition to the direct impacts captured in the Risk Register, associated impacts have been considered in the risk assessment process at each phase of the Project lifecycle.

Risk management in the design phase is an essential role in the delivery of work health and safety and environmental objectives across the lifecycle of the PEP. Risk considerations at the design phase will provide further opportunity to mitigate inherent risks of the latter phases of the PEP.

B.20.6.2 Health and Safety Risk Management

The design, construction, operational, and possible decommissioning phases of the PEP are covered by an extensive regulatory framework extending well beyond the work health and safety legislation. This framework presents a number of statutory obligations centred on the person conducting business or undertakings and extending to, without necessarily being transferred to, POTL, tenants, staff and contractors responsible for design, construction, operation and demolition/disposal.

POTL meets these obligations through corporate governance and responsibilities to inform and direct compliance. POTL’s OHSMS and EMS provide processes to facilitate risk mitigation actions and the monitoring and review of control performance.

Health and safety risk management forms part of the larger risk management process, which is continual throughout the Project and linked to POTL’s corporate risk management process. Other contexts such as environmental management, property and infrastructure, security and emergency management provide important elements to supporting the mitigation of health and safety risks to workers and people in the port environment, adjacent areas and communities.

Port Expansion Project EIS

Part B

Section B21 – Security, Property & Infrastructure

AECOM BMT WBM

Part B

B.21 Security Property Infrastructure

B.21.1 Relevance of the Project to Security, Property and Infrastructure

The purpose of this chapter is to assess the aspects concerning security property and infrastructure management in response to hazard and risk conditions as recognised and prepared for at the Port of Townsville. This chapter will inform the design and operation of risk management and contingency systems as addressed by the Commonwealth, Queensland and Port of Townsville Limited (POTL) counter-terrorism and critical infrastructure protection requirements and arrangements affecting the Port Expansion Project (PEP).

A variety of threats associated with all aspects of national security have the potential to impact on critical infrastructure and the continuity of essential services associated with the Port of Townsville and the PEP.

B.21.2 Assessment Framework and Statutory Policies

The following legislation and policies are relevant to the assessment and management of emergencies associated with the PEP and the Port of Townsville:

B.21.2.1 Commonwealth Legislation

The *Maritime Transport and Offshore Facilities Security Act 2003* is the principal Commonwealth legislation establishing a scheme to safeguard against unlawful interference with maritime transport. The Act gives effect to Australian implementation and interpretation of the *International Ship Port Security Code*. It establishes a regulatory framework to safeguard maritime transport and protect ships, ports, and port facilities. Provisions under the Act specify requirements in relation to:

- maritime security levels and maritime security plans
- ship security plans
- establishment of maritime security zones
- reporting obligations in relation to certain maritime transport security incidents
- security compliance information from maritime industry participants.

POTLs and port users commitment to security, as required under the *Maritime Transport and Offshore Facilities Security Act 2003*, is monitored by the Office of Transport Security, Department of Infrastructure and Transport.

The Australian Government has implemented a maritime security regime to help safeguard Australia's maritime transport system and offshore facilities from terrorism and unlawful interference. Under this regime all security regulated ports, port facilities, offshore facilities, port and offshore service providers and ships (collectively, marine industry participants) undertake security risk assessments and implement security plans to address identified risks. This includes but is not limited to:

- measures that need to be in place at different security levels
- the powers and responsibilities of officials
- reporting incidents and events
- screening and clearing weapons and prohibited items
- the Maritime Security Identification Card(MSIC) Scheme
- enforcement of the *Maritime Transport and Offshore Facilities Security Act 2003*.

Following 11 September 2001, the international community implemented a system to secure the maritime transport sector against the threat of terrorism. The international Ship and Port Facility Security (ISPS) Code, developed by the International Maritime Organisation (IMO) by December 2002, was the result.

B.21.2.2 International Ship Port Security Code

The *International Ship Port Security Code* (IMO, 2004) provides for considerable flexibility to allow for required security measures to be adjusted so that they meet the assessed risks facing particular ships or port facilities. The *International Ship Port Security Code* has two parts:

- Part A: mandatory provisions covering the appointment of security officers for shipping companies, individual ships and port facilities. It also includes security matters to be covered in security plans to be prepared in respect of ships and port facilities
- Part B: guidance and recommendations on preparing ship and port facility security plans.

B.21.2.3 National Guideline for Protecting Critical Infrastructure from Terrorism

The *National Guideline for Protecting Critical Infrastructure from Terrorism* (NTCT, 2011) describes an intelligence-led, risk informed approach to develop adequate levels of protective security for Australia's critical infrastructure, minimal single points of failure, and rapid, tested recovery arrangements. The guideline provides an explanation of processes for the identification of critical infrastructure, intelligence-led risk management and communication and information management.

B.21.2.4 National Counter-Terrorism Plan

The *National Counter-Terrorism Plan* (NCTC, 2005) outlines responsibilities, authorities and the mechanisms to prevent, or if they occur, manage acts of terrorism and their consequences in Australia. The national counter-terrorism arrangements provide wide ranging and extensive communication and media strategies to ensure effective and timely provision of accurate information to the public. The *National Counter-Terrorism Plan* is structured on prevention and preparedness, response and recovery, and incorporates sub-plans with relevance to the PEP including maritime, surface transport, critical infrastructure and regulated hazardous materials.

B.21.2.5 National Surface Transport Security Strategy

The *National Surface Transport Security Strategy* provides a high level framework for a nationally consistent approach by governments for preventive security in the surface transport security system. Surface transport security policy in Australia rests on two fundamentals:

- regulatory responsibility for security in the surface transport sector rests with the state and territory governments
- surface transport owners and operators have primary responsibility for security arrangements at their own facilities, assets and networks.

B.21.2.6 Australian Maritime Security Arrangements

The Commonwealth *Guide to the Australian Maritime Security Arrangements* (2009) produced by Border Protection Command identifies eight Australian maritime security threats:

- illegal activity in protected areas
- illegal exploitation of natural resources
- marine pollution
- prohibited imports and exports
- irregular maritime arrivals
- compromise to biosecurity
- piracy, robbery or violence at sea
- maritime terrorism

Pertinent to maritime security for the Port of Townsville, the guide defines the Australian maritime jurisdictions:

- Australian Criminal Jurisdiction: territorial sea/internal waters up to 12 nautical miles to sea

- Australian Offshore Jurisdiction: offshore constitutional settlement (Commonwealth) within, as applicable, 12 nautical miles, then extending to 200 nautical miles (economic exclusion zone) and having jurisdiction over foreign nationals and vessels
- Crimes of the Sea Cooperative Scheme: enabling application of criminal law to Australian ships and nationals and certain foreign-registered ships.

B.21.2.7 Queensland Security Legislation

The *Transport Security (Counter-Terrorism) Act 2008* provides for planning for the protection of particular surface transport operations and their users against significant adverse impacts associated with terrorist acts.

B.21.2.8 Queensland Counter-Terrorism Strategy

The *Queensland Counter-Terrorism Strategy* (QPS, 2011) provides a state-level framework for government agencies and their stakeholders in the key areas of focus for counter-terrorism activities from 2011 to 2013. The *Queensland Counter-Terrorism Strategy* strategic focus has been identified through a scanning process, which includes consideration of the current and emerging threat context and an assessment of current gaps and recent lessons learnt. Five key areas are identified:

- countering violent extremism
- mass gatherings
- infrastructure protection
- public information and modern media
- interoperability.

The Queensland Counter-Terrorism Committee, through its member agencies, is responsible for the development, oversight and implementation of this strategy. The committee is chaired by Queensland Police Service and comprises senior representation from nominated Queensland government agencies. Port security representation arrangements are primarily through the Department of Transport and Main Roads. Since the adoption of the *Queensland Counter-Terrorism Strategy*, the names of a number of these agencies have changed, together with some of their areas of responsibility.

- Queensland Police Service
- Department of the Premier and Cabinet
- Department of Community Safety
- Department of Transport and Main Roads
- Queensland Health
- Department of Employment, Economic Development and Innovation
- Department of Environment and Resource Management
- Multicultural Affairs Queensland

B.21.2.9 Queensland Infrastructure Plan

The Queensland Infrastructure Plan (DLPG, 2011a) defines infrastructure as the ‘physical structures and facilities required for a community or economy to function’.

In terms of high priority infrastructure, Port of Townsville features in the following ways:

- building on Townsville’s role as a regional hub
- efficient freight movement and export links
- supporting industrial development
- support development of the North West Queensland Minerals Province.

B.21.2.10 Regional Security Plans

The Queensland government, in collaboration with the Local Government Association of Queensland (2004), produced a variety of guideline documents under the title of *Local Government Counter-Terrorism Risk Management Kit*. This resource kit provides basic advice to local governments, disaster coordination groups, police and authorities, and emergency response organisations. The resource kit is based extensively on general risk management principles.

Plans are developed and delivered with simultaneous alignment with applicable elements of state and national security strategies, coopting the coordination and resource inputs from government departments located in the region. Intelligence, prevention, enforcement and preparedness are handled through police forces (state and Federal, and intelligence agencies) and response and recovery services are assigned to the broader regional disaster coordination group.

B.21.2.11 Port of Townsville Security Management Governance and Policy

POTL maintains its own security management processes and has stated security policy objectives to:

- provide security procedures and practices for port operations to protect the security of facilities, infrastructure, people, maritime operations and the wider community
- establish safeguards to reduce the risk to any persons in the Port of Townsville including company staff, visitors, contractors, suppliers, passengers, crew and other port personnel
- improve the security skills and awareness of company personnel ashore and onboard berthed ship
- prepare contingency measures for emergencies relating to possible security incidents.

POTL's security policy is supported by *Port Operators' Security Assessment*, *Port of Townsville Security Plan*, comprehensive training and awareness for port employees, and audit and review processes. Further to preparedness, POTL is a participant in the Townsville District Disaster Management Group, to which it has aligned response and recovery contingencies. These regional plans are explained in Chapter B22 (Emergency Management).

B.21.3 Existing Values, Uses and Characteristics

POTL has an existing security policy and associated governances to support the conduct of port operations, to protect the security of facilities, infrastructure, people, maritime operations and the wider community, apply appropriate safeguards, security training and awareness for its staff and preparations for response to security events.

The port and its immediate precincts are used for the following purposes:

- industrial: port infrastructure; bulk product storage and handling; manufacturing and services
- transport: waterways; road; rail; air (seaplane and helicopter); commodities and people
- government: state and Commonwealth operations centre; defence facilities
- recreational: commercial and private watercraft; commercial and public land activities
- residential: permanent domestic; short-term commercial accommodation
- commerce: retail; food and beverage; entertainment.

POTL has a proven capability to respond to and manage security events associated with its present operations.

B.21.4 Assessment of Potential Impacts

Security breach events and terrorist attack present a recognised potential threat (TDDMG, 2011). Extrapolating from the *Townsville District Disaster Management Plan*, the main security risks for the Project are likely to be a consequence of the following human interaction events:

- Ross River dam breach
- terrorism
- transport incident

- chemical/fuel/oil spill

POTL has considered and assessed risks that have the potential to impact its operations. Potential hazards and risks are associated with:

- increased level of security associated with port operations and infrastructure areas
- broadening of geographic boundaries for ‘at risk’ receptors and consequential increase of risk by increased scope of impacts, proximity to impacts and frequency of exposure to impacts
- raised security threat potential by nature and size of operations, number and variety of targets, increased potential impacts and increased critical value of property and infrastructure assets.

B.21.5 Mitigation Measures and Residual Impacts

POTL has an approved *Maritime Security Plan* in place, which is required by Commonwealth legislation in accordance with the *Maritime Transport and Offshore Facilities Security Act 2003*. The *Maritime Security Plan* meets the requirements under the Act and is routinely externally audited by the Commonwealth Office of Transport Security.

The *Maritime Security Plan* will be amended to incorporate the PEP as it nears its operational stage. POTL works closely with relevant port stakeholders, including tenants, operators and companies in the port and with the Office of Transport Security to ensure the *Maritime Security Plan* is complied with and is relevant to changing needs.

The *Maritime Security Plan* forms part of the larger risk management process in dealing with hazards and risks associated with the port environs, which is linked to POTL’s corporate risk management process.

B.21.6 Assessment Summary

The Port of Townsville is recognised as essential infrastructure, described as part of Australia’s physical facilities and supply chains, which if destroyed, degraded or rendered unavailable for an extended period, would significantly impact on social or economic values (NCTC, 2005).

The nature of maritime business and infrastructure associated with the Port of Townsville falls within the statutory requirements of the *Maritime Transport and Offshore Facilities Security Act 2003,* which provides safeguards against unlawful interference with maritime transport and establishes security levels for the Port of Townsville and its projects and infrastructure.

As an essential hub for surface transport and supply-chain infrastructure, the *Transport Security (Counter-Terrorism) Act 2008* also has relevance to the port and its projects. Security, property and infrastructure for the Project is inherently linked to:

- *National Counter-Terrorism Plan*
- *Critical Infrastructure Protection National Strategy*
- *Queensland Counter-Terrorism Strategy 2008-2010*
- *Queensland Infrastructure Protection and Resilience Framework*
- Queensland Local Government Area (LGA)
- Port of Townsville Limited organisational governances, policies, procedures and plans.

Changes associated with, and during the course of, the PEP construction and operation will require variation and modification of the existing arrangements to suit the nature of work, risk of security event and degree of preparedness required to mitigate the risk. It is anticipated that additional Project-risk specific security management plans will be required as applicable regarding:

- mitigation of the potential adverse effects of a security or terrorist event
- preparation for managing the effects of an event
- effectively responding to, and recovering from, a disaster or security event.

Updates of POTL security management governances for the change in risk profile will translate directly to variation of the existing *Townsville District Disaster Management Plan* and, where applicable, to the *State Disaster Management Plan*.

Port Expansion Project EIS

Part B

Section B22 – Emergency Management

B.22 Emergency Management

B.22.1 Relevance of the Project to Emergency Management

The purpose of this chapter is to assess the Port Expansion Project (PEP) in relation to emergency management and response to disaster conditions as recognised and prepared for at organisational, regional and state levels. This chapter discusses regulatory requirements and obligations concerning emergency management for the Project and examines various impacts and existing mitigation strategies to prevent, prepare for, respond to and recover from disaster conditions that may affect the PEP.

Queensland is highly susceptible to extreme climatic events and natural hazards such as tropical cyclones, floods, bushfires, and storms. Additional potential hazards resulting from the presence of humans such as failure to design adequately, industrial incidents, anti-social behaviour, issue motivated groups, and terrorism have resulted in the development of a coordinated approach to reducing risk and the creation of response frameworks to deal with these events.

The objective of emergency management is to systematically analyse and evaluate the potential impacts of extreme events and where necessary, provide risk mitigation treatments and strategies, including forecasts of the residual risk. The risk assessment process informs the production of a risk management plan that identifies mitigation measures that can be integrated into a cohesive emergency management response.

Collectively emergency and disaster management plans capture significant emergency issues including:

- terrorist attack
- marine collision reduction
- fire prevention/protection
- leak detection/minimisation
- release of contaminants
- emergency shutdown systems and procedures.
- emergency situations

B.22.2 Assessment Framework and Statutory Policies

The following legislation and policies are relevant to the assessment and management of emergencies associated with the PEP and the Port of Townsville.

B.22.2.1 State and Commonwealth Work Health and Safety Legislation

Work health and safety legislation at state and Commonwealth levels (Harmonised W&S Legislation) provides the framework to protect the health, safety and welfare of workers at work and of other people who might be affected by the work. Part of this requirement is enacted through s. 43 of both the state and Commonwealth work health and safety regulations, which obligate a person conducting a business or undertaking at a workplace to prepare, implement and maintain an emergency plan. Section 43 of both state and Commonwealth regulations states:

> *(1) A person conducting a business or undertaking at a workplace must ensure that an emergency plan is prepared for the workplace, that provides for the following -*
>
> *(a) emergency procedures, including -*
>
> *(i) an effective response to an emergency; and*
>
> *(ii) evacuation procedures; and*
>
> *(iii) notifying emergency service organisations at the earliest opportunity; and*
>
> *(iv) medical treatment and assistance; and*
>
> *(v) effective communication between the person authorised by the person conducting the business or undertaking to coordinate the emergency response and all persons at the workplace;*

(b) *testing of the emergency procedures, including the frequency of testing;*

(c) *information, training and instruction to relevant workers in relation to implementing the emergency procedures.*

(2) *A person conducting a business or undertaking at a workplace must maintain the emergency plan for the workplace so that it remains effective.*

(3) *For subsections (1) and (2), the person conducting the business or undertaking must consider all relevant matters including -*

(a) *the nature of the work being carried out at the workplace*

(b) *the nature of the hazards at the workplace*

(c) *the size and location of the workplace*

(d) *the number and composition of the workers and other persons at the workplace.*

(4) *A person conducting a business or undertaking at a workplace must implement the emergency plan for the workplace in the event of an emergency.*

As a 'person conducting a business or undertaking at a workplace' Port of Townsville Limited (POTL) is required to comply with the regulations.

The work health and safety legislation provides these obligations as a contingency to support the 'person conducting a business or undertaking's obligations to provide safe and healthy workplaces through applied risk management. The work health and safety legislation also applies to all project lifecycle phases through design, construction, operation and eventual decommissioning, demolition and disposal (of all or part).

Emergency management for the Project is also inherently linked to:

- state disaster management legislation and plans
- region and city disaster management plans
- Port of Townsville Limited organisational governances, policies, procedures and plans.

The management of an emergency situation is coordinated by the provisions of the *Public Safety Preservation Act 1989*. This act provides for protection of members of the public in terrorist, chemical, biological, radiological or emergencies

B.22.2.2 Queensland Disaster Management Legislation

The state *Disaster Management Act 2003* requires the government (delegating to the authority of the State Disaster Management Group to issue the *Queensland State Disaster Management Plan* (SDMG, 2011) and empowers Emergency Management Queensland, Department of Community Safety to maintain the plan.

The *Disaster Management Act 2003* aims:

(a) *to help communities—*

(i) *mitigate the potential adverse effects of an event; and*

(ii) *prepare for managing the effects of an event; and*

(iii) *effectively respond to, and recover from, a disaster or an emergency situation;*

(b) *to provide for effective disaster management for the State;*

(c) *to establish a framework for the management of the State Emergency Service and emergency service units to ensure the effective performance of their functions.*

Guiding principles for the legislation include:

- planning for prevention, preparation, response and recovery
- accounting for both natural and human action events
- assigning local governments with the responsibility for managing disaster events in their area

- supporting and resourcing district and state groups to support local governments to undertake their emergency management responsibilities.

A disaster is defined as:

> *A serious **disruption** in a community, caused by the impact of an **event,** that requires a significant coordinated response by the State and other entities to help the community recover from the disruption.*

For the definition:

- ***serious disruption** means—*

(a) loss of human life, or illness or injury to humans; or

(b) widespread or severe property loss or damage; or

(c) widespread or severe damage to the environment.

- ***event** means—*

(a) a cyclone, earthquake, flood, storm, storm tide, tornado, tsunami, volcanic eruption or other natural happening;

(b) an explosion or fire, a chemical, fuel or oil spill, or a gas leak;

(c) an infestation, plague or epidemic;

(d) a failure of, or disruption to, an essential service or infrastructure;

(e) an attack against the state;

(f) another event similar to an event mentioned in paragraphs (a) to (e).

B.22.2.3 State Disaster Management Plan

The *State Disaster Management Plan* (SDMG, 2011) aims to apply the intent of the *Disaster Management Act 2003* and describe the approach to disaster management operations in all events, whether natural or caused by human acts or omissions and provides supplementary hazard specific plans, functional plans and disaster management guidelines.

Under the *State Disaster Management Plan*, disaster management groups are established at local, district and state levels and supported by disaster coordination centres. During operations, when required disaster coordination centres at all levels are activated to:

- coordinate resources
- provide support to disaster management groups
- provide communications between levels and across agencies.

In Queensland, a range of agencies have primary management responsibilities for risks associated with a specific hazard. These are described in Table B.22.1.

Table B.22.1 Disaster Agencies and Hazard Specific Plans

Specific Hazard	Primary Agency	State and National Plans
Animal and plant disease	Department of Agriculture, Fisheries and Forestry	*Queensland Veterinary Emergency Plan* *Australian Veterinary Emergency Plan* *Australian Emergency Plant Pest Response Plan*
Biological (human related)	Queensland Health	*State of Queensland Multi-agency Response to Chemical, Biological, Radiological Incidents*
Bushfire	Queensland Fire and Rescue Service	*Wildfire Mitigation and Readiness Plans (Regional)*
Chemical	Queensland Fire and Rescue Service	*State of Queensland Multi-agency Response to Chemical, Biological, Radiological Incidents*
Influenza pandemic	Queensland Health	*Queensland Pandemic Influenza Plan* *National Action Plan for Human Influenza*

Specific Hazard	Primary Agency	State and National Plans
		Pandemic
Ship-sourced pollution	Department of Transport and Main Roads	*Queensland Coastal Contingency Action Plan* *National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances*
Radiological	Queensland Health	*State of Queensland Multi-agency Response to Chemical, Biological, Radiological Incidents*
Terrorism	Queensland Police Service	*Queensland Counter-Terrorism Plan* *National Counter-Terrorism Plan*

At a state level, disaster risk assessment outcomes have been documented in a state-wide risk register. The *State Risk Register* identifies residual and transferred risk, which identifies gaps and community vulnerability, while highlighting the broader social and economic impacts associated with disasters.

Risk treatments (mitigation) are an outcome of the risk assessment process. The *State Risk Register* can be used to guide the priority development of projects and allocation of funding to projects that will enhance disaster resilient investment across Queensland.

Mitigation may be in the form of:

- design improvements to provide more resilient new infrastructure, update or strengthen existing infrastructure or services
- prepared communities and response agencies and arrangements in place
- resilience activities including partnerships between sectors, community education
- a clear understanding of hazards, their behaviour and interaction with vulnerable elements.

Disaster preparedness is building capability and resilience in the community to ensure that all functions and services that are needed to better manage the consequences of a disaster can do so. Preparedness should start in the community, but applies equally to government, non-government organisations, industry and commerce. Preparedness includes:

- community education and awareness
- resilience
- disaster management planning
- training and education
- exercises
- communication.

The *State Disaster Management Plan* provides a summary of the state disaster management operations diagram (Appendix V1). The PEP will operate in the City of Townsville and is assigned to the Townsville Disaster District.

In the event of declaration of an emergency, an emergency response phase is evoked. The response phase of disaster management involves the conduct of activities and appropriate measures necessary to respond to an event. Response is undertaken as a component of disaster operations being those activities undertaken before, during and after an event to help reduce loss of human life, illness or injury to humans, property loss or damage, or damage to the environment, including, for example, activities to mitigate the adverse effects of the event.

Functional planning for disaster management and response matters is provided at a state government departmental level as shown in Table B.22.2. Specific roles and responsibilities are further expanded in the *State Disaster Management Plan*.

Table B.22.2 Queensland Government Departmental Responsibilities

Function	Functional Lead Agency[1]
Building and engineering services	Department of Public Works
Communications services	Department of Public Works
Electricity, fuel and gas supply	Department of Energy and Water Supply
Emergency supply	Department of Public Works
Health services	Queensland Health
Public information	Department of the Premier and Cabinet
Transport systems	Department of Transport and Main Roads
Warnings	Department of Community Safety
Economic recovery	Department of Employment, Economic Development and Innovation
Environmental recovery	Department of Environment and Resource Management
Human-social recovery	Department of Communities
Infrastructure recovery	Department of Local Government and Planning

1 Agency names are as listed in the *State Disaster Management Plan*. Some names have recently changed.

The *State Disaster Management Plan* extends beyond management of the conditions associated with the initiating emergency event. The recovery phase of disaster management involves disaster relief; being the provision of immediate shelter, life support and human needs to persons affected by, or responding to, a disaster; and the broader disaster recovery; being the coordinated process of supporting affected communities in the reconstruction of the physical infrastructure, restoration of the economy and of the environment, and support for the emotional, social, and physical wellbeing of those affected. Recovery is undertaken as a component of disaster operations (Appendix V1).

The *State Disaster Management Plan* includes a final element, being post-disaster assessment. This provides essential information from the examination of the effectiveness of mitigation measures, an analysis of the state of preparedness in readiness for the impacts of a disaster, of the disaster operations themselves and extends into the effectiveness of recovery.

B.22.2.4 Townsville District Disaster Management Plan

In accordance with the *State Disaster Management Plan* and to meet the object of the *Disaster Management Act 2003* to devolve responsibility to local government, the Townsville District Disaster Management Group (TDDMG) has produced the *Townsville District Disaster Management Plan*.

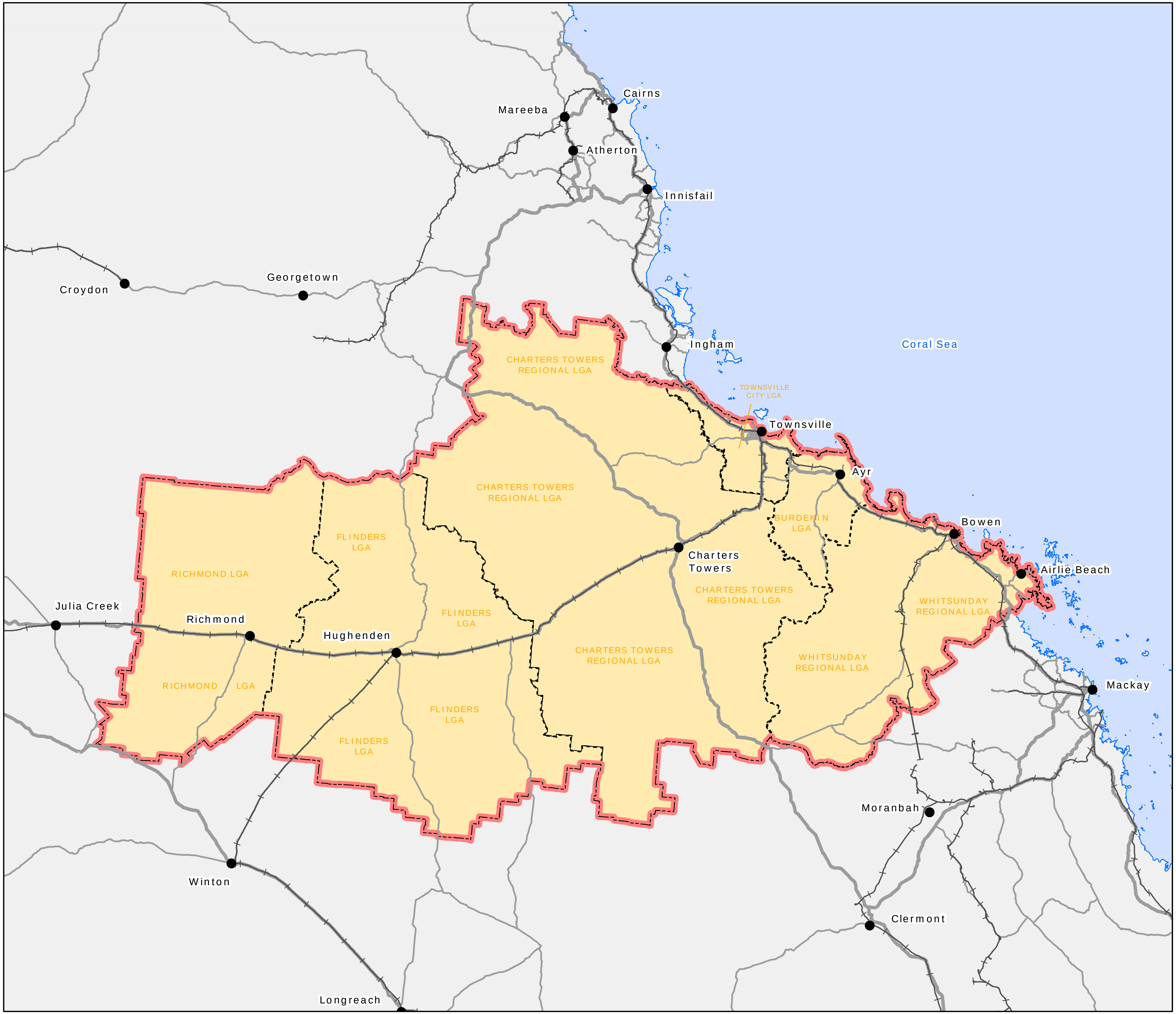
The objectives of the *Townsville District Disaster Management Plan* are to:

- facilitate the implementation of effective and efficient disaster management strategies and arrangements
- develop, review and assess the effectiveness of disaster management for the district including arrangements for mitigating, preventing, preparing for, responding to and recovering from a disaster
- comply with the State Disaster Management Group's *Strategic Policy Framework*, the *State Disaster Management Plan*, the *District Disaster Management Guidelines* and any other guidelines relevant to district level disaster management
- develop, implement and monitor priorities for disaster management for the district
- detail information management processes
- strengthen partnerships in providing disaster mitigation
- align with contemporary disaster management practices
- provide for business continuity arrangements
- maintain consistency with the requirements for disaster planning as contained in the *Disaster Management Act 2003* and associated guidelines.

The *Townsville District Disaster Management Plan* covers the local council areas (Figure B.22.1) of:

- Hinchinbrook

- Palm Island
- Townsville
- Burdekin
- Charters Towers
- Flinders and Richmond.

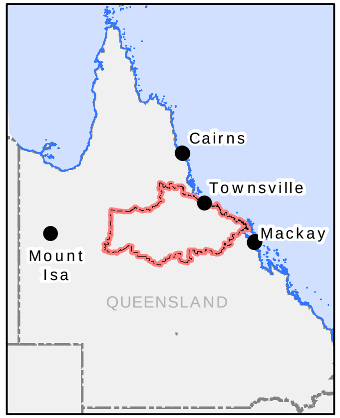


PORT EXPANSION PROJECT EIS

Townsville Disaster District

Figure B.22.1

Legend
- Localities
- Highways
- Main Roads
- Main Railway Lines
- Local Goverment Areas
- Townsville Disaster District



Scale: 1:4,000,000 (when printed at A4)

0 25 50 100 150
Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_123

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
Townsville Disaster District - NRW LGA 2009

Collectively, the Townsville Disaster District has a population of more than 230,000, with approximately 80% of the inhabitants residing in Townsville City Council. While potential impacts are likely to focus primarily on Townsville City Council, the councils of Hinchinbrook, Palm Island and Burdekin connect Townville City Council by sea and Charters Towers Regional Council adjoins to the west of Townsville City Council. The *Townsville District Disaster Management Plan* is informed by a systematic evaluation and assessment of risk for disaster events which include:

- flood
- tropical cyclones
- storm tide (surge)
- tsunami
- landslide
- dam breach
- emergency animal disease
- terrorism
- earthquake
- bushfire
- transport incident
- chemical/fuel/oil spill

The *Townsville District Disaster Management Plan* refers to threat specific plans relevant to the PEP. These include:

- Department of Transport (Maritime Division) – *Oil Spill Contingency Plan*
- Department of Employment Economic Development and Innovation – *Emergency Animal Disease*
- *Queensland Biosecurity Strategy*
- Queensland Fire and Rescue Service – *Wildfire Contingency Plan*
- Port of Townsville: *Oil Spill Contingency Plan*
- *Queensland Coastal Contingency Action Plan*
- *NQ Water: Ross River Dam: Emergency Action Plan*
- *Burdekin Dam Action Plan*
- *Tropical Cyclone Storm Tide Warning Response System*
- *National Storm Tide Mapping Model for Emergency Response*

As noted elsewhere, the names of the agencies are in accordance with those identified in the plans, but a number of these have recently been renamed and some responsibilities have been reallocated between some of the new agencies.

The *Disaster Management Act 2003* provides for the establishment of Local Disaster Management Groups (LDMG) to support the development of strategies to facilitate prevention, preparedness, response and recovery. The Act also provides for the creation of District groups to support the LDMG through the coordination of wider resources. This is articulated through the Townsville District Disaster Management Plan. Functional responsibilities of Queensland government departments are aligned with those described previously in Table B.22.2 and are adjusted to align with the needs of the LDMG.

The *Townsville District Disaster Management Plan* also incorporates a framework for reviewing emergency plans that will have benchmark applications for organisational plans developed in support of governance arrangements of the PEP.

B.22.2.5 Port of Townsville Emergency Management Governance and Policy

POTL maintains its own emergency management processes incorporated in an Integrated Management System. Specifically these include but are not limited to:

- *Emergency Management Plan* risk assessments
- emergency response plans covering port precincts, cyclones, fire and oil spills
- emergency notification system and emergency evacuation procedures
- ship emergency and general Information

Additionally, POTL has established an Emergency Management and Emergency Risk Management Committee with responsibility to assess, monitor and review hazards having the potential to impact port operations.

B.22.2.6 Application of Australian Standards

Australian and international standards provide guidance for determining the practicability of risk treatment(s), advice on acceptable and recommended practice, and information for decision making.

The following Australian standards and guidelines are relevant to this assessment:

- *AS/NZS ISO 31000:2009 Risk management – principles and guidelines* (Standards Australia, 2009)
- *AS 3745-2010 Planning for emergencies in facilities* (Standards Australia, 2010)
- *CS FP 001-1995 Fire emergency response* (Standards Australia, 1995)
- *AS 1678 (Series):1999 Emergency procedure guide – transport* (Standards Australia, 1999)
- *AS 1670 (Series) Fire detection, warning, control and intercom systems* (Standards Australia, 2004b)
- *AS 3846:2005 The handling and transport of dangerous cargoes in port areas* (Standards Australia, 2005a)
- *Handbook 203:3006 Environmental risk management – principles and processes (HB203:2006)*
- *HB 76:2010 Dangerous goods - initial emergency response guide*
- *Handbook 76:2010 Dangerous goods - initial emergency response guide (HB 76:2010)*

B.22.3 Existing Values, Uses and Characteristics

POTL emergency response and management governances cover proposed works associated with the PEP. The organisational approach to emergency response and management is underpinned by POTL policies stating commitment to:

- providing a safe port
- preventing all workplace injuries and illnesses
- ensuring all employees and others on port land are safe

POTL has a proven capability to respond to and manage emergency conditions associated with its present operations. Changes associated with the delivery of the PEP will require variation and modification of existing provisions to suit the nature of proposed work, risk of catastrophic or natural events and degree of preparedness required to mitigate the risk.

The additional layers of disaster management planning at a local, regional and state levels as required by the *Disaster Management Act 2003* reinforce organisational plans and processes for emergency response and management. Processes at all three levels (organisation, locally, district and state) are aligned in their objectives to:

- mitigate the potential adverse effects of an event
- prepare for managing the effects of an event
- effectively respond to, and recover from, a disaster or an emergency situation.

B.22.4 Assessment of Potential Impacts

The guiding standard for preparation of state and district disaster management plans, the *National Emergency Risk Assessment*, presents consequence and likelihood values that differ significantly to the consequence values commonly used in the work health and safety context. These values along with disaster impact definitions are shown in Appendix V2.

The adequacy of risk treatments for emergency response and management at the organisation level are informed by statutory requirements, mainly the *Work Health and Safety Act 2011* with guidance from *AS3745:2010 Planning for emergencies in facilities* (Standards Australia, 2010) . Catastrophic event and disaster risks potentially impacting on the PEP are also treated holistically through the overlay of, as applicable, the *State Disaster Management Plan*.

The *State Disaster Management Plan*, while taking a risk assessment based approach to understand the state's risk exposure, takes an 'all hazards' approach, meaning the functions and activities applicable to one hazard are most likely applicable to a range of hazards and consequently a disaster management plan captures the functions and activities applicable to all hazards. The plan addresses delivery of its model underpinned by the principles of prevention, preparedness, response and recovery, and focusses on implementation, operation and effectiveness facilitated by approaches centred around:

- all agencies approach
- use of local (district) disaster management capability
- establishing a prepared and resilient community.

At the regional level, disaster emergency interventions require more risk detail to establish priorities, prepare plans and allocate resources. The *Townsville District Disaster Management Plan* summarises the main disaster hazards (not ranked) for the area to be:

- by natural event
  - flood
  - tropical cyclones
  - storm tide (surge)
  - tsunami
  - landslide
  - emergency animal disease
  - earthquake
  - bushfire
- by human interaction event
  - dam breach
  - terrorism
  - transport incident
  - chemical/fuel/oil spill

B.22.4.1 Potential Impacts

The risk assessment for issues identified by both POTL and the Townsville Disaster Management Group is summarised in Table B.22.3, describing the source of the emergency event, the potential hazard arising, and the rating of risk significance based on the analysis of consequential impacts and the likelihood of occurrence. Outcomes of the assessment are discussed below.

Table B.22.3 Combined Emergency Event Risk Analysis (TDDMG and Port of Townsville)

Reference	Source of Emergency	Hazard	Likelihood	Consequence	Initial Risk
TDDMG	Natural event	Flood	Unlikely	Minor	Low
TDDMG	Natural event	Tropical cyclones	Likely	Catastrophic	Extreme
TDDMG	Natural event	Storm tide (surge)	Possible	Major	High
TDDMG	Natural event	Tsunami	Rare	Minor	Low
TDDMG	Natural event	Landslide	Rare	Insignificant	Low
TDDMG	Natural event	Animal disease emergency	Possible	Major	High
TDDMG	Natural event	Earthquake	Rare	Catastrophic	High
TDDMG	Natural event	Bushfire	Rare	Insignificant	Low
TDDMG	Human interaction event: intentional	Terrorism	Possible	Catastrophic	High
TDDMG	Human interaction event: incidental	Dam breach	Rare	Catastrophic	High
TDDMG	Human interaction event: incidental	Transport incident	Unlikely	Major	Medium
TDDMG	Human interaction event: incidental	Chemical/fuel/oil spill	Unlikely	Major	Medium
Port of Townsville	Human interaction event: incidental	Fire (ship/berth/land)	Rare	Major	Medium
Port of Townsville	Human interaction event: incidental	Oil spill	Unlikely	Major	Medium
Port of Townsville	Human interaction event: incidental	Utility failure	Possible	Moderate	High
Port of Townsville	Human interaction event: incidental	Channel blockage	Rare	Major	Medium
Port of Townsville	Human interaction event: incidental	Structural damage to pier or wharf	Rare	Major	Medium
Port of Townsville	Human interaction event: incidental	Infectious disease	Possible	Moderate	High
Port of Townsville	Human interaction event: intentional	Terrorist incident	Possible	Catastrophic	High
Port of Townsville	Human interaction event: incidental	Dangerous goods spill (other than oil)	Unlikely	Moderate	Medium
Port of Townsville	Human interaction event: incidental	Gas escape	Unlikely	Moderate	Medium
Port of Townsville	Human interaction event: incidental	Crane collapse	Rare	Major	Medium
Port of Townsville	Human interaction event: incidental	Marine incident (grounding or collision)	Possible	Moderate	High
Port of Townsville	Human interaction event: incidental	Industrial incident	Possible	Moderate	High
Port of Townsville	Human interaction event: incidental	Explosion	Rare	Catastrophic	High
Port of Townsville	Human interaction event: intentional	Bomb threat	Likely	Insignificant	Medium
Port of Townsville	Natural event	Severe storm event (includes cyclone)	Likely	Catastrophic	Extreme
Port of Townsville	Human interaction event: incidental	Road/rail incident	Possible	Major	High

Reference	Source of Emergency	Hazard	Likelihood	Consequence	Initial Risk
Port of Townsville	Human interaction event: incidental	Aircraft incident	Rare	Major	Medium
Port of Townsville	Human interaction event: incidental	Quarantine incident	Possible	Moderate	High
Port of Townsville	Human interaction event: intentional	Hostage situation	Rare	Major	Medium
Port of Townsville	Human interaction event: incidental	Radioactive material leak	Rare	Moderate	Medium
Port of Townsville	Natural event	Flooding	Unlikely	Minor	Low

B.22.4.2 Natural Events

Both POTL and the TDDMG rank flooding as a low risk. High intensity rain events (typically associated with cyclones) can result in flooding of the Ross River and catchment, which may impact the PEP. The main effects of these events are likely to impact works in the south-eastern precinct of the PEP adjacent to the mouth of the Ross River. Flooding from a catastrophic breach of the Ross River Dam may have both direct and collateral impacts on the PEP. To a lesser degree, release of water from the Ross River Dam during flood management may have some impact, depending on management of the rate and volume of water released.

Tropical cyclones are historically the most severe natural events with the potential to result in a fatality in Queensland. Cyclones carry disaster risks associated with damaging wind, damaging waves/tides/currents, water inundation and riverine flooding. Townsville is in a region of Australia with known experience of impact from cyclones (both direct and cyclones in the region delivering consequential damage), which may impact on the PEP and its lifecycle phases.

Animal disease risk constitutes a threat to Queensland and Australia. As a port of entry to and exit from Australia the Port of Townsville carries the associated risk of impact. Additionally, being located in a tropical area increases the potential threat associated with various tropical diseases and infections. The continuity of port operations during the construction of the PEP means that animal disease impacts have the potential to occur over the lifecycle of the PEP.

Other natural events, linked with tsunami risk, landslides, earthquakes and bushfires carry a lower threat of impact to the PEP.

B.22.4.3 Human Interactions

Human interactions relate to major and significant events resulting in emergency response management. These may relate to the built environment or social behaviour where control is lost (through design or degree of human action) resulting in damage.

Structural failure of utilities and the Ross River Dam are recognised as high risk potential factors with the potential to impact on Townsville, its port and the PEP.

Terrorist attack also presents a recognised potential threat. Consequential impacts may be incurred by PEP across each of its phases (this aspect is further discussed in Chapter B21).

Industrial fire (shipboard, berth or land bound/building) presents a risk and potential impact for operations.

Road, rail and waterway transport links connect and traverse the Port of Townsville. The port is in the flight path of the secondary runway of Townsville airport and is likely to be beneath the south-bound bank area (turn) of aircraft departing the primary runway of the airport. A variety of transport threat scenarios exist and as such present impact potential for the PEP.

The Port of Townsville has a variety of statutory defined ‘major hazard facilities’ operating in the precinct. Additionally, hazardous materials are also transported through the port by sea, road and rail in bulk quantities and have an increased impact potential for the Project. The location of any potential hazardous material and dangerous good stores associated with the PEP is unable to be detailed at this phase of the project.

B.22.5 Mitigation Measures and Residual Impacts

B.22.5.1 Mitigation Measures

POTL has considered and assessed risks associated with disaster and catastrophic events as part of its ongoing operation of the port. Based on this, the organisation has prepared and implemented various governances, procedures and plans for emergency management of situations that may potentially arise from its business and operational responsibilities.

The PEP has various potential impacts integral to its own operations. It will also be subject to potential impacts associated with natural and human initiated disaster impacts by reason of its geographical location. Mitigation and management of additional potential impacts would be dealt with through incorporation into existing emergency management measures implemented by POTL. The specific location for emergency management areas within the PEP (for example, incident control points, firefighting equipment) is unable to be detailed at this phase of the project. Emergency management measures will be compliant with the Environment Management Plans detailed in Part C of this EIS.

Mitigation of disasters and catastrophic impacts are also addressed at district and state levels through the respective disaster management groups delivering plans and programs for prevention, preparedness, response and recovery. Delivery is coordinated through the 'all agencies' program across Commonwealth, state and local governments. In these structures there is scope for interplay between organisations and regional disaster management groups. Mitigation of potential impacts on the PEP would be by way of a review of existing disaster plans and amendment, as required, to ensure an integrated and holistic approach to these matters is maintained.

Personnel involved in design, construction, operational and decommissioning phases of the Project will need to be engaged and fully understand the emergency response and management processes and requirements in the context of:

- natural and human interaction disaster risks and impacts
- Port of Townsville Limited's governances
- procedures and plans for emergency management
- TDDMG and the group's regional disaster plan
- Emergency Management Queensland and the *State Disaster Management Plan*.

B.22.5.2 Residual Impacts

The risks presented in Table B.22.3 show that risk levels range from low to extreme. Initial risk levels, as shown by the risk assessment, can have the potential to cause major impacts. Emergency and disaster management plans play an important role in safeguarding against the consequence of these risk events occurring and restoration of services post-event occurrence, particularly in situations that have a likely occurrence, such as cyclones.

Indirect and cumulative impacts can also arise. For example, industrial fire or a significant chemical spill present the potential for direct (immediate area contamination) and indirect (smoke and fume contamination to the community and environment) impacts. Construction infrastructure damaged during cyclone (e.g. temporary bulk fuel storage), may impact the Project directly (by loss and recovery) but also has the potential to indirectly impact on the community, waterways and environment through spillage contamination.

As many emergency management impact mitigation actions centre on behaviour and procedural requirements, over time and with repeated exposure to low consequence events, this may result in complacency and reduced effectiveness of emergency response processes. For example, frequent experience with management of low level natural events (e.g. flooding) may diminish exposed persons' readiness to respond to rare but more severe events. Formal procedures, communication and education (including practice) are essential to maintain the reliability of emergency response mitigation measures and plans.

These residual risks are prominent for activities associated with change, as well as disaster conditions arising from situations of rapid and often unpredictable changes to normal operating conditions. As such, risk and mitigation assessments undertaken that pertain to emergency management will consider the potential for indirect and cumulative impacts.

B.22.6 Assessment Summary

The Project lifecycle spans all aspects from concept initiation to design through construction, commissioning, operation and ultimately decommissioning. Impacts with catastrophic consequence potential for the Project cover natural and human interaction events. In particular tropical cyclones were identified as a significant source of emergency hazard. Human interaction events such as utility and dam failures, terrorism, and industrial incidents were also noted as potentially significant initial risks.

Emergency management planning for the port follows formal processes structured on the principles of *AS 3745-2010 Planning for emergencies in facilities* (Standards Australia, 2010) and governances used have been independently audited and accredited. These approaches are consistent with current industry practice for emergency management.

There are a number of statutory obligations for POTL for design, construction, operation and decommissioning. Provision of emergency management processes, as covered in the *Work Health and Safety Regulations 2011*, is an included aspect of these obligations.

POTL recognises the need to meet its obligations in respect of work health and safety, environmental and other regulatory areas by instigating appropriate corporate governances and responsibilities to inform and direct compliance. This extends to its contribution to the district and state disaster management strategies, which will continue during the construction and operation of the PEP

Emergency and disaster management plans form part of the larger risk management process in dealing with hazards and risks associated with the port environs, which is linked to POTL's corporate risk management process. Other contexts such as the Port of Townsville Health and Safety Management System, Environmental Management System and security and management of critical infrastructure provide important elements to mitigation of consequences arising from emergency events.

Port Expansion Project EIS

Part B

Section B23 – Summary of Key Risks, Impacts & Mitigations

AECOM BMT WBM

B.23 Summary of Key Risks, Impacts and Mitigations

B.23.1 Overview of Key Risks and Impacts

The Port Expansion Project (PEP) involves:

- development of a new harbour (the outer harbour) enclosed in a new breakwater (north-eastern breakwater) and revetments
- deepening the bathymetry of existing channel alignments, together with minor widening near the proposed outer harbour entrance
- development of land by reclamation to the north-east of the existing port area based on re-use of over 4,000,000 m³ of dredged material
- development of port infrastructure including berths and wharves.

Based on analysis, investigations and assessment presented in the preceding EIS chapters, a range of potential, predicted and residual impacts have been identified. Based on the assessment, many potential impacts can be managed through the adoption and monitoring of recommended mitigation measures. The series of specific measures are identified in the various chapters (within the assessment summary tables) and also stated in greater detail in Part C of the EIS, which sets out a range of comprehensive environmental management plans for key development components and activities such as dredging, maritime construction activities and vessel operations.

The potential for residual impacts (following the application of mitigation measures) has also been identified and investigated in each chapter; those residual impacts in the marine environment have been identified as matters potentially requiring an environmental offset. An offset proposal has been developed to address these residual impacts, in the marine environment, as outlined below in Section B23.2 of this chapter.

Air and noise effects will arise during PEP's construction phases. A high quality air monitoring system and predictive tools will enable adaptive management of port development activities to both control emission levels and manage potential exposures at locations in South Townsville and Townsville. Further environmental assessments will precede landside development through the *Sustainable Planning Act* and other approval mechanisms so more detailed analysis and validation will be given to those derived developments when the nature of potential developments and emission characteristics are known.

Construction and operational impacts, including potential cumulative impacts, have been identified specifically for each physical, ecological, socio-economic and cultural factor. Having assessed the likelihood and consequences of the set of development aspects and potential impacts, a detailed set of mitigation measures has been formulated and compiled into succinct outcome-based EMP to guide their implementation, monitoring and corrective actions throughout the development of PEP. Relevant mitigation and management strategies are prescribed in EMPs put forward, at this planning stage, in response to the Terms of Reference and EIS Guideline stipulations.

Overall assessment in relation to risks of cumulative impacts on significant environmental values and ecological factors, especially for matters of national environmental significance, is made separately in Chapter B24.

B.23.1.1 Summary of Key Development Aspects and Potential Impacts

The following (Table 23.1) summarises development aspects associated with PEP infrastructure and activities.

Table 23.1 Summary of PEP development infrastructure and construction activities and their potential impacting mechanisms

Description of PEP elements and activities	Key potential impacting mechanisms
North-eastern breakwater and revetment infrastructure (around reclamation perimeter).	Permanent loss of benthic habitat Changes to hydrodynamics and coastal processes
Western breakwater (if required)	
Dredging for augmentation of channels and development of outer harbour.	Water quality (resuspension of seabed sediments) Change to (deepening) seafloor habitat in channels and harbour
Outer harbour basin with approximately 5,100,000 m³ in situ marine sediment material removal to create a new outer harbour basin.	
Deepening of existing Platypus and Sea channels.	Temporary loss of seafloor benthic habitat
Seabed preparation for breakwater and revetments (plus areas in bunded reclamation area) with volume of soft uncompressible material of approximately 750,000 m³.	Permanent loss of benthic habitat
Handling and placement of sediments by dredger with approximately 4,300,000 m³ marine sediments secured in bunds for land reclamation over tidal waters and approximately 5,600,000 m³ of geotechnically unsuitable sediments onto the Dredge Material Placement Area.	Water quality (resuspension of seabed sediment) Sedimentation on seafloor at DMPA Noise; Vessel interaction
Development of port land and infrastructure.	Water quality (runoff and spills) Dust mobilisation Noise and vibration; Light
Bunds around a reclaimed area of approximately 100 ha on tidal lands eastwards of the existing harbour configured to retain fill in stages (with settlement areas for the temporary management and treatment of tailwater). Surface capping layer (approx 1 m thick) and pavement will be applied over fill material (approximately 700,000 m³ imported fill).	Water quality (tailwater release) Permanent loss of benthic habitat Dust mobilisation
Port navigation with installation and reconfiguration of aids to navigation.	Noise; Vessel interaction
Up to six berths and wharves in the outer harbour (Berths 14 through 19). Berth pockets will be dredged to an all-tides depth of approximately –15.5 m CD.	Noise and vibration
Land areas for industry's future cargo storage and handling including road and rail transport corridors.	Water quality (runoff and spills) Noise; Dust mobilisation
Road infrastructure including an internal road in a corridor 25 m wide on the reclamation area. Connection via existing Benwell Road to the Eastern Access Corridor	Noise and vibration; Dust mobilisation
Rail infrastructure including a rail reserve 25 m wide on the reclamation area to service bulk goods haulage.	Noise and vibration; Dust mobilisation
Buildings, utilities and other built services	

B.23.1.2 Potential Alternative Port Sites and Configurations

Essential in the port planning and environmental impact assessment was a phase where the "best" potential regional infrastructure development was determined. In that early phase, consideration was given to potential alternative options including the PEP arrangement. The location and details of the short-listed alternatives is shown in Part A of the EIS.

The preferred development option was established as the proposal presented as 'PEP', as it provides the following overall benefits and managed outcomes:

- protected berths for cargo transfer and better protection during sea states and weather events;

- does not require new landside and sea access infrastructure corridors by making use of the existing shipping channels and the Eastern Access Corridor now under construction;
- has the least overall capital cost of the alternative options and minimises port infrastructure duplication and operating costs by being an extension of the existing port facility,
- minimises both additional channel dredging required as it uses the existing channels and the amount of dredged material disposal by placing some of it into reclamation;
- by developing in an area of modified environmental values with a management intent of 'moderately disturbed' (adjacent to the existing port and urban areas according to draft Water Quality Objectives) with manageable wider-field environmental effects in the GBR World Heritage Area.

B.23.1.3 Summary of Key Impacts requiring Mitigation and Monitoring

The following sections summarise the most sensitive receptors, the potential impacts that may or would arise because of PEP aspects and the measures to be applied to mitigate and monitor the predicted effects.

B.23.1.3.1 Risk ranking

The EIS has adopted a widely used risk-based approach to impact assessment, including where relevant standards have required specific methodologies or parameters. The general approach used in the chapters considers:

- *Magnitude of potential impact* (e.g. consequence) which includes an assessment of the intensity, scale (i.e. geographic extent), duration of impacts and sensitivity of environmental receptors to the impact.
- *Likelihood of impact* which assesses the probability of the impact occurring.

The method of assessment and the assigned risk ratings are described in Chapter A2.4. The key environmental values and environmental management risks likely to be affected by the PEP were identified in the EIS (specified in Part B). For each value identified with risks of impact and, where it is mitigable, a management action or plan provides an environmental management strategy for its risk management. Aspect based environmental management plans (EMPs) are contained in Part C of EIS.

Initially, a preliminary risk assessment identified potential impacts, as summarised in Tables 23.2 to 23.4 below, and these are rated according to the consequences of the impact, and their likelihood. The preliminary risk assessment does not include any measures to mitigate risk or ameliorate impacts and, as such, was developed as an unmitigated scenario, in order to establish why different risks were addressed by the various available mitigations.

Three main groups were established in relation to environmental receptors of the natural and built environments being:

- Marine factors, such as benthic habitat and marine vertebrates
- Terrestrial factors, including bird ecology, air quality and acoustic environment
- Social and cultural factors, such as heritage, amenity, economics and social values

Three environmental risk categories were established as low, medium and high as shown for each of the main groups of marine, terrestrial and social/cultural factors in Tables 23.2 to 23.4.

This risk identification process, together with consultation advice from stakeholders, enabled key aspects to be identified for analysis and assessment. An assessment of each attribute has been undertaken as part of this EIS, commensurate with its risk. Appropriate measures have subsequently been nominated for each attribute to address potential risks as shown in subsequent sections.

Table 23.2 Marine factors and potential unmitigated effects from key aspects - original overall risk rating (shown as High; Medium; Low in Table B23.5)

Chapter / Factor →	Coastal Processes	Sediment quality	Water resources	Water quality	← Marine Ecology →				
Risk rating Low=L; Medium=M; High=H	Marine Factors ↓								
Key Aspects ↓	Hydrodynamics & Coastal Processes	Sediment Quality	Water resources	Water Quality	Benthos	Fish	Mammals	Reptiles	Ecosystem Integrity
Physical presence	M	M	L	L	L	-	L	L	L
Marine noise and vibration	-	-	-	-	-	L	H	H	-
Sediment resuspension – turbidity	-	L	-	H	H	L	L	L	M
Ground disturbance and excavation	M	-	-	-	M	-	L	L	L
Marine discharges including spills	-	-	L – M	L – M	L	L	L	L	L – M
Introduced species	-	-	-	-	L	L	-	-	H
Light	-	-	-	-	L	-	L	M	-
Vessel Movements	-	-	-	L	-	L	M	H	L

** those combinations marked as '-' have risk ratings less than Low

.

Table 23.3 Terrestrial factors and potential unmitigated effects from key aspects - original overall risk rating (shown as High; Medium; Low in Table B23.5)

Chapter / Factor →	← Land →		Noise & Vibration	Air Quality	GHG	Terrestrial Ecology	Climate change and Hazards	Waste
Risk rating Low=L; Medium=M; High=H	Terrestrial Factors ↓							
Key Aspects ↓	Land Use	Land Contamination	Acoustic Environment	Atmosphere		Terrestrial ecology	Climate change and hazards	Waste
Port physical presence (after construction)	L	-	-	L	L	M	H	M
Fill and excavation (at construction)	L	M	M	H	M	L	M	L
Other port construction activities	M	L	H	M	L	L	-	L
Particulates or fumes during operations (product related)	L	-	-	M	-	-	-	-
Discharges including spills and unplanned emissions (construction & operations)	L	M	-	-	-	L	-	M
Light	M	-	-	-	-	L	-	-
Transport activity (inc rail and roads) during construction	H	-	M	M	L	-	-	-
Transport movements (inc rail and roads) during operations	M	-	M	L	L	-	-	-
Shipping during operations	-	L	L	-	L	-	L	L

** those combinations marked as '-' have risk ratings less than Low

Table 23.4 Social, cultural and built factors and potential unmitigated effects from key aspects – original overall risk rating (shown as High; Medium; Low in Table B23.5)

Chapter / Factor →	Social environment, consultation and sustainable development		Scenic Amenity	Port Operations	Transport & Infrastructure	Economics	Indigenous cultural heritage	Non-indigenous cultural heritage
Risk rating Low=L; Medium=M; High=H	Social and Built Factors ↓							
Key Aspects ↓	Social values	Consultation & Extension	Amenity and aesthetics	Maritime Infrastructure Networks	Land Infrastructure Networks	Economic Environment	Heritage	
Port physical presence including trade throughput	M	L	H	L	M	H*	M	-
Fill and excavation (at construction)	-	L	M	L	-	-	M	-
Other port construction activities	-	L	M	L	L	-	-	-
Particulates or fumes during operations (product related)	M	M	L	-	-	-	-	-
Discharges including spills and unplanned emissions (construction & operations)	M	M	-	-	-	-	-	-
Light spill during operations	L	M	H	L	-	-	-	-
Transport activity (inc rail and roads) during construction	H	M	L	-	H	M	M	M
Transport movements (inc rail and roads) during operations	M	L	L	-	H	H*	-	M
Shipping during operations	L	L	L	M	-	-	-	-

** those combinations marked as '-' with risk ratings less than Low; *high beneficial effects

Although certain factors are of greater relevance, each factor is important and an assessment of the impacting mechanisms and potential impacts is presented within each chapter, along with specific mitigations and their monitoring requirements.

In order to present a summary of the key mitigations, an overall perspective of the key risks can be made by taking the information, both from the preceding Part B chapters and the unmitigated summary tables above (Tables B23.2-23.4). The ranking of the key environmental factors in Tables 23.5 provides a high level summary.

Table 23.5 Overall unmitigated risk rating of environmental factors based on constituent aspects

MARINE FACTORS	TERRESTRIAL FACTORS	SOCIAL & BUILT FACTORS
- Marine ecology	- Noise and vibration	- Social matters including stakeholder consultation
- Water quality	- Air quality	- Scenic Amenity
	- Land	- Transport & Infrastructure
- Hydrodynamics & Coastal Processes	- Climate change and natural hazards #	- Economics
	- Terrestrial ecology	- Port Operations #
- Sediment quality	- Greenhouse gases **	- Indigenous cultural heritage**
- Water resources	- Waste	- Non-indigenous cultural heritage**

operations phase ** construction phase

The key mitigations are considered summarily in the subsequent section B23.1.4 for the following key environmental factors:

- Marine ecology and water quality
- Noise and vibration
- Air quality
- Land
- Social matters including stakeholder consultation
- Transport and infrastructure
- Scenic amenity

B.23.1.4 Summary of Mitigation Measures and Monitoring for Key Factors

Each development phase has been outlined in various levels of detail below as they are important to the implementation of important management measures in anticipation of development. PEP development phases would be:

- planning, design and pre-construction
- construction
- operations

Because of its relevance to the implementation of the PEP development program, more information has been provided for planning/pre-construction in the section that follows. Most detail on construction and operational development aspects and the stipulated mitigation and monitoring can be obtained from the EMPs detailed in Part C of the EIS.

Decommissioning is not relevant for reclaimed land and any decommissioning of port land developments would be considered and implemented by port leaseholders for their respective industrial or commercial infrastructure so would be subject to future decisions in relation to environmental assessment.

B.23.1.4.1 Planning Phase Strategies and Mitigations

This EIS identified a number of strategies and measures to be adopted by POTL that require adoption and review in the planning, design and pre-construction phases of PEP (refer Table 23.6).

Table 23.6 Key mitigation strategies and measures for application during the planning phase (including design and pre-construction)

Factor	Potential Impact	Key Strategies and Mitigation Measures
Marine ecology and nature conservation and water quality	Productivity and health of benthos	Collect 12 months of baseline water quality data at key receptor sites at Magnetic Island and nearshore (Strand and Cape Pallarenda) - on-going at the time of preparation of this EIS. Establish Dredging Advisory Panel and develop the Reactive Monitoring Program in accordance with the Dredge Management Plan, as described in Part C. Devise percentile based Total suspended sediment trigger values adopted for 'Intensity Level', 'Threshold Level' and 'Duration Level'. Requirements from EIS included in contractor documentation eg: • Schedule and contract dredger so that capital dredging of channels would not be carried out during late spring and summer. • Contracts specify dredge controls including an environmental valve ("green valve") used in overflow pipes of the trailer suction hopper dredger to reduce the volume and potential dispersion of sediments from dredging.
	Noise and vessel effects on marine vertebrate fauna	Contractor would develop procedures for managing in relation to marine megafauna (as outlined in the Dredge Management Plan in Part C) to be implemented during dredging and construction.
	Light spill on nesting and roosting vertebrates	Lighting will be designed (lux intensity and wavelengths; mountings and spread) to minimise emissions in relation to potential disruption of nesting and hatching of marine turtles on The Strand beach and birds on the Ross River southern bank.
	Introduced marine species	The existing marine pest management plan will be reviewed to identify any additional risks of marine pest introductions. The plan will be developed by DAFF in accordance with AQIS and other regulatory agency requirements.
Sediment Quality	Ensure contamination levels of all material to be disposed at sea is within NAGD	Conduct sampling and testing of sediments proposed to be placed at sea. This will be in accordance with the National Assessment Guidelines for Dredging (NAGD 2009) and form the basis for an application for a Sea Dumping Permit. Identified contamination to be managed in accordance with land based disposal procedure outlined in the Dredge Management Plan in Part C.
Climate Change	Risk of sea level rise and storm intensity on port infrastructure	Designing storm water infrastructure and drainage conduits and outlets for increased cyclone intensity and limiting overtopping design criteria for marine structures to the capacity of associated drainage infrastructure. Design marine structures (wharves, breakwaters and revetments) based on cyclone and sea level rise projections, including data from Severe Tropical Cyclone Yasi for wave climate analysis and a 0.5m increase in sea level by 2070 (covering the 50 year design life of the expansion).
	Vessel safety during weather events	Adapt the Port Contingency and Continuity Plan to include the PEP area and latest climate scenarios.
GHG	Load of GHG emissions	Develop targets and goals and a set of key performance indicators Develop a greenhouse gas inventory to effectively monitor, audit and report on the site's greenhouse gas emissions. Introduce actions for greenhouse gas reduction for the construction phase.
		Investigate renewable energy options for future PEP facilities and incorporate findings in design of energy supplies.
	Use of embodied energy	In design, consider the feasibility of use of sustainable (and/or recyclable) materials and materials sources prior to procurement for construction.
Waste	Waste generation	During design, consider whole of life environmental cost of products chosen for construction; ensure product durability.

Factor	Potential Impact	Key Strategies and Mitigation Measures
		Formulate contractual clauses for waste management practices.
Transport	Road network congestion	Specify appropriate improvement measures to reduce additional traffic from workers performing construction activities such as car pooling; times of shifts and offsite ‘Park and Ride’ facility. Determine appropriate transport routes (i.e. high order roads) for construction related activities to reduce impact on state and local road networks and incorporate into construction tenders. Investigate opportunities to improve intersections affected by the additional operational traffic by providing cost effective solutions that will alleviate additional traffic.
	Rail network	Work with government to further the implementation of the *Mount Isa Rail Infrastructure Master Plan* to address future rail capacity requirements.
Air	Particulates into the air during construction	Methods sought, at tender, which minimise dust generation during construction.
Acoustic environment	Noise emissions during piling and rockfill	Design consideration of control strategies and methods sought at tender that minimise noise during construction to include enclosures, silencers or the substitution of alternative construction processes especially in relation to piling.
Social values & amenity	Visual effects of PEP on foreshore amenity	During design, spatial layout to detail features of streetscape design, use of planting, car parking, built form (use of building materials, finishes and colours), placement of buildings and structures on site and light spill to integrate the project into the surrounding landscape. Design to minimise light spill from the site in so far as consistent with existing Operational Health and Safety and Land Use codes.
	Employment opportunities	Contractor to develop a Local Industry Participation Plan and Indigenous employment strategy in collaboration with Indigenous representative groups in Townsville.
	Increased vessel traffic and potential loss of fishing access Noise and dust during the construction and operation of the PEP	Identify permissible and restricted waterway activities that will apply to PEP construction and operation. Provide information and updates to the public and forecast any periods of intense activity and/or changes to access.
	Transport related noise and dust affecting amenity of residents	Plan PEP with the opening of the EAC Road through the Townsville State Development Area. Liaise with Department of Transport and Main Roads and Townsville City Council and residents regarding revised Local Road and Traffic Management Plan including heightened road safety campaign. Liaise with Townsville City Council to continue to advocate restrictions on any further incompatible residential land uses along Boundary Street or Benwell Road as part of Council’s preparation of its new planning scheme.

B.23.1.4.2 Environmental Management during Construction and Operation

The environmental management strategy is the delivery mechanism which synthesises the management and mitigation measures determined by this environmental impact and risk assessment process and translates them into a set of requirements for PEP implementation.

The management strategy for each value has been developed to enable the PEP to be delivered with no greater than the level of residual predicted effects and risk events set out in the EIS, and to enable the management and mitigation measures to be delivered in accordance with applicable legislation and policy. Each management strategy has stated performance objectives, management actions, performance criteria, as well as monitoring, reporting, and corrective actions. These management strategy components will play pivotal roles in governing the actual work method undertaken with respect to key PEP elements over both construction and operations being:

- Construction activity
- Dredging activity
- Vessel and maritime activity
- Port operational activity

POTL maintains its commitment to sustainable development and operation through its Environmental Management System (EMS). The EMS provides a framework for environmental management at the Port of Townsville, and reflects POTL's environmental policy and commitments to manage its activities with concern for people and the environment.

Throughout the EIS, recommended mitigation measures will be applied to the various construction and operational activities which may risk environmental impacts. Different mitigation measure apply to different phases and geographical (landside or portside) areas of implementation. To accommodate these variances a suite of Environmental Management Plans (EMPs) has been prepared which separates construction versus operational requirements, and landside versus portside requirements. This format will aid in the EMP implementation and therefore the effectiveness of the plan. The structural relationship of the EMPs is illustrated in Figure B.23.1.

The proposed environmental management system provides (Figure B.23.1) objectives and outcomes based on the results of the impact monitoring phases. The EMPs are designed to provide for continual feedback and reporting allowing POTL stakeholders to conduct audits or investigations as necessary in the event of an incident, or as a means of identifying areas of improved environmental management.

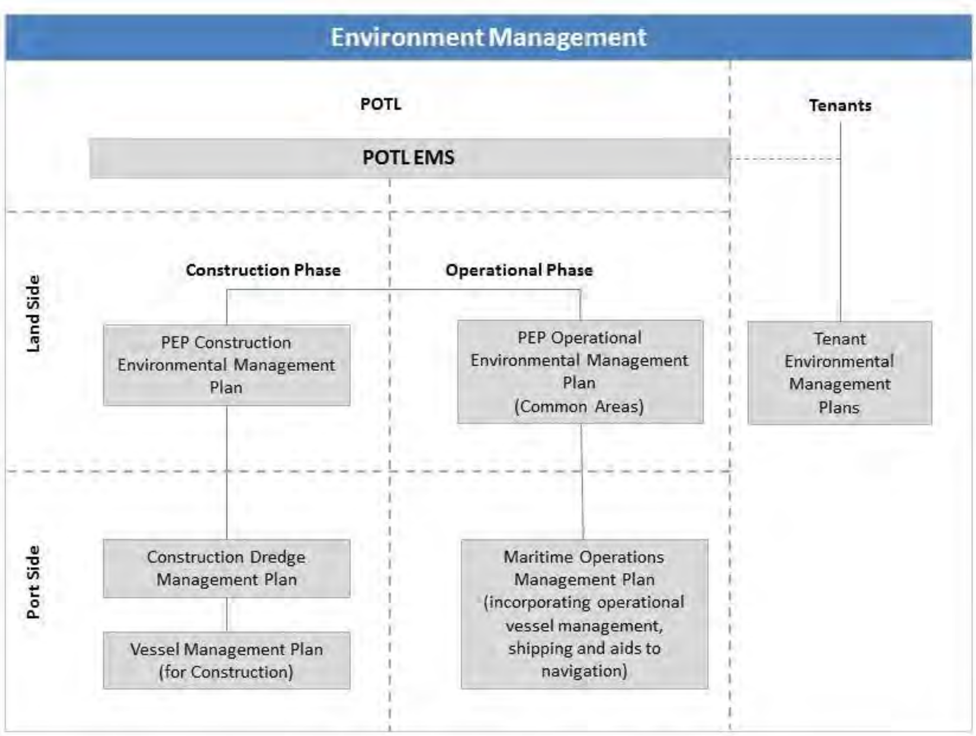


Figure B.23.1 Interaction of the set of POTL PEP environmental management plans

In order to apply appropriate mitigations to manage potential impacts, the set of management plans shown in **Figure B.23.1** has been prepared to include a range of specific management measures.

Those primary aspects where the PEP may potentially cause impacts are listed below along with a summary of mitigation measures is below.

B.23.1.4.3 Mitigation Measures and Monitoring during Construction and Operation

This EIS identified a number of strategies and measures to be adopted by POTL that require implementation, monitoring and review for the construction phases of the PEP are summarised in Table 23.7. Three plans address the mitigation and monitoring requirements for the construction phase being the:

- Dredge Management Plan - DMP (Chapter C2.1)
- Construction Environmental Management Plan - CEMP (Chapter C2.2)
- Vessel Traffic Management Plan (Construction) – VTMPC (Chapter C2.3)

Two other plans address the mitigation and monitoring requirements during operations:

- Operations Environmental Management Plan – OEMP (Chapter C2.4)
- Maritime Operations Management Plan – MOMP (Chapter C2.5)

These Plans should be sourced for the full and complete set of mitigation and monitoring actions.

Also identified in preceding Part B chapters and in the series of Plans in Part C are a number of specific monitoring and reporting requirements to be adopted by POTL throughout the construction phases of the PEP. Monitoring requirements identified for each environmental factor are aimed at enabling:

- Early detection of environmental management risks
- Development of baseline environmental information for the Port from which trends and changes in the environmental quality of the Port over the period of construction can be detected.

Records of the ongoing site monitoring shall be maintained to allow auditing and encourage the use of preventative action, as well as corrective action following non-compliance.

B.23.1.4.4 Residual Impacts

Environmental offsets only become applicable when the impacts from a development or action cannot be avoided or minimised and where all other Government standards are met. The environmental offsets package proposed in Section B23.2 relates to the following residual impacts on marine ecology values from the PEP development aspects shown below:

Affected Marine Habitat	Area
Permanent loss of soft benthic habitat beneath and within the perimeter of the rock walls	110 ha
Temporary loss of benthic habitat for capital dredging of outer harbour and deepening of navigation channels	220 ha

B.23.1.5 Stakeholder Engagement and Project Reporting

In support of both its planned port construction and operation, POTL already has a range in systems in place. It also has a strong record of cooperation with different levels of government, the community and other stakeholders through a range of policies, procedures and practices that are not specifically required under legislation. Currently POTL has policies that contribute towards the establishment of an environment of transparency and good governance practices.

Mitigation measures encourage a pro-active approach to risk management and performance outcomes given strong and ongoing community engagement. Such processes can be incorporated within POTL's overarching Stakeholder Engagement Management Plan. The Port's existing Port Community Partnerships Forum (PCPF) has proved to be an effective forum through which interested community-based groups can comment on Port related policies, development plans, management programs and ongoing operations.

The Forum also provides an opportunity for the Port to provide the community with information regarding its developments and operations and future development activities at the Port, which would include the PEP. Presently, the Forum meets at least quarterly, depending on the specific projects or issues that may require discussion. Use of this forum for the exchange of information relating to the PEP is expected to provide an effective means of ensuring that any changing social outcome requirements can be readily identified through interactive community engagement.

Specifically, during construction and operations, outcomes of comments, advice and complaints from the community shall be communicated to POTL for review of corrective actions and handled in the way described in the series of management plans in Part C of the EIS.

Table 23.7 Key mitigation strategies and measures for development phases (C = construction including dredging; O = Operations)

Key Factors	Potential Impact	Phase	Key Mitigation Strategies and Measures	Monitoring and Reporting
Marine ecology and conservation	Reduced productivity and health of benthos	C	Conduct dredge operations with actions outlined in Dredge Management Plan (DMP).	Chapter B6 Baseline and marine performance monitoring of relevant aquatic habitat indicators as set out in the Reactive Monitoring Programme in the DMP – seagrass and hard coral communities. Monitoring following major campaigns at the DMPA to assess duration of impacts and recovery on benthos and movement of sediment into adjacent areas. Regular site inspections carried out to monitor the construction area for compliance with light and waste management procedures, and hazardous material handling procedures. For construction refer DMP; CEMP; VTMPC For operations refer MOMP
		C,O	Implementation of appropriate stormwater and waste management measures. Any spills of dangerous goods shall be managed in accordance with POTL's authorised Emergency Spill Response Plan.	
	Noise and vessel effects on marine vertebrate fauna	C	Ensure vessel operations according to Dredge Management Plan and/or Vessel Traffic Management Plan (Construction) including requirements for: ▪ megafauna spotters and marine mammal observations and response procedures. ▪ marine turtle deflectors would be mounted on the draghead of the TSHD and action for the correct use of constructional plant such as water jets and pumps.	
	Light spill on nesting and roosting animals	C	Light levels from the dredging and land side construction works limited to lighting necessary for the safe vessel operation and the health and safety of those on board and ashore.	
	Introduced marine species	C	Apply Dredge Management Plan and/or Vessel Traffic Management Plan (Construction) including actions at 'Port of Origin', during transit between 'Port of Origin' and Port of Townsville and while in Port of Townsville.	
Water quality	Advection dispersion of suspended sediments	C	Refer above to "Productivity and health of benthos" Reactive monitoring programme implementation (including the review of trigger levels) overseen by an advisory panel of experts reporting to the Environmental Supervisor for the PEP.	Chapters B2, B5 Regular inspections and monitoring of tailwater and stormwater runoff to check for cleanliness and potential for contaminants to impact on water quality and to ensure compliance with regulated performance limits for key parameters such as turbidity and pH (see Part C2.2). Regular site inspections to check for leaks, spillage and damage to bunded storage areas. Immediately notify POTL in the event
	Tailwater and fill manage-ment	C	Apply Dredge Management Plan to settle and retain sediments within the onshore reclaim. The low risk of PASS to be managed by Construction Environmental Management Plan (CEMP).	
	Runoff into Cleveland Bay	C,O	Development and implementation of a site based response plans and stormwater management for POTL operations. Future operators to use source control measures including storage sheds. Erosion and sediment controls would be regularly inspected and maintained.	
	Unplanned	C,O	Manage vessel activity in relation to VTMPC and MOMP	

Key Factors	Potential Impact	Phase	Key Mitigation Strategies and Measures	Monitoring and Reporting
	emissions		Adopt procedures to manage risks of spills or discharges plant and contractors operators from vessels. Develop and implement spill response plans.	of an uncontained spill. Site specific management actions including erosion and sediment controls, would be developed and implemented by the contractor prior to construction. For construction refer DMP; CEMP, VTMPC For operations refer OEMP, MOMP
GHG	GHG load	C	Implement greenhouse gas reduction management plan and conduct awareness training as part of site inductions.	Refer CEMP; Chapter B11
Land	Acid sulfate soils	C	Refer to tailwater and fill management for 'Marine Water Quality'.	Chapter B1, B2, B5 Regular site inspections to check for leaks, spillage and damage to bunded/storage/refuelling areas and equipment. Monitor the pH of retained water in the dewatering ponds and soils of reclaimed areas. Monitor and report against the stated requirements of ASS Environmental Management Plan to be developed prior to construction and implemented during the construction phase. Monitor and record sources, condition and movement of fill. Immediate notification to POTL or DEHP in the event of uncontained spills. Refer CEMP; OEMP
	Risk of contamin-ation	C,O	Apply Construction Environmental Management Plan including storage and handling of chemicals, oils and fuels in clearly designated areas, as far as practicable from residences, watercourses and other sensitive receptors. Minimise risk of fuel/oil spills by regular inspections and maintenance of machinery. Development and implementation of a site based response plans and stormwater management for POTL operations. Future operators to use source control measures including storage sheds. Operation of berths and cargo handling facilities by port tenants in compliance with relevant management plans.	
Terrestrial ecology	Introduced flora and fauna	C, O	Minimise risk of introduction and spread of weeds by actions on constructional plant fleet and haulage vehicles and implement measures if required.	Refer CEMP; OEMP Chapter B7
	Indirect	C, O	Implement control measures to manage noise and light emissions (refer to Noise and Vibration).	

Key Factors	Potential Impact	Phase	Key Mitigation Strategies and Measures	Monitoring and Reporting
	effect on shorebirds			
Land transport	Road network uprate and loading	C,O	Pavement rehabilitation and maintenance to cater for the additional loadings from construction related heavy vehicles if required by pavement impact assessment. Construction heavy vehicles to use designated heavy vehicle routes. Tenants whose facilities may generate significant traffic to develop traffic management plans.	Chapter B14 All heavy vehicle movements to be recorded by contractor and reported to POTL. Refer CEMP; OEMP,
	Increased usage of existing rail	O	Continue negotiation and liaison with ail authorities and owners to develop rail access via the Eastern Access Corridor. Progressive rail infrastructure renewal programmes adopted by Queensland Rail.	Refer OEMP; Chapter B14
Air	Particulates emitted into air	C,O	Apply the measures of the Construction Environmental Management Plan (CEMP). During construction, adopt reactive monitoring program and apply reactive management procedure including adjust work practices (as required) based on wind observations (e.g. ceasing dust-generating works under extreme wind conditions or when dust is observed to leave the site in excess of quality thresholds). Development and implementation of a site based plans for Port tenants. Future operators to use source control measures including covered facilities.	Chapter B9 Visual monitoring and observation of weather conditions that result in dust liberation during construction. Continuous air quality monitoring campaigns. Record and respond to legitimate complaints. Implement Reactive Air Quality Monitoring Program during construction. Refer CEMP; OEMP
	Vehicular emissions	C	Actions in CEMP applied to limit emissions while on site.	
Noise	Noise emissions during piling and rockfill	C	Information and advice to community and stakeholders on nature and duration of piling and rockfill placement. Piling operations restricted to activities to prescribed daytime work hours, excluding Sundays and Public Holidays with strict adherence to noise requirements. Monitoring, and adjusting where necessary, elements or methods of piling, such as reducing the height and weight of the impact hammer.	Chapter B10 Noise and/or vibration monitoring would be carried out and recorded in the POTL database to identify areas and/or events where noise is creating complaints. For construction refer CEMP For operations, refer OEMP
	Daytime acoustic amenity	O	Transport movements via approved transport routes. Selection and management of equipment with consideration for low noise emissions. Operate a complaints management system.	
Social values &	Visual effects of	C,O	Implement Dredge management plan, Construction environmental management plan and Vessel Traffic Management (Construction) Plan.	Chapters B13, B14 Daily site inspections to monitor for

Key Factors	Potential Impact	Phase	Key Mitigation Strategies and Measures	Monitoring and Reporting
amenity	PEP on coastal amenity		Progressive stabilisation of reclaimed land. Engage via Port Community Partnerships Forum. Refer to Water Quality	water pollution, rubbish and dust associated with the construction. Engage with and report back findings to Port Community Partnerships Forum For construction phase refer CEMP; DMP, VTMPC For operations, refer OEMP, MOMP
	Increased vessel traffic and potential loss of waterway access	C	Information and advice to community and stakeholders on restrictions that may need to apply from time-to-time well in advance of requirement during construction stages. Use the Port Community Partnerships Forum, *Stakeholder Engagement Management Plan* or *Complaints Policy* as avenues to regularly convey information and receive feedback regarding POTL's practices.	
	Transport and port land noise and dust emissions	C,O	Refer to Transport, Air and Noise mitigations above	

B.23.2 Ecologically Sustainable Development

ESD is an overall objective of all levels of government within Australia. The core objectives and guiding principles of the National ESD Strategy provide a basis for the achievement of ESD (ESD Steering Committee, 1992). A comparative analysis of how the PEP conforms to the core objectives and guiding principles is provided in Table 23.8 below.

Table 23.8 - Comparative analysis of how the PEP conforms to the *National Strategy for Ecologically Sustainable Development* (ESD Steering Committee, 1992)

Core Objectives	
To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations	The PEP facilitates economic development that builds on the regions resources, existing supply chain and infrastructure. It safeguards the welfare of future generations by providing additional direct and indirect employment and investment into to the region through increased access to markets, particularly for bulky goods and general cargo. The PEP will build on an existing port infrastructure in a manner which minimises adverse environmental effect thereby also minimising costly remediation or mitigation strategies.
To provide for equity within and between generations	The PEP provides for inter-generational equity by: ▪ enhancing long-term access to port related direct and indirect employment. ▪ increasing regional employment potential through increased mining due to expanded access to markets. ▪ additional scope for improved services and infrastructure to the region due to a greater investment potential through expanded mining agriculture and related trade activity. ▪ ensuring sound environmental management practices are incorporated into the design and operation of the project through all of it stages which address the social environment and economic concerns presently and into the future
To protect biological diversity and maintain essential ecological processes and life-support systems	The PEP utilises and extends onto existing port facilities in a manner that avoids highly sensitive areas. The PEP EIS incorporates environmental design considerations, operational requirements in the form of Environmental Management Plans and a range of environmental mitigation measures that ensure biodiversity and essential ecological processes are maintained.
Guiding Principles	
Decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations	The EIS assesses the PEP in terms of project stages described in Section A.3.3 extending beyond 17 years. The detailed assessment of environmental, social and economic impacts is effectively provided well into the operational stages of the project. Additionally more detailed project

	approvals process will ensure that further effective decision making is undertaken in a manner than aligns with the findings of the EIS.
Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation	The EIS assesses the PEP in a manner that addresses key environmental issues that are reflected by legislation and government policies. The findings and recommendations of the EIS will form part of a statutory framework for further detailed assessments including where such detail has been unable or not warranted to be assessed in detail as part of the EIS. The EIS incorporates the most recent scientific publications, policy documents, field surveys and best-practice principles that have been available that relate to the PEP and its surrounding area.
The global dimension of environmental impacts of actions and policies should be recognised and considered	The PEP EIS has specific regard for World Heritage Area issues that reflected in the EPBC Act as a matter of National Environmental Significance. This notably applies to the World Heritage status of the GBRMP. The environmental impact assessed by the PEP EIS has a direct bearing on the values of the World Heritage Area. This is especially addresses in the assessment of overarching cumulative effects which are dealt with for some individual impact types and in the overall assessment in section B.24.
The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised	The PEP will facilitate economic development that builds on the regions mineral resources through expanded and more efficient and effective access to markets. The EIS has shown that this in turn is expected to lead to increased potential for other services throughout the region to support mining and mineral processing and trade as well as greater scope for social services and civic improvements and environmental management through increased GDP which may flow into the region.
The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised	The PEP EIS identifies the site for the PEP as the most environmentally effective option due to the present ports existence, its favourable location in terms of environmentally sensitive areas and the ports past record of effective environmental management. The PEP provides a key component of the ports overall plan to provide a world's best practice port facility that forms an integral and effective part of the regions supply chain infrastructure and which will effectively contribute to the competitiveness off the regions products.
Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms	The EIS considers a range of valuation and pricing indicators and estimates associated with the PEP. Incentive mechanisms have been addressed in terms of positive employment strategies, particularly for indigenous people.
Decisions and actions should provide for broad community involvement on issues which affect	The EIS process incorporates extensive preliminary consultation (referred to in section A.2.5) with a

them	range of government, private sector and community stakeholders which has contributed to the identification of key environmental, social and economic issues and potential impacts. The EIS is also subject to a formal public consultation and review by the Coordinator General which is needed to ensure a comprehensive level of community involvement and accounting of relevant issues.

B.23.3 Offsets for Residual Impacts

Environmental offsets are used to replace the value of environmental features irreversibly lost in development that supports a growing economy and population. They are only considered once environmental impacts have first been avoided, then minimised. Measures to avoid mitigate and manage risks and effects are summarised in the preceding section and in fuller details in Part C of this EIS.

Certain unmitigable residual impacts occur on marine environmental values and these matters and a means of offsetting are considered in this section.

B.23.3.1 Introduction

The Queensland Government defines an environmental offset as 'an action taken to counterbalance unavoidable, negative environmental impacts that result from an activity or development' [Queensland Environmental Offsets Policy (2009)].

In the Australian Government EPBC Act Environmental Offsets Policy (October 2012), offsets are defined as 'measures that compensate for the residual adverse impacts of an action on the environment'. The new policy was released as this EIS was being finalised for submission to Government. Efforts have been made to incorporate the eight offset principles/requirements identified in the policy into the assessment of offsets that may be required for the PEP project. However, because of the newness of the EPBC Act Policy, the extensive negotiation and planning that had previously been undertaken for the old draft version of the Policy and the concurrent timing of the release of the Policy with finalisation of the EIS, there may be a need for slight modification of the final offset package. This can easily be undertaken during the assessment phase for the EIS.

The EIS Guideline for the project (April 2012) provides a specific section (5.12) on offsets. The Guidelines states that:

> "*The Section of the EIS must outline plans to offset the remaining residual impacts of the proposal. Environmental offsets may be appropriate when they:*
>
> *a) Are necessary to protect or repair impacts to a protected matter – i.e. a matter of national environmental significance or the environment more broadly;*
>
> *b) Relate specifically to the matter (for example, species) being impacted; and*
>
> c) *Seek to ensure that the health, diversity and productivity of the environment are maintained or enhanced.*"

In accordance with the above, environmental offsets have been investigated as part of the PEP EIS in relation to the three principal Acts under which approval is being sought:

- *State Development and Public Works Organisation Act 1971* – Queensland State Government (as part of the Coordinator General's Report and Conditions).
- *Environment Protection and Biodiversity Conservation Act 1999* – Australian Government (Controlled Actions).
- *Great Barrier Reef Marine Park Act 1975* – Australian Government – Great Barrier Reef Marine Park Authority (Marine park permit – dredging works in the marine park).

The legislative and policy framework for offsets is outlined below. In general, all policies recognise the need for, and promote the coordination of Australian Government and Queensland Government offset requirements. A proposed offset package for the PEP has been developed in accordance with this strategic intent.

B.23.3.2 Queensland Government Offset Policies

Offsets in Queensland are assessed in accordance with the Queensland Environmental Offsets Policy (2009). The Policy sets out the framework for environmental offsets in Queensland which includes consideration of specific-issue offset policies.

In the case of the PEP where the majority of development activities are below high water mark, offset policies and guidance published by Fisheries Queensland (formerly DEEDI now part of the DAFF) will apply. This will guide application of the broader Queensland Government Offset policy in relation to the loss of fish habitat associated with the PEP dredging and reclamation activities. On 25 May 2012 responsibility for managing Fish Habitat Areas (FHAs) moved from DAFF to the Department of National Parks, Recreation, Sport and Racing (NPRSR). The Machinery of Government arrangements for management of FHAs and assessment of applications for works in a FHA had not been finalised at the time of writing the EIS.

Under normal circumstances involving a project application under the Sustainable Planning Act 2009, for assessment via the Integrated Development Assessment Scheme (IDAS), a referral to DAFF pursuant to the Fisheries Act 1994 would only be triggered if a development was likely to involve loss of marine plants or works in a declared Fish Habitat Area. Once triggered, the marine Fish Habitat Offset Policy would then apply more broadly to the development, requiring consideration of loss of fish habitat in addition to marine plants.

In the case of the PEP, the Terms of Reference for an environmental impact statement published by the Queensland Government assume that a development permit for operational work that is the removal, destruction or damage of a marine plant, is required. However, the investigations for the EIS have concluded that no marine plants are present in the development footprint and therefore a development permit for removal, destruction or damage of marine plants is unlikely to be required. Further, the Terms of Reference (p.35) indicate that, ‘where relevant’, environmental offsets should be discussed in accordance with applicable specific-issue offset policies, one of which is the Fish habitat Management Operational Policy FHMOP005 (now replaced by the Fish Habitat Offset Policy FHMOP005.2).

POTL could argue that the Fish Habitat Offset Policy is not relevant since there are no marine plants in the development footprint to trigger referral to DAFF. However, in an effort to be fully inclusive in its assessment, the loss of fish habitat has been retained in POTL’s offset considerations.

The following FHMOP005.2 principles incorporate the Queensland Government Environmental Offset Policy (QGEOP) principles that direct the way offsets must be used to contribute to Ecologically Sustainable Development:

1. Offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy;
2. Environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact;
3. Offsets must achieve an equivalent or better environmental outcome;
4. Offsets must provide environmental values as similar as possible to those being lost;
5. Offset provision should minimise the time-lag between the impact and delivery of the offset;
6. Offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values; and
7. Offsets must be legally secured for the duration of the offset requirement.

Section 2.1 of FHMOP005.2 states that offsets may be direct offsets or indirect offsets. For direct offsets, spatial areas of fish habitat are used as a surrogate for loss or gain of fisheries productivity. Principles for selection of direct fish habitats offsets are:

- equivalent or better environmental outcomes (QGEOP Principle 3);
- similar environmental values (QGEOP Principle 4); and
- additional protection and management (QGEOP Principle 6).

Where the principles cannot be achieved using direct offsets, indirect offsets are considered as financial reparation based on loss of values of function and services of fish habitats (a surrogate for loss based on habitat/ fisheries specific component adjustment of ‘total ecosystem services’ for estuaries). Offsets such as those below may be considered:

(a) Fish habitat enhancement;

(b) Restoration and rehabilitation or creation of fish habitat;

(c) Fish habitat exchange with increased security (additional or new protection for an area e.g. Fish Habitat Area; minimum of five times the impact area);

(d) Contributions in-kind or as a monetary payment for:

i. Applied research, investigative resource inventories, fish habitat mapping projects;

ii. Education, training or extension;

iii. Enhancement, restoration, rehabilitation or creation;

iv. Fish habitat exchange or increased security.

In calculating the value of a fish habitat offset package, the calculator provided in Attachment 4 of FHMOP005.2 should be used. Key principles used to calculate these values include the following:

- Use of an annual discount rate of 0% to determine the present value of marine fish habitat mosaic value lost or gained using a timeframe of fifty (50) years for calculating the permanent loss/gain of fish habitat and two (2) to twenty (20) years for temporary losses/gains of fish habitat;
- Requiring an impact area ratio of 1:1 for direct offsets involving enhancement, restoration, rehabilitation, connectivity or creation and a ratio of 5:1 for direct offsets involving fish habitat exchange or increased security;
- Establishing a metric for fisheries specific ecosystem services value set at 11% of Total Ecosystem Services (TES) for estuaries that is applied across all marine fish habitat types (bare, seagrass, mangrove or saltmarsh area). This equates to a 2012 value of $6,800 per hectare per year; and
- Differential application of the TES valuation metric between areas below HAT (Zone A) and above HAT + 20 metre separation distance (Zone B).

Offsets under FHMOP005.2 are negotiated on a case by case basis between the proponent and Fisheries Queensland and are generally confirmed by a condition of approval, a letter of agreement or deed of agreement between the proponent and the Government (example deed provided in Attachment 5 of FHMOP005.2).

B.23.3.3 Australian Government Offset Policies

B.23.3.3.1 EPBC Act

A new Australian Government policy for offsets under the EPBC Act was released at the time of preparation of this EIS. This new policy is the relevant document to consider with respect to the EPBC controlled action approval. The new policy was finalised on 20 September 2012 and applies from 2 October 2012 for any projects currently under assessment for which a proposed decision has not yet been made (EPBC Act Environmental Offsets Policy, 2012).

Under the new policy (2012), the Australian Government states that the Offsets Policy provides transparency around how the suitability of offsets is determined and that the suitability of proposed offsets is considered as part of the decision as to whether or not to approve a proposed action under the EPBC Act.

The EPBC Act environmental offsets policy (2012) has five key aims:

1. Ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
2. Provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
3. Deliver improved environmental outcomes by consistently applying the policy;
4. Outline the appropriate nature and scale of offsets and how they are determined; and
5. Provide guidance on acceptable delivery mechanisms for offsets.

There are eight overarching principles that are applied in determining the suitability of offsets. These overarching principles are given effect as offset requirements 7.1 to 7.8 in the EPBC Act Offset Policy (pages 18 to 24). Suitable offsets must:

1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action;
2. Be built around direct offsets but may include other compensatory measures;

3. Be in proportion to the level of statutory protection that applies to the protected matter;
4. Be of a size and scale proportionate to the residual impacts on the protected matter;
5. Effectively account for and manage the risks of the offset not succeeding;
6. Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs;
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable; and
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

B.23.3.3.2 Great Barrier Reef Marine Park

In general, as the GBRMP is a matter of NES under the EPBC Act, it is likely that any offsets will be determined under the policy context of the EPBC Act (as outlined above).

The Great Barrier Reef Marine Park Authority does not currently have a published policy on offsets, although a draft policy statement was provided to POTL in good faith as part of pre-EIS consultation.

In a recent Ports Australia meeting with the Great Barrier Reef Marine Park Authority and the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) advice was provided that the integrity and resilience of Great Barrier Reef communities needed to be explicitly considered when planning offsets and that a net benefit to the Great Barrier Reef as a whole was an objective likely to be pursued in forthcoming policy development.

B.23.3.4 Residual Impacts

Environmental offsets are only applicable when the impacts from a development or action cannot be avoided or minimised and if all other Government standards are met.

Thus, offsets should only be considered once options and alternatives have been examined and it is not feasible or practicable to design out the impacts, and once best practice mitigation measures have been applied.

Based on the findings of the PEP EIS investigations, the key aspects of the project that require consideration of environmental offsets relate to the following residual impacts from the development in the marine environment.

B.23.3.4.1 Adverse Residual Impacts – Permanent

A permanent, irreversible impact would occur as a result of the PEP reclamation and breakwater construction. While there are no seagrass communities (observed as part of current sampling or historically) or rocky reefs present in the footprint of the works, the reclamation and associated breakwater construction would result in the loss of approximately 110 ha of unvegetated soft benthic substrate. The soft sediment habitats and communities within the proposed reclamation area have been mapped and are described in Chapter B6 Marine Ecology. These habitats are characterised as having low to moderate biodiversity values but are contained within the core habitat area of the Australian snubfin and other coastal dolphin species. They also represent loss of marine fish habitat in the Great Barrier Reef World Heritage Area and therefore become a matter of interest to the Australian Government in relation to matters of NES.

B.23.3.4.2 Adverse Residual Impacts – Temporary

Capital dredging proposed in the Outer Harbour and the deepening (and minor widening) of the Platypus Channel and deepening of the Sea Channel would alter the seabed from its current bathymetry. The total area of capital dredging in the Outer Harbour and Channels is estimated to be approximately 220 ha. The soft sediment habitats within the proposed dredging areas have been mapped and are described in Chapter B6 Marine Ecology. The areas subject to capital dredging in the nearshore are characterised as having low to moderate biodiversity values; with low biodiversity values present in the offshore channels. The proposed footprint of capital dredging has no seagrass communities (observed as part of current sampling or historically) or rocky reefs present.

The capital dredging associated with the PEP is predicted to be a temporary impact noting that the deeper areas would re-colonise with benthic organisms rapidly following disturbance (within months).

The benthic assemblages that recolonise these areas would be similar in character to other areas of the Port where dredging has previously occurred.

B.23.3.4.3 Beneficial Residual Impacts – Permanent

There would be a permanent beneficial impact from the creation of rock wall habitat around the perimeter of the reclamation along the major breakwaters. This has been estimated in the design as creating 10.55 ha of subtidal rock wall habitat and an additional 1.45 ha of intertidal rock wall habitat. As outlined in Chapter B6 Marine Ecology, the ecosystem services provided by the created rock wall are greater than the current unvegetated soft benthic sediments they are replacing for reef associated species. Key values include habitat for fisheries of commercial and recreational significance, supplemental feeding habitat for foraging green turtles and opportunistic high tide roosting habitat for migratory and resident waterbirds.

B.23.3.4.4 Dredge Material Placement

The approved Dredge Material Placement Area (DMPA) in Cleveland Bay has a long history of use (both in terms of one-off capital and annual maintenance dredge material placement). It has been demonstrated as part of the current and previous studies to be a highly dispersive site that is not accumulating dredge material in the long term.

Ecological surveys as part of the current study have demonstrated that the DMPA does not contain sensitive habitats such as corals and rocky reefs, although small patches of rock have been observed interspersed throughout the DMPA. Seagrass assemblages that have been observed historically in the DMPA are patchy and ephemeral. POTL currently holds permits under Commonwealth and State legislation to disturb these benthic communities in the DMPA in the context of both capital and maintenance material placement.

In terms of long term changes to ecological values, as outlined in Chapter B6 Marine Ecology, soft sediment benthic assemblages within the DMPA have been found to have equivalent to or of marginally greater biodiversity value compared to surrounding ‘undisturbed’ Cleveland Bay areas.

Based on these findings, dredge material placement activities associated with the PEP are not viewed as a direct residual impact requiring offset.

B.23.3.4.5 Adverse Residual Impacts from Dredging – Temporary

Based on the findings of the assessments, potential indirect impacts from dredging include:

- Temporary and intermittent light extinguishment from turbidity (dependent on wind, currents and other metocean conditions) and sedimentation on benthic primary producers including hard coral reefs and seagrass;
- Temporary impacts on ambient water quality; and
- Impacts on hydrodynamics and seabed morphology.

As outlined in Chapter B6 - Marine Ecology, these impacts have not been assessed as having irreversible or long term residual impacts on surrounding values on the basis they are managed appropriately. It is therefore essential that management and reactive monitoring commitments as outlined in the Dredge Management Plan (Chapter C2.1) are implemented so that potential impacts are avoided and minimised to the greatest practical extent.

Given the implementation of these monitoring and management commitments, the residual impacts on sensitive receptors from the indirect impacts of dredging (e.g. water quality) should not require consideration of an offset. That is, they are unlikely to have a significant impact on matters of National Environmental Significance. However, the additional impacts on resilience from Cyclone Yasi and floods and resultant poor water quality have heightened sensitivity about potential impacts on the Great Barrier Reef World Heritage Area and so these temporary impacts have been taken into consideration in the development of an offset package.

B.23.3.5 Offset Proposal

Based on the findings of the PEP EIS investigations as identified in the sections above, there are some aspects of the project that require consideration of environmental offsets. Those investigations have included engagement with the relevant State and Australian Government agencies to inform the formulation of an offsets package. The agencies have provided insight into their expectations with respect to the nature of offset proposals, however, they had not seen the full EIS at that stage. It is noted that even as this EIS is being prepared, emphases and expectations from government are changing.

Acknowledging this context, the formulation of the proposed offsets proposal for the PEP has been informed by:

- Investigation and assessment of potential project impacts and likely direct and indirect residual environmental impacts;
- Community and regulator sensitivities to those impacts;
- The relevant State and Commonwealth legislation and policies and recent discussions indicating a move towards a broader 'net benefit' policy position;
- The offsets requirements stipulated in the Australian Government EIS Guideline;
- The regulatory context in which the approval is taking place including the concurrent processes involving the Great Barrier Reef World Heritage Area and UNESCO;
- The potential of offsets proposals to enhance the future environmentally responsive and responsible operation and development of the Port; and
- The total value of the Port Expansion, its commercial nature and its importance to the future of Port of Townsville and the region.

The key elements of this offsets proposal are described in Sections 6 (direct offsets) and Section 7 (indirect offsets) of this chapter.

Table 23.8 contains a summary of the tidal habitats affected by the PEP and the calculated value lost and gained as a result of proposed offsets, as described in sections 6.1 and 6.2 using the Total Ecosystem Services (TES) approach set out in FHMOP005.2.

Table 23.8 Estimated residual direct and indirect impacts and proposed marine habitat creation or protection offsets

Affected Habitat	Area	Calculated value lost as per FHMOP005.2	Calculated value gained as per FHMOP005.2
Permanent loss of soft benthic habitat beneath and within the perimeter of the rock walls	110 ha	$37 million	
Temporary loss of benthic habitat for capital dredging of outer harbour and deepening of navigation channels.	220 ha	$30 million	
Creation of rock wall habitat around the perimeter of the project.	10.55 ha		$3.58 million
Creation of sub-tidal rock wall habitat.	1.45 ha		$246,000
Protection of an additional area of intertidal benthic habitat as Fish Habitat Area	1,240 ha		$142 million ^
Once-off contribution to administrative cost of establishing expanded FHA			$50,000
Contribution to management and enforcement of expanded FHA	$10,000 p.a. for 10 years		$100,000
Totals		**- $67 million**	**+ $146 million**

^ Calculated value based on *disturbance regulation* component only of TES (i.e. 33.8% as per Figure 3-1 in Attachment 3 of FHMOP005.2 *Marine Fish Habitat Offset Policy*) resulting in a TES value of $2,298 instead of $6,800 per hectare per year.

B.23.3.6 Direct Offsets

B.23.3.6.1 Direct Offsets - Fish Habitat Area Extension

As POTL is unlikely to be unable to create or restore similar sub-tidal benthic habitat elsewhere, equivalent to that which is to be removed by the PEP, the approach has been to investigate an offset involving fish habitat increased security (refer DAFF 2012, Table 3,the Queensland Government

Environmental Offsets Policy and EPBC Act offset requirement 7.1). An extension of the Cleveland Bay Fish Habitat Area (FHA) under the Queensland *Fisheries Act 1994* is proposed. The benefits of the extension of the FHA are as follows:

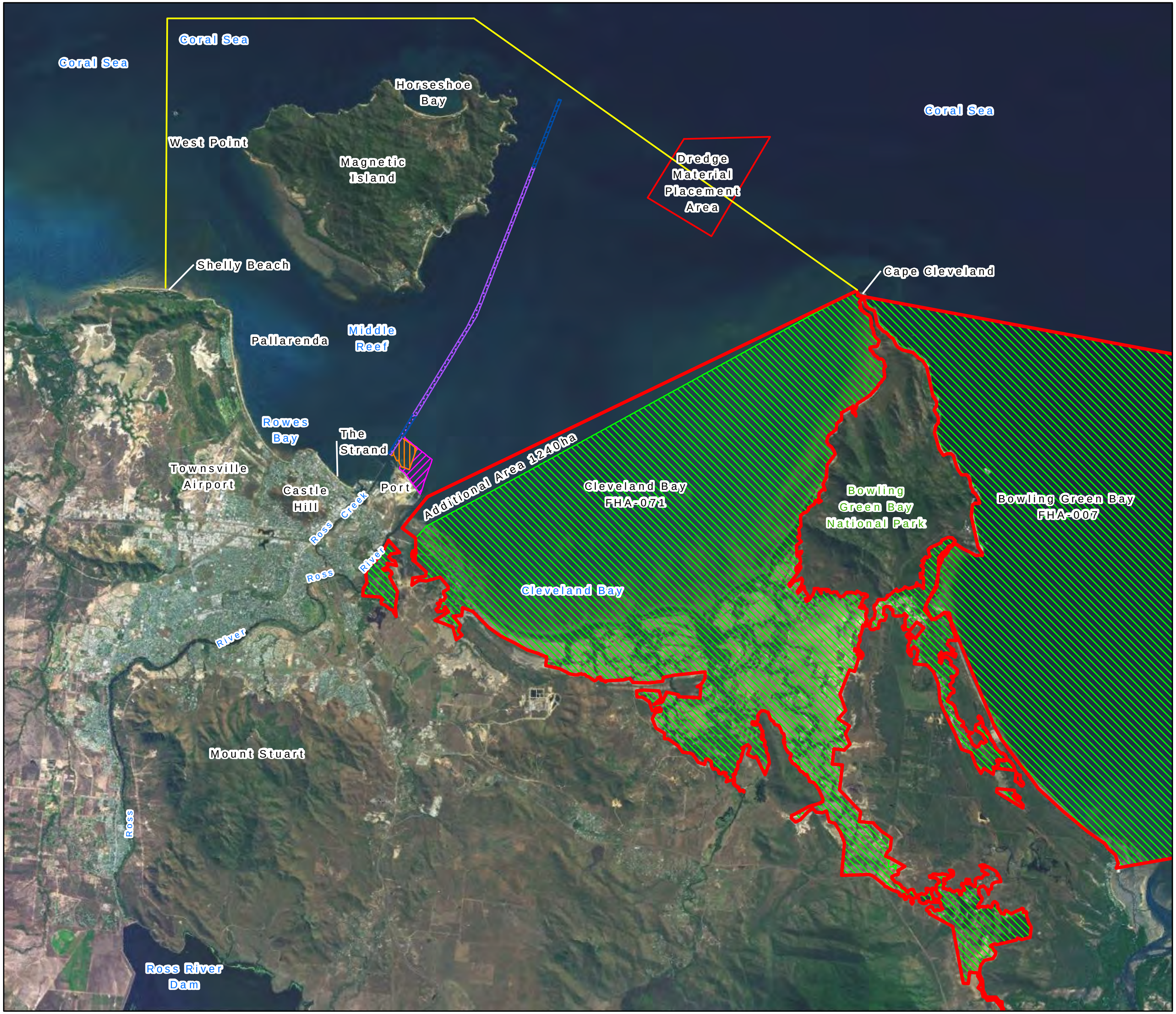
- It protects benthic habitat of approximately 1,240 hectares, similar to that which is being lost/modified (110 ha) (similar environmental values - QGEOP Principle 4; EPBC Act requirements 7.1, 7.4);
- It provides for legislated protection of the habitat and strict regulation of future development in terms of maritime works and structures (additional protection and management – QGEOP Principle 6; EPBC Act requirement 7.2);
- With a connection to Unallocated State land (USL) and the Biodiversity Reserve established as an offset for the Townsville Port Acess Road, it provides protection for a mosaic of fish habitat values from intertidal to subtidal areas (equivalent or better environmental outcomes QGEOP Principle 3) (EPBC Act requirement 7.1);
- The proposal is consistent with Table 2 (offsets considered acceptable) in FHMOP005.2, noting that the area identified for expansion was previously sought by the then QDPI for inclusion in the existing Cleveland Bay FHA. At that time, the area was rejected on the basis that part of it was identified for development by POTL;
- The proposal extends a current fish habitat area that is already governed and patrolled by the Queensland Government (EPBC Act requirement 7.8); and
- In addition to fisheries values, the extension area is likely to include marine areas that are used as habitat by threatened inshore dolphin species as well as areas traversed by dugong and turtles to nearby permanent seagrass meadows in southeastern Cleveland Bay. It is also likely to include intertidal marine areas used for foraging by listed migratory bird species (a matter of NES) (EPBC Act requirement 7.1).

While POTL does not own or lease the seabed proposed for the FHA extension, POTL has previously objected to the inclusion of the seabed immediately adjacent to and east of the Ross Rover channel mouth in the FHA. At that time it was thought that the area might be required for a large rock wall and expanded mooring area for the Marine Precinct Project. What POTL would do in this case is rescind the previous objection for inclusion of the area in the FHA, allowing for greater legislative protection of the benthic habitat.

Figure B.23.2 shows the current extent and proposed extension of the Cleveland Bay Fish Habitat Area. As shown in Figure B.23.2, the additional area of approximately 1,240 ha to be extended, compared to the 110 ha lost to reclamation, exceeds the 5:1 ratio sought by the new Fisheries Queensland Offset Policy FHMOP005.2.

As shown in Table 23.8, using the calculator in FHMOP005.2, the estimated ecosystem services value for protection of this habitat is calculated as approximately $142 million. This is considered to be a conservative estimate, using only the ‘disturbance regulation’ component of the Total Ecosystem Services (TES) coefficient discussed in FHMOP005.2 (i.e. 33.8% as per Figure 3-1 in Attachment 3 of FHMOP005.2 (*Maine Fish Habitat Offset Policy*) which results in adopting a lesser TES value of $2,298 instead of the full $6,800 per hectare per year).

In accordance with the new policy, funding of $50,000 is also proposed to support the costs of declaration (surveys, administration, consultation, public notification), and ongoing management and enforcement (funding of $10,000 per annum for 10 years).



PORT EXPANSION PROJECT EIS

Proposed Extension to the Cleveland Bay FHA

Figure B.23.2

Legend

- Port Limits
- Dredge Material Placement Area
- Channel to be Dredged
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- Existing Fish Habitat Area
- Proposed Fish Habitat Area

N

Scale: 1:200,000 approx. (when printed at A4)

0 1 2 4 6 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 16-Oct-2012

FILE NAME 60161996_PLN_139

Data Source:
Cleveland Bay Fish Habitat Area, Figure 6.1 - BMT WBM 2012.
Imagery - ESRI 2012

B.23.3.6.2 Indirect Offset – Creation of Additional Rock Wall Habitat

There would be a permanent beneficial impact from the creation of rock wall habitat around the perimeter of the reclamation along the major breakwaters. This has been estimated in the design as creating 10.55 ha of subtidal rock wall habitat and an additional 1.45 ha of intertidal rock wall habitat.

Using the calculator in FHMOP005.2, the value of this additional habitat is calculated as $3.58 million for the rock wall habitat and $246,000 for the intertidal habitat.

B.23.3.7 Indirect Offsets

The sections below outline proposed funding commitments representing offsets to the temporary loss of marine habitat from the project and temporary water quality impacts on marine communities from dredging. It should be noted that the commitments as outlined below would be in addition to expected best practice reactive impact monitoring that is proposed prior to, during and following construction activities as outlined in the Dredge Management Plan (Chapter C2.1). Note also that the temporary water quality impacts from dredging and reclamation construction would be intermittent and short term. The proposed offsets would deliver water quality and environmental health benefits to Cleveland Bay for a much longer term than the predicted project impacts.

B.23.3.7.1 Indirect Offset – Improving Water Quality Entering the GBRWHA

Part A

Key management challenges for the Great Barrier Reef World Heritage Area are to build the resilience of the GBR and its core habitats to impacts from future climate change and to halt and reverse the decline in the health of inshore reefs and seagrass beds. For this reason, PEP will take all reasonable and practical measures to avoid or minimise impacts on water quality from development and operation. However, it is also widely recognised that water quality is greatly affected by runoff within the catchment areas of the Reef.

The Burdekin River is the largest single exporter of suspended sediment (~4M tonnes pa on average) into the GBR lagoon, representing ca. 25% of the total average annual load exported from the GBR catchment area. Agricultural development in the Burdekin catchment over the past ~160 years is believed to have increased sediment loads exported by the Burdekin up to eight times. Recent research papers (Brodie *et al*. 2012) have demonstrated that fine sediments (particularly in rafts of congealed marine snow) from the Burdekin can extend into Cleveland Bay and even further northwards into Halifax Bay.

During flood plume conditions, the GBR Water Quality Guidelines for suspended sediment, chlorophyll and nutrient parameters are exceeded on almost all occasions in lagoonal waters. River runoff also transports agricultural pollutants such as pesticides (predominantly herbicides) into the GBR lagoon. A general decline in the overall ecosystem health of the GBR has partially been linked to an increase in suspended sediment, nitrogen and phosphorus terrestrial loads exported to the lagoon. While POTL does not directly contribute sediment into Cleveland Bay, dredging activities are aimed at removing the sediment that has entered the navigation channels from external sources. In doing so, water quality is temporarily adversely affected.

Water quality improvement in the GBR Region is occurring through a range of programs. One such program - relevant to the location of the Port - is the North Queensland Dry Tropics Sustainable Agriculture Program.

One of the core goals of the NQ Dry Tropics sustainable Agriculture Program is to improve the quality of agricultural runoff into the GBR Lagoon. Efforts to reduce sediment load to the GBR Lagoon are delivered through on-ground works in grazing lands. The framework for the program includes measures that would:

- Remediate areas with chronic low ground cover to reduce erosion from gullies and hillslope;
- Manage areas of mixed land types to reduce preferential grazing which leads to patches of chronic low ground cover;
- Manage stock access in riparian areas to reduce erosion from stream banks and to increase filtering capacity of riparian zone; and
- Protect floodplains and other sensitive areas from impact of grazing stock to reduce erosion.

As an indirect offset, POTL will offer the following funding to support the NQ Dry Tropics Sustainable Agriculture Program:

- *Funding commitment: $400,000 per year for a period of five years toward on-ground actions to improve water quality (total commitment of $2 million).*

The aim of this investment in the improvement of water quality in the long term would be to increase the resilience of the reefs and seagrass areas in the Cleveland Bay component of the World Heritage Area (a matter of NES) through the reduction of nutrients and sediments that cause smothering and stress. This would confer a long term benefit to the World Heritage Area that should improve the viability of the protected matter. A reduction in total sediment load from the Burdekin catchment may also benefit the Port in the context of reducing the volume of annual maintenance dredging of fine sediments that accumulate in the shipping channel and berths and thus reduce the water quality impact from dredging over the full term of the asset.

Part B

Research organisations affiliated with NQ Dry Tropics, such as the Australian Centre for Tropical Freshwater Research, undertake research programs in the catchment of Cleveland Bay/Bowling Green Bay in an effort to identify areas where on-ground actions would have the greatest effect in reducing sediment inputs to these Bays.

As an indirect offset, POTL is proposing to fund research that seeks to identify the source of sediments within grazed properties and within Cleveland Bay and use geochemical tracing signals to understand the soil types most susceptible to erosion.

- *Funding commitment:* Project 1: Identify the source of sediment within grazed properties. $40,000 per year for 3 years;
- *Funding commitment:* Project 2: Determine the geological provenance and dominant particle size of eroded sediments. $30,000 per year for 3 years; and
- *Funding commitment:* Project 3: Use existing geochemical tracing signals to type fine sediments in Cleveland Bay. $30,000 per year for 3 years.

B.23.3.7.2 Indirect Offset – Commitment to Research and Long Term Ecosystem Health Assessment in Cleveland Bay

Ecosystem Health Monitoring Program

Similar to past experiences in Moreton Bay and more recently in Port Curtis, the extent of population growth and development occurring or proposed in and around Cleveland Bay are key drivers for consideration of broader, formal marine ecosystem health monitoring program (EHMP).

Funding commitments are outlined in Table 23.9 that relate to establishing such a program noting the benefits of coupling this commitment with a broader partnership arrangement with local universities and research institutions, other industries, Townsville City Council, GRBMPA and the State Government.

The Port's proposed contribution to an EHMP would be focussed on initial establishment and then a financial contribution to annual water quality monitoring and public reporting. Ecosystem health monitoring and research is also proposed for biotic components of the system – namely seagrass, corals, fish and megafauna.

It must be stressed that this proposed EHMP is over and above a reactive monitoring program that would be undertaken during the construction phases of the PEP i.e. additional to what would likely be required in monitoring conditions for any dredging approval granted - described in the Dredge Monitoring Plan (Chapter C2.1).

- *Funding commitment:* $1 million in the first year for establishment of the EHMP, then $100,000 per year for 10 years towards water quality health assessment and public reporting;
- *Funding commitment:* Biennial seagrass health assessment: $75,000 every second year for10 years;
- *Funding commitment:* Seagrass research project (to be identified): $40,000 per year for 5 years;
- *Funding commitment:* Biennial coral health assessment: $40,000 every second year for 10 years; and

- *Funding commitment*: Biennial fish health assessment: $50,000 every second year for 10 years.

A conceptual diagram for the structure of the EHMP is presented in Figure B.23.3 below.

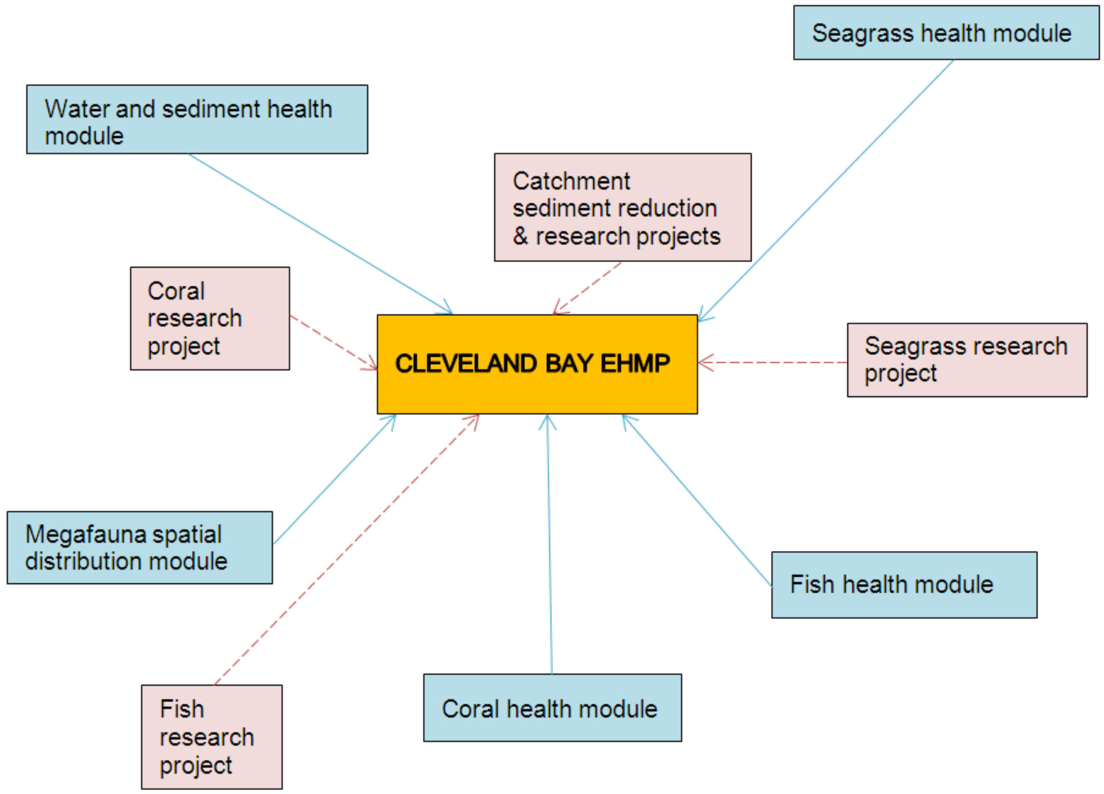


Figure B.23.3 Conceptual diagram for Cleveland Bay EHMP

It is anticipated that the EHMP would be overseen by an Independent Scientific Panel and that POTL would provide secretariat support. The Independent Scientific Panel would provide guidance on what parameters would be measured and the methodology to be used and would produce (or oversee production of) an annual report card for Cleveland Bay. The findings from the physical and biotic health modules and research programs would constitute the data from which the report card would be prepared. This governance arrangement should satisfactorily address the governance, auditing and reporting requirements of EPBC Act offset policy. Figure B.23.4 below is a conceptual overview of how the Independent Scientific Panel could function.

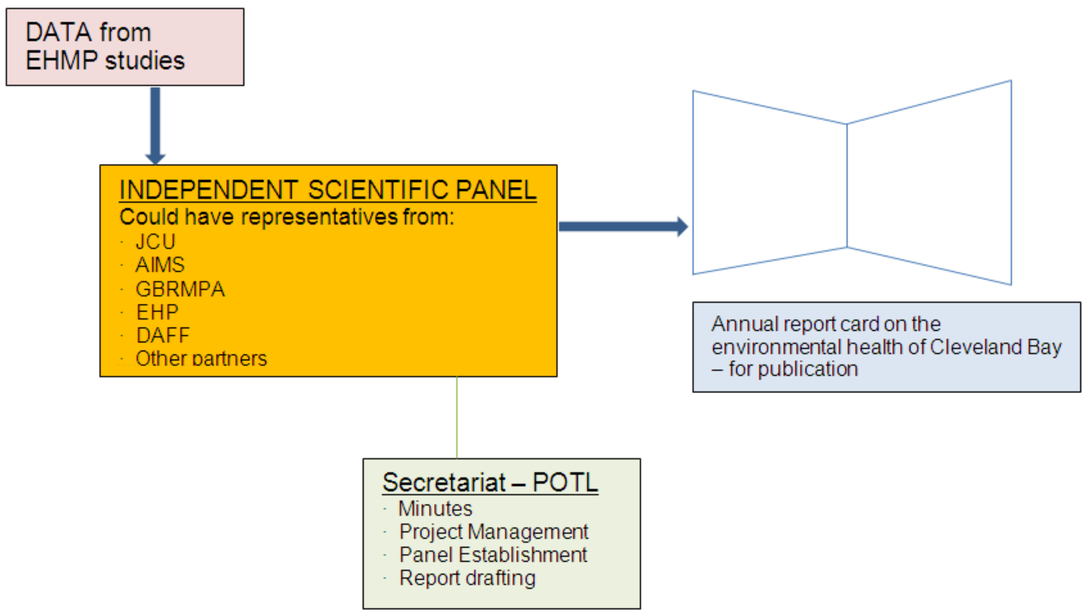


Figure B.23.4 Conceptual overview of how Independent Scientific Panel could function

Marine Megafauna

It is difficult to identity a specific direct or indirect impact on megafauna that technically would require an offset. No seagrass beds (feeding areas for dugong and turtles) would be directly impacted. No other identified food sources for cetaceans would be directly impacted. The strandings data have not indicated that ship impact is a threatening process in Cleveland Bay. Loss of benthic habitat for the reclamation has already been accounted for in the provision of legislative protection for higher quality benthic habitat nearby. It is also difficult to identify indirect impacts other than a potential temporary deterioration in water quality over some seagrass beds during the dredge campaign/s. Specific mitigation measures would be undertaken during dredging to keep any sediment impacts below levels that cause seagrass death or decline. Nonetheless, the potential for impacts to marine megafauna in Cleveland Bay from this project remain an issue of public and scientific concern and importance to POTL even if they can't be accurately quantified.

In order to address this public concern, and to acknowledge that species of turtle, dugong and dolphin in particular, are listed species pursuant to the EPBC Act that use parts of the Great Barrier Reef World Heritage Area in which the proposed development is located, POTL is proposing to undertake research activities that will improve knowledge about these species and allow better management decisions to be made. This research would be in addition to normal species monitoring requirements during construction, and would contribute to the Cleveland Bay EHMP.

- *Funding commitment:* Project 1: Undertake marine megafauna aerial survey and spatial distribution assessment for five years, with additional monitoring during the winter months when anecdotal information suggests that dolphin numbers increase: $120,000 every second year for 10 years.

A research project is also proposed to examine the triggers for, occurrence and effects of schooling baitfish (as a key food source) on dolphin frequency and usage of Cleveland Bay. This information would help POTL to understand whether any additional management measures are required when baitfish are schooling, adding to our general understanding of resource use by inshore dolphins.

- *Funding commitment:* Project 2: Research project investigating baitfish schooling triggers. $75,000 per year for 3 years.

B.23.3.7.3 Summary of Offset Funding Commitments

The funding commitments discussed above are summarised in Table 23.9.

Table 23.9 Research commitments as offsets for indirect impacts

Initiative	Funding and Duration	Total Commitment
Contribution to the NQ Dry Tropics Sustainable Agriculture program: on-ground management actions to reduce sediment inputs to Cleveland Bay	$400,000 p.a. for 5 years	$2 million
Research that seeks to better identify the source of sediments and geological origins in the catchment.	Project 1. $40,000 p.a. for 3 years Project 2. $30,000 p.a. for 3 years Project 3. $30,000 p.a. for 3 years	$120,000 $90,000 $90,000
Seed funding for a Cleveland Bay EHMP Program and contribution to water quality health monitoring annually	$1 million establishment seed funding $100,000 per year for 10 years	$2 million
Biennial seagrass health assessment	$75,000 every second year for 10 years (total)	$375,000
Seagrass Research Project	$40,000 per year for 5 years	$200,000
Coral health assessment	$40,000 every second year for 10 years (total)	$200,000
Fish health assessment	$50,000 every second year for 10 years (total)	$250,000
Megafauna survey and spatial distribution assessment	$120,000 every second year for 10 years (total)	$600,000
Research project investigating baitfish schooling (dolphin food source)	$75,000 per year for 3 years	$225,000
	Total	**$6.15 million**

B.23.3.8 EPBC Act Offset Requirements

Table 23.10 summarises the proposed offset package with descriptive accounting against the new EPBC Act Offset Policy. Because the policy and accompanying Offset Assessment Guide containing the offset calculator was released as the EIS was undergoing final review, some time will be required to accurately complete the computations. This can be undertaken in the period between submission and final decision by SEWPAC should it be required in addition to the calculations and habitat/species values already presented in this document.

Table 23.10: Elements of the proposed offset package in relation to stated requirements

EPBC Offset requirement		How the proposed offset package meets the requirement
7.1	Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter.	The major conservation outcome proposed is the additional legislative protection proposed for 1,240 ha of soft bottom benthic habitat. An extension to the Cleveland Bay Fish Habitat Area is proposed (see Figure B.23.2). The other significant offset proposal that should contribute to improved viability of protected communities and species in Cleveland Bay is the proposed contribution of $2 million to the NQ Dry Tropics Sustainable Agriculture Program. This program involves direct on-ground works on agricultural properties in the Burdekin River catchment – thereby delivering reduced sediment loads to Upstart, Bowling Green, Cleveland and Halifax Bays in the World Heritage Area. The Sustainable Agriculture program is a component of the Reef Rescue program and is auditable and reportable to Australian Government standards. $3.85 million is also proposed for an Ecosystem Health Monitoring Program for Cleveland Bay. This program contains both regular survey and research modules for

EPBC Offset requirement		How the proposed offset package meets the requirement
		water and sediment quality, coral health, seagrass health, megafauna health and fish health. The program would be managed by an independent scientific panel.
7.2	Suitable offsets must be built around direct offsets but may include other compensatory measures.	Additional compensatory mechanisms include a further contribution of $300,000 for research into the source of sediments and geological origin of sediments entering Cleveland Bay. An indirect ecological benefit of the PEP development would be the creation of approximately 12 ha of additional rock wall habitat. There is a small but largely unrecognised benefit to fisheries communities from rock walls with interstitial spaces in and upon which flora and fauna can colonise. The organisms currently occupying the rock walls around the Port are more fully described in Chapter B6 – Marine Ecology.
7.3	Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.	The offset package proposed in far in excess of the anticipated impacts to the protected matters. This has been deliberately developed to provide a broad range of benefits/assistance to enhance the resilience and viability of the Cleveland Bay component of the GBR World Heritage Area – and to recognise the national and international level of protection applied to this area.
7.4	Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.	The residual impact on benthic soft bottom habitat is the permanent loss of approximately 110ha of benthic habitat of demonstrated low ecological value. The offset proposed is additional conservation protection for 1,240ha of higher ecological quality soft bottom benthic habitat in the same ecological area as the residual loss (see Total Ecosystem Services calculations in accordance with QLD Government Fisheries Offset Policy FHMOP005.2 in section 6.1 of this document). This equates to a ratio of approximately 1:11 habitat lost to habitat with additional legislative protection.
7.5	Suitable offsets must effectively account for and manage the risks of the offset not succeeding.	The proposed offset package is multi-factoral and multi-disciplined. That is, not all the eggs are being placed in one basket, but all components do aim to improve the resilience and viability of Cleveland Bay (WHA) and the listed species and communities within it. One component of the package would provide additional legislative protection to a large area of benthic habitat important to seagrass communities and to endangered and vulnerable megafauna. Another component would directly reduce sediment inputs to Cleveland Bay from external sources. Another component would provide research funding to a range of programs that would enable POTL and regulators to better understand how the system functions and where future conservation inputs may best be focussed. Yet another component would take a holistic view of the health of Cleveland Bay and the broader stressors that may act upon it. Thus, if one component is not successful, or not as successful as anticipated, there are multiple other components in play that would mitigate that risk and contribute to a positive environmental outcome for Cleveland Bay.
7.6	Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs.	None of the offsets proposed is currently required in planning regulations, conditions of existing authorities or other schemes or programs. Any commitments that may have existed in the past (e.g. previous megafauna and seagrass spatial distribution projects) have now expired, leaving the way open for new commitments.

EPBC Offset requirement		How the proposed offset package meets the requirement
		This requirement applies in particular to the proposed Ecosystem Health Monitoring Program (EHMP) for Cleveland Bay (see section 7.2 and Table 7-1 of this document). None of these commitments is currently required. In addition to the EHMP, the dredging program would also have a Reactive Monitoring Program that would cover water quality and other abiotic and biotic factors. The Reactive Monitoring Program for dredging would be a separate program for managing potential construction impacts and is not included as an offset. The EHMP would be a completely new, integrated, scientifically robust ecological health assessment program for the whole of Cleveland Bay and would be governed independently of localised project impact assessment and management.
7.7	Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.	POTL is proposing to commence the funding and implementation of offsets immediately following commencement of construction of the project (so in a timely manner). The methodology for the research projects would be determined by one of the following: the independent scientific panel established for the EHMP, by NQ Dry Tropics or by a recognised research institution. In this way the content and methodology of the projects would be independent of POTL, devised by scientific experts in that discipline and be robust, transparent and measurable.
7.8	Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	The Sustainable Agriculture program is a component of the Reef Rescue program. NQ Dry Tropics would be the third party delivery agency. NQ Dry Tropics already reports to the Australian Government on program outcomes in a format acceptable to the Australian Government. The EHMP would be managed by an independent scientific panel with transparent structural and governance arrangements. The EHMP would produce a report card that would be presented to the community and to regulators annually thus providing public review not only of the workings of that group, but of the stressors and success (or otherwise) of broad scale management actions for the benefit of Cleveland Bay as a whole.

B.23.3.9 Cost and Staging

The full extent of offsets required will be negotiated with the relevant approval agencies and are expected to be given effect through the EIS decision making process. Any conditions and/or a separate deed of agreement can be developed during that process.

It is preferable that most offset commitments be implemented around the time the development has formally commenced so there is not a significant lag time between addressing the offset commitment and the construction phase. However, because the project is staged for episodic construction activity over a 30 year time period, some offsets may be able to be staged or banked for future application.

An implementation schedule will be prepared to accompany the final offset package that seeks to provide greater direction to the timing of offset commitments. That schedule will outline the preferred timing of commitments under categories of pre-construction (offsets that are reasonable to be implemented following approval but prior to commencement of work), and construction-based offsets (offsets would be triggered at the time of commencement of the works or at the commencement / completion of major stages).

Port Expansion Project EIS

Part B

Section B24 – Cumulative Impacts

AECOM BMT WBM

B.24 Cumulative Impacts

This section describes the cumulative impacts of the Port Expansion Project (PEP) and other projects in terms of key environmental values affecting Cleveland Bay including its physiographic settings, its ecological and landscape values in the context of the PEP Project Area's relationship with other development in and around Cleveland Bay and the broader region.

Detailed descriptions of the environment of the Project Area, the surrounding areas and specific impacts on defined environmental values from PEP have been made in the preceding chapters of Part B.

Air and noise effects on built environments and its inhabitants are described in Chapters B9 and B10. The predicted impacts of PEP on specific marine biophysical and terrestrial ecological factors are considered in Chapters B3 to B7.

The following section builds on earlier assessment undertaken for the Environmental Impact Statement (EIS) and assesses the cumulative impacts associated with the Project and other projects specifically in relation to matters of national environmental significance (MNES) with regard to:

- the identification of the world heritage and national heritage values expressed in the vicinity of the PEP, including an evaluation of the contribution of locally defined values to the overall values for the Great Barrier Reef World Heritage Area (GBRWHA) and national heritage place
- an overview of the context of the PEP relative to that which is expected in the Project Area, the broader Townsville area and along the Great Barrier Reef coast generally, being the ports and coastal development of the Ross Coastal Plain
- a description of cumulative impacts in terms of the contribution of and effects of the Project on the:
    - integrity and outstanding universal values of the GBRWHA criteria
    - ecosystem resilience, including reference to issues identified in the Great Barrier Reef Outlook Report 2009 (GBRMPA, 2009).

B.24.1 Matters of National Environmental Significance

Cumulative impacts are specifically assessed in terms of matters of national environmental significance (MNES) that affect the Project in accordance with the controlling provision of *Environment Protection and Biodiversity Conservation Act 1999*, being:

- world heritage properties (ss. 12 and 15A)
- national heritage places (ss. 15B and 15C)
- wetlands of international importance (ss. 16 and 17B)
- listed threatened species and ecological communities (ss. 18 and 18A)
- listed migratory species (ss. 20 and 20A)
- Commonwealth marine areas (ss. 23 and 24A)
- Great Barrier Reef Marine Park (GBRMP) (ss. 24B and 24C)

The world heritage property and national heritage place provisions are the principal MNES as PEP infrastructure and activities, as well as other coastal developments, occur within or adjacent to these areas. The components of these two respective MNES encapsulate many of the environmental values including factors of biodiversity and marine habitats, landscape, geological and heritage values potentially affected by PEP and the other port and coastal development projects. It is considered in Section B.24.2. Other MNES are considered in further detail in Sections B.24.3 to B.24.5. As it is pivotal to ecosystem function, Section B.24.6 presents assessment on ecosystem and ecological integrity and resilience of the Great Barrier Reef values in Cleveland Bay.

B.24.1.1 Overview of Cumulative Impacts in the Great Barrier Reef

The Commonwealth government, including the Great Barrier Reef Marine Park Authority (GBRMPA), and the Queensland government have recently formally agreed (16 February 2012) to undertake a comprehensive strategic assessment of the GBRWHA and adjacent coastal zone in accordance with s.146 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The strategic assessment will examine the impacts of actions on the MNES in the GBRWHA and adjoining coastal zone under the Queensland coastal management, planning and development framework. The assessment is due to conclude in 2015.

The PEP EIS is being considered in the context of the strategic assessment of the GBRWHA. That strategic assessment is a key recommendation of the recent UNESCO mission and report on the status of the GBRWHA. In the context of the strategic assessment, the Port of Townsville is historically significant as a long-standing and established port. On the strength of the information in this EIS, the port been identified as being suitable for expansion, upon a determination that the PEP does not result in significant or unacceptable impacts to the GBRWHA.

A joint international expert mission to the GBRWHA by the UNESCO World Heritage Centre and the International Union for Conservation of Nature took place in March 2012. The objective of that monitoring mission was to assess the overall state of conservation of the outstanding universal values of the Great Barrier Reef and to assist the Commonwealth government with the strategic assessment. The UNESCO mission concluded that the GBRWHA is 'affected by a number of current and potential threats and that decisive and immediate action is required to secure its outstanding universal values over the long-term'. Threats identified by UNESCO include climate change, catchment runoff, coastal development, ports and shipping, and direct extractive use. That 2012 UNESCO finding closely parallels the management topics previously identified by GBRMPA (2009), which grades the scale and complexity of management matters within the Great Barrier Reef (Figure B.24.1). From the perspective of the PEP, it is important to appreciate that various aspects and activities may already co-exist to result in a set of threats and impacting processes that risk cumulative effects on Great Barrier Reef values. In Figure B.24.1, the GBRMPA (2009) figure shows ports and shipping as a management topic of moderate complexity concentrated around ports and their shipping lanes, so relatively limited in scale.

Identification of potential cumulative impacts including PEP (both temporary and permanent) on GBRWHA and its biophysical, social and cultural heritage elements and MNES has been undertaken in the following sections.

Management topic	Scale	Complexity		
		Social	Biophysical	Jurisdictional
Biodiversity protection	Region-wide	minor	major	moderate
Climate change	Region-wide	major	major	major
Coastal development	Coastal catchment areas and mainly inshore waters	major	major	major
Commercial marine tourism	Region-wide but variable in intensity	major	moderate	moderate
Defence	Limited in area and duration	minor	minor	minor
Fishing	Region-wide but variable in intensity	major	major	moderate
Heritage	Region-wide	moderate	minor	moderate
Ports and shipping	Concentrated around ports and shipping lanes	moderate	moderate	moderate
Recreation (not including fishing)	Region-wide but variable in intensity	major	moderate	moderate
Scientific research	Region-wide but limited in intensity	minor	moderate	minor
Traditional use of marine resources	Region-wide but variable in intensity	major	moderate	moderate
Water quality	Great Barrier Reef catchment and mainly inshore waters	major	major	major

Figure B24.1 Scale and Complexity of Great Barrier Reef Management Topics (GBRMPA, 2009)

B.24.1.2 Regional Projects

The PEP is proposed in an existing, major port fully within established port limits to service a major regional city (i.e. Townsville) and the North Queensland region. Gradual growth of the port has been due to the historic growth of Townsville, its role in World War II, and its strategic location adjacent to some of the world's richest base minerals areas. The port has coexisted with the Great Barrier Reef's through its increased recognition as an important biodiversity area and its status as a world heritage property and a national heritage place. Throughout this time, the port has also maintained and grown its status as an important regional Australian port. This has been reflected in the continued recognition of a declared port area outside of a number of different conservation management zones that have been created, including the GBRMP zones and declared fish habitat areas.

The port has both benefited from the growth in the regions that it services and contributed to that growth by enabling the import of goods and minerals for value-adding processing (e.g. nickel ore processing at Yabulu) and the export of goods to growing overseas markets (e.g. agricultural products and minerals). The growth and related other projects has been varied, especially when considered in terms of the size of the regions over which the port and the PEP are expected to have an interaction.

The cumulative impact on world heritage and national heritage values is influenced by the sum of related impacts and can also be affected by the magnitude and extent of individual impacts relative to others that occur. In this regard, the PEP is likely to have its greatest impacts centred in Cleveland Bay and primarily in the Project's development footprint.

The projects that are likely to have the greatest potential contribution to an overall cumulative impact in Cleveland Bay are those projects that are associated with the port itself or which have a direct relationship to the port's and region's growth, including:

- Townsville Marine Precinct
- Port of Townsville Berth 4, 8 and 10 expansions (port inner harbour)
- Port of Townsville Berth 12 and associated vessel manoeuvring areas (port outer harbour)
- Minor improvement works and maintenance dredging to Port of Townsville shipping channels
- Townsville State Development Area, south of Ross River
- Eastern Access Corridor (EAC), including Townsville Port Access Road (TPAR) and rail access

- Townsville Recreational Boating Park (Ross River).

These projects, collectively with PEP, are referred to in this chapter as port and coastal development, all generally situated at the bay's interface or adjacent to the world heritage area on the Ross River coastal plain.

Additional to the effects from port and coastal developments are anthropogenic nutrient and sediment loads from catchment and point source releases from Ross River coastal catchments (Ross River, Ross Creek and Bohle River) and the Cleveland Bay Wastewater Treatment Plant into Cleveland Bay, in part, induced by regional population and urban development related to economic prosperity. These sources can be considered to be a large part of the set of developments of the Ross River coastal plain. Other future industrial projects expected to use the Port of Townsville are primarily expected to have an indirect contribution to cumulative impacts on Cleveland Bay values and the broader GBRWHA through increased shipping activity and potential for fugitive contaminant emissions from port-based trade infrastructure into adjacent receiving waters. In contrast to localised catchment discharges are the major sediment loads that also occur into the Great Barrier Reef lagoon from seasonal discharges of the Burdekin-Haughton systems (Figure B.24.2) into the high nutrients coastal strip (NA3) marine bioregion.

Cumulative impacts of increased shipping on the broader GBRWHA need to be considered in the context of other port development along the Great Barrier Reef coast, especially Abbot Point, Hay Point and Gladstone. Those ports have no direct association with the PEP or the Port of Townsville, being specialised ports catering for much larger and more frequent shipping for single cargo types (e.g. coal or gas products) than will be the case for the PEP. The information collated and assessed may provide messages and guidance for planning and management of shipping activity at Port of Townsville.

Unlike the other ports, the PEP is part of a much broader plan for the rationalisation of the port's facilities with a view of securing the port in its role as a key multi-cargo facility to service the region's and Queensland's diverse growth needs and to remain as the largest multi-cargo port in Queensland, north of Brisbane. Although the importance of this role is high when considered in the context of other port development, the combined effect of PEP and other regional projects on the GBRWHA outside of Cleveland Bay is very low when:

- its shipping movements are compared to that of the other Queensland ports
- its footprint is already concentrated on a long-standing, established maritime centre for trade, urban and industrial development.

The likely overall impact of the PEP and port development has been shown to be small:

- in relation to the values, qualities and pressures from other activities in the Great Barrier Reef
- compared to its regional context of development as part of a major growing regional city whose population is expected to grow to almost 300,000 by 2031.

Much of this increase in pressure from a set of stressors (such as from additional catchment development and population growth) will already take place in the absence of any further specific environmental assessment that is required to address cumulative environmental effects through existing planning controls; yet only recently formally pursued by the bilateral strategic assessment by DSEWPC, GBRMPA and Department of Environment and Heritage Protection.

Notably, the increase in number of small craft and boats (including local ferries) induced by growth in wealth and the regional population exerts a pressure on the wellbeing of iconic world heritage megafauna by accentuating the risk of boat strike.

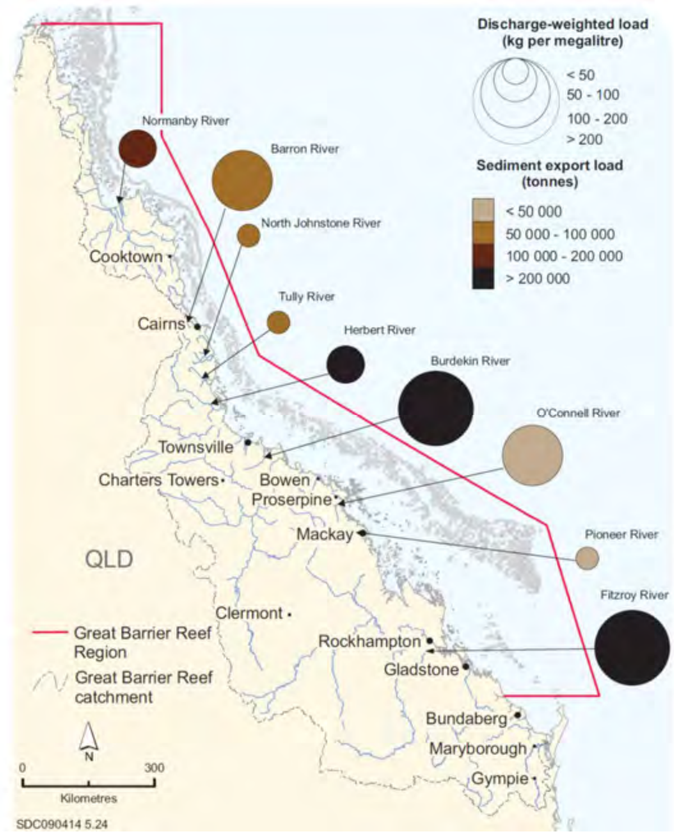


Figure B.24.2 Sediment Export Load (average tonnes per annum) (GBRMPA, 2009)

B.24.1.3 Summary of Cumulative effects on Cleveland Bay from Port and Coastal Development

Figure B.24.3 illustrates, at a high level, the potential activities that may lead to cumulative impacts on coastal and marine waters and certain MNES. Table B.24.1 shows the series of effects summarised from Section B.24.1.2 with a relative rating of the main pressures from each of the regional Cleveland Bay and Ross River coastal plain projects.

Assessment and discussion in the following sections relate to the cumulative effects that may arise from the set of projects and activities shown in Table B.24.1. What is evident is that the main impacting mechanisms from port and coastal developments of the Ross coastal plain as shown in Figure B.24.3 are:

- potential contaminant releases into nearshore waters including from risk events or chronic low level emissions, such as spills of chemicals and certain products, or the risk of a large event offshore because of a vessel founding or an onshore tank failure
- sediment re-suspension by dredging and excavation of the seabed causing a temporary change in water quality, beyond localised direct disturbance of the seabed
- releases to water from stormwater, catchment runoff and treated wastewater modified by a variable series of treatment measures and management requirements
- noises from port and coastal construction campaigns, including piling events.

Many of these source controls and emissions are outside the direct control of POTL and other port developers, contractors and operators.

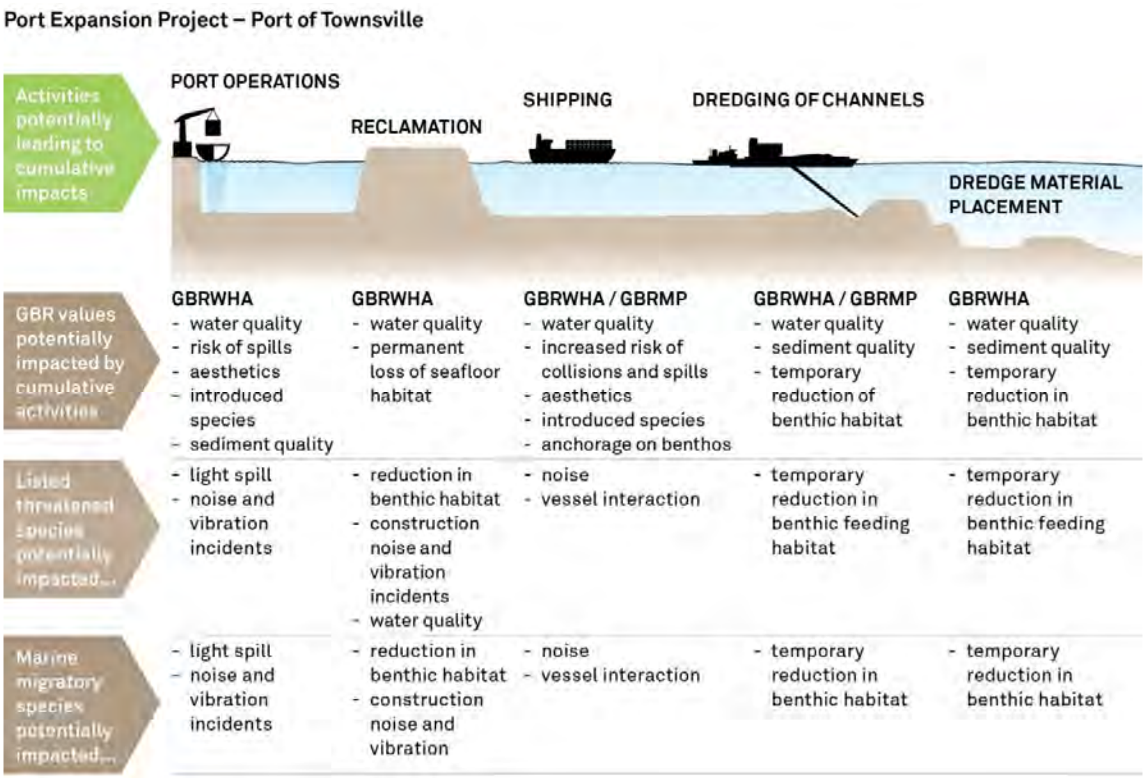


Figure B.24.3 PEP Interactions with Regional Processes and Impacting Mechanisms

Table B.24.1 Impacting Mechanisms that may risk Great Barrier Reef and Other MNES Values

Project/Activity	Key Aspects	Impacting Mechanisms on Great Barrier Reef and Other MNES values						
		Contaminant¹	Sediment re-Suspension	Seabed Reclaim	Point and Non-point Source Releases	Noise	Light and amenity	Vessel Interaction
PEP outer harbour	Basin dredging; reclaim filling; wharf piling; dredge material placement area (DMPA); ship berthing; loading/unloading of products	√	√√	√	√	√	√	×
Inner harbour berth works	Berth dredging; wharf piling; DMPA; ship berthing; loading/unloading of products	√	√	×	×	√	×	×
Berth 12	Berth dredging; wharf piling; DMPA; ship berthing; loading/unloading of products	√	√	√	×	√	√	×
Shipping channel dredging	Channel dredging; DMPA; vessel movement	√	√√	×	×	√	×	√
Townsville State Development Area	Land modification; industry development; industrial and commercial operations	√	×	×	√	×	√	×
TPAR and EAC	Land modification; transport development and operations	√	×	×	√	√	√	×
Port related shipping ²	Trade vessel from domestic and international ports of origin	√	×	×	×	√	×	√√
Land uses in and near coastal catchments	Handling and treatment of industrial and domestic wastewater	√	×	×	√√	×	×	×
	Wet weather catchment outflows from urban, commercial and broadscale land uses	√√	√	×	√√√	×	√√	×
	Various land uses and activities	?	×	×	×	×	√	×
	Recreational boating	?	?	×	×	√√	?	√√

1 Spill risk and fugitive emissions
2 Shipping-related effects from port developments (other than dredging) also risk introduced marine pests
? Indeterminate; risk of event may occur
√ Known to occur
√√ Occurs readily or more than occasionally
√√√ Constant or large occurrence

B.24.2 World and National Heritage Values and Conservation Management

The GBRWHA extends from low water along the east coast of Australia to the outer edge of the Great Barrier Reef. The Great Barrier Reef is also a national heritage place. The PEP site is wholly in the GBRWHA. Other regional conservation values are managed through a series of land based national parks, and marine parks and habitat zones, attributed by various regulatory instruments.

The Great Barrier Reef is the largest and best known coral reef ecosystem in the world, spanning a length of 2,300 km along two-thirds of the east coast of Queensland. The reefs of the Great Barrier Reef - almost 3,000 in total - represent approximately 10% of all the coral reef areas in the world (Spalding, Ravilious, & Green, 2001). Its natural heritage and conservation value is superlative and beyond question.

B.24.2.1 World Heritage Property

The Australian Government submitted a retrospective statement of Outstanding Universal Value (OUV) for the Great Barrier Reef to the UNESCO World Heritage Centre in 2012 (Appendix W1). The statement of OUV was approved by the World Heritage Committee in mid-2012. No statement existed at the time of the original Great Barrier Reef listing in 1981. The criteria for OUV in the retrospective statement reflect the contemporary criteria used by UNESCO. The world heritage criteria are periodically revised and therefore the criteria against which the property was listed in 1981 are not identical with the current criteria. The 1981 criteria include:

- *be outstanding examples representing the major stages of earth's evolutionary history – Criterion(i)*
- *be outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment – Criterion (ii)*
- *contain unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty, such as superlative examples of the most important ecosystems to man - Criterion (iii)*
- *be habitats where populations of rare endangered species of plants and animals still survive – Criterion (iv).*

The evaluation of the property was carried out by the UNESCO World Heritage Committee by adopting a broad comparative approach to ensure that the World Heritage List properties have 'outstanding universal value' (OUV) against a set of ten criteria. These criteria are also currently preserved within the Commonwealth jurisdiction by *Gazette No. S 99, 21 May 2007.* More complete consideration of the four nomination criteria and their justification is given by (Lucas, Webb, Valentine, & Marsh, 1997).

Both the Commonwealth and Queensland governments have legislative responsibilities in the GBRWHA and are committed to its sustainable management and protection of its environmental values. The *Great Barrier Reef Intergovernmental Agreement 2009* (DSEWPC, 2009) sets out the joint management arrangements between the two governments to ensure an integrated and collaborative approach to the management of the marine and land environments in and adjacent to the GBRWHA.

The GBRWHA covers Cleveland Bay and, in various areas in the bay, it supports a range of different natural values of various habitat attributes, quality and complexity. The Port of Townsville, including the Project Area, is located entirely in the GBRWHA. The PEP is assessed to have biologically-localised direct and indirect effect on marine ecosystems in the GBRWHA during both the construction and operational stages. These relate to irreversible loss of soft sediment habitat due to reclamation, and ongoing activities associated with day-to-day operations of the port facility. Temporary impacts to corals, sparse seagrasses, benthic fauna and amenity could occur as a result of unmitigated dredge plumes. Noise generated by dredging and piling during construction may also result in the temporary avoidance of construction areas by marine megafauna, so a wide range of mitigation strategies have been established to reduce the risk of harm to marine ecological values supported in the GBRWHA.

Subsequent sections describe and discuss the specific values and qualities associated world heritage values in Cleveland Bay.

B.24.2.2 National Heritage Place

The Great Barrier Reef was one of 15 Australian world heritage places included in the National Heritage List on 21 May 2007.

The Great Barrier Reef is the only national heritage place potentially affected by the PEP and other coastal developments. The natural and cultural heritage values associated with the world heritage criteria cited, also apply to the Great Barrier Reef as a national heritage place. Ongoing consideration of national heritage values is done in relation to the world heritage values of the Great Barrier Reef.

The scale and extent of the Great Barrier Reef is demonstrated in Figure B.24.5 showing its non-reef bioregions. Cleveland Bay is a small part of the extensive high nutrients coastal strip (NA3) marine bioregion, radiating hundreds of kilometres away from Townsville and positioned well inshore of an expanse of the inner mid-shelf lagoon (NB5) before reaching the nearest reef bioregion (known as the exposed mid-shelf reefs). Although biodiversity is low compared to some reef bioregions, productivity is high because of light availability at the seabed in depths less than 10 m. Today, the expanse of lagoon floor is managed in several ways with marine park zoning plans covering examples of all habitats in the Great Barrier Reef ecosystem, with a minimum of 20% of each of the 40 distinct non-reef bioregions protected as shown in Figure B.24.4 .

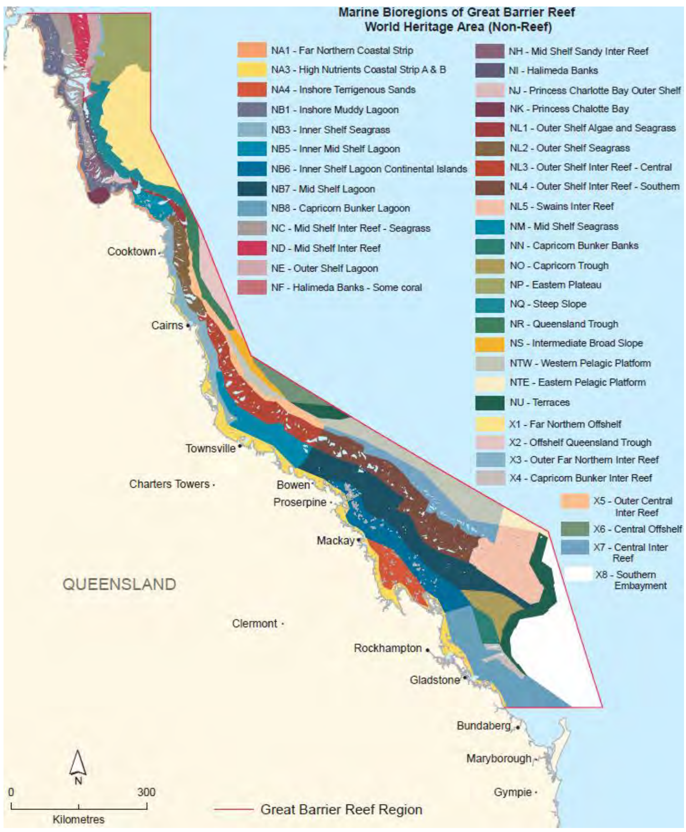


Figure B.24.4 Non-Reef Bioregions of the Great Barrier Reef (GBRMPA, 2009)

B.24.2.3 World Heritage Outstanding Universal Value

This section briefly describes how port and coastal developments including PEP would inter-relate with the components that make up the outstanding universal value of the Great Barrier Reef in order to manage or avoid significant impacts. The assessment has adopted a high level of precaution and avoidance of individual, cumulative or combined impacts on the outstanding universal value and its long-term conservation (Lucas, Webb, Valentine, & Marsh, 1997). The content in **Error! Reference source not found.** (*Assessment of world heritage attributes in Cleveland Bay's setting of the Great Barrier Reef*) summarises potential cumulative effects against stated examples of natural attributes that comprise elements of the stated criteria used for the original nomination, its world heritage listing and which are now recognised in the current Statement of Outstanding Universal Value (reproduced in full in Appendix W1).

Assessment details in Tables A1 to A4 (refer Appendix W1) show port and coastal development in Cleveland Bay that would affect some natural attributes of the Great Barrier Reef's outstanding universal value in certain ways in localised areas. However, none of the cumulative activities significantly impacts, degrades or compromises any of the series of examples of world heritage attributes within the Cleveland Bay setting of 'high nutrients coastal strip' bioregion of the Great Barrier Reef, as evidenced by the content of Table B.24.2.

In terms of the natural attributes derived from the criteria underpinning outstanding universal value, the following matters and values are most prominent, given the need for responses through risk management, mitigations and offsets described in preceding EIS technical chapters:

- Sensitive habitats and the diversity of flora and fauna; protect regional mangroves; intertidal seagrasses; mudflats and *Halimeda* macroalgae from reclamation or risks of habitat connectivity severance or unplanned emissions such as large spills and discharges.
- Species of plants and animals of conservation significance including migrating whales, dolphins, dugong, sea turtles, seabirds and concentrations of large fish. There will be irreversible loss of 110 ha of subtidal soft sediment habitat from PEP and reduced availability of feeding habitat for nearshore dolphin species.
- Feeding and or breeding grounds for migratory seabirds, cetaceans and sea turtles; localised loss of benthic feeding habitat; temporary decrease in water quality affecting feeding ground biomass and potential noise intrusions; increased boat and shipping movements will increase the risk of vessel strike to marine megafauna.

B.24.2.4 Specific Values and Habitats in Cleveland Bay

While analysis of the four nomination criteria and attributes comprising Outstanding Universal Value indicate few risks, they are not necessarily directly applicable to the Cleveland Bay situational setting. Outstanding universal value represents a broader landscape across many Great Barrier Reef bioregions.

In relation to both the world heritage area and NA3 bioregion, Valentine (1994) derived the following simplified list of natural heritage attributes that contribute to the Great Barrier Reef's 'outstanding universal value', as follows:

- largest and most complex expanse of living corals;
- unique forms of marine life;
- great diversity of life forms;
- most spectacular scenery on earth;
- exceptional natural beauty;
- major feeding grounds of dugongs and turtles.

Similarly, world heritage attributes in greater Cleveland Bay may be categorised into qualities and values 'more recognisable' to stakeholders. In the biophysical context of the inner mid-shelf lagoon and high nutrients coastal strip marine bioregion, these can be identified as:

- open expanses of water and seabed with natural marine physical and chemical processes
- benthic biota, including corals
- marine vertebrates, such as fish, dugongs, turtles and cetaceans and their marine habitats
- birds foraging, nesting and/or roosting
- scenery, natural beauty and aesthetics.

Consideration of the impacts of port and coastal development on Cleveland Bay has been undertaken, in order to protect these nature conservation values, in specific areas in what is a relatively small part of the GBRWHA. Overall, in summary, port and coastal development is predicted to manage risks and effects as shown in Table B.24.2. The actual means of management that achieves the avoidance or reduction of risks or effects are described for PEP in the preceding technical chapters (B1 to B22), B23 and the set of environmental management plans in Part C of the EIS.

Each of the main environmental values of greater Cleveland Bay is examined in further detail in subsequent sections. Table B.24.3 presents an overall assessment of the significance of the risk of impact in relation to stated criteria for Great Barrier Reef world heritage values.

Table B.24.2 Major Environmental Risks and Effects from Port and Coastal Development on GBRWHA Values

Great Barrier Reef World Heritage Values	Section	Major environmental risks and responses from port and coastal developments
Open expanses of water and seabed with natural marine physical and chemical processes	B.24.2.5.1 (Also B.24.3.1.2 Shipping)	▪ Manage the risk of spills that may cause persistent, severe or extensive chemical effects on waters, sediment or biota ▪ Reduce emissions that chronically change water and sediment quality conditions ▪ In design phase, staging of dredging and construction
Benthic biota, including corals	B.24.2.5.2 (Also B.24.6 ecosystem resilience)	▪ Avoid or reduce effects to live hard corals from sediment re-suspension associated with dredging activities ▪ Reduce the area and type of impact to soft bottom benthic biota (dominated by worms, echinoderms, crustaceans, sponges and algae) ▪ Avoid or reduce potential indirect effects on seagrass and corals
Marine vertebrates, such as fish, dugongs, turtles and cetaceans and their marine habitats	B.24.2.5.3 B.24.4.1 B.24.4.1	▪ Avoid or reduce the pressure on dugong and turtle populations arising from reductions in regional seagrass meadows (their extent and/or biomass) ▪ Avoid or reduce disturbances to cetaceans by controlling emission of intrusive noises from constructional plant
Birds foraging, nesting and/or roosting	B.24.5.2	▪ Manage risk of disturbances to bird roosting and nesting by noisy activities and light spill during design phase
Scenery, natural beauty and aesthetics Heritage	B.24.2.5.5 B.24.2.6	▪ Reduce incompatibilities of port development activities with natural scenic qualities and heritage values of Cleveland Bay ▪ Integrate development components and rationalise land use

Table B.24.3 Assessment of Impacts on GBRWHA Values against EPBC Act Significance Criteria

EPBC significance criteria	Assessment of Port and Coastal Development Impacts on GBRWHA Values
Reduce the diversity or modify the composition of plant and animal species in all or part of a world heritage property.	Projects will lead to modifications to benthic community structure as a result of dredging and reclamation adjacent to development footprints. These impacts are expected to be highly localised (i.e. in the construction/dredging footprint), and are not expected to result in broader scale long-term impacts to the biodiversity values of Cleveland Bay.
Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property.	Port development will remove soft sediment habitat as a result of reclamation. Such habitats are well represented throughout Cleveland Bay, and adjacent the local vicinity of the port. No habitat types are known to be unique to Cleveland Bay, or the areas of disturbance. Other benthic habitat disturbance will be Project specific with a period of recovery of benthos after disturbance of the seabed. The known Project footprints will not isolate marine habitats, nor will barriers to fauna movements or physical connectivity be created between Ross River, Ross Creek and Cleveland Bay.

EPBC significance criteria	Assessment of Port and Coastal Development Impacts on GBRWHA Values
Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a world heritage property.	No marine flora or fauna species are known to be endemic or unique to the Cleveland Bay region. While inshore dolphin species are able to continue to move throughout the Bay, coastal pressure on the feeding habitat exists from a number of sources and their requirement of seabed near the mouth of Ross River is not well understood.
Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in the world heritage property.	Impacts to the abundance of benthic marine flora and fauna species will occur. Such impacts are expected to be highly localised and, in many cases, of a temporary nature. Long-term declines in the population status of any species are not expected to occur as a result of port and coastal development. Although not fragmented, isolated or substantially damaged, habitat of inshore dolphins will be examined through offset funding by POTL for improved Bay-wide research.

B.24.2.5 Cumulative Effects on Marine Values in Cleveland Bay

The following sections examine potential cumulative effects on Cleveland Bay's Great Barrier Reef natural attributes and values in further detail. It also does this in the context of other recorded major threats and pressures existing regionally and arising from sources other than ports, shipping and coastal development. It is important to do this to establish the need for, or adequacy of, project-specific mitigations and the assigned program of offset investments (Chapter B23).

B.24.2.5.1 Protection and Management of Water and Sediment

Daily, monthly and seasonal variations in water quality of inshore non-reef bioregions of the Great Barrier Reef lagoon are a function of natural conditions including bathymetry, tidal state, winds and seabed sediment composition. Additional to natural processes is a growing load of sediment from cleared catchments with associated or co-related nutrients (from soil fertilisers) and contaminants (from pesticide application or industrial uses). The total annual average sediment load discharged into the Great Barrier Reef waters is now estimated to have increased four to eight-fold since European settlement, the bulk coming from catchments that have large grazing areas (GBRMPA, 2009), due mainly to increased soil erosion cleared to establish pasture for grazing. Over the past 150 years, sediment inflow onto the Great Barrier Reef has increased as a result of extensive forest clearing, especially the clearing of lowland rainforests and wetlands for sugar cane and the clearing of dryland forest for cattle. The latter, especially, creates sheet erosion where the nutrient-rich uppermost layer of topsoil is washed into rivers draining to the Great Barrier Reef lagoon during heavy rain.

The use of pesticides (including herbicides, insecticides and fungicides) continues in the Great Barrier Reef catchments particularly in areas under crop cultivation. According to GBRMPA (2009), seven herbicides are in widespread use. Contemporarily-used pesticides (such as diuron, atrazine and tebuthiuron) are now being detected and measured in inshore waters. Pesticides are being widely detected in low concentrations in some of the waters and animals of the Great Barrier Reef and in waters of its catchments. Their presence is of concern as they can accumulate in marine plants and animals and persist for many years after entering non-target off site receiving environments. Information on non-point source chemical loads to Great Barrier Reef lagoonal waters is shown in Figure B.24.5.

Increased sedimentation and inputs of nutrients and contaminants to Great Barrier Reef waters are affecting inshore areas, causing algal blooms and pollutant accumulation in low levels in sediments and marine species, reducing light and smothering corals and other benthos. Sea temperatures are increasing because of climate change, leading to bleaching of corals, and increasing ocean acidity is affecting rates of calcification. These processes combined are essential to the fundamental ecological processes of primary production and building coral reef habitats on the Great Barrier Reef.

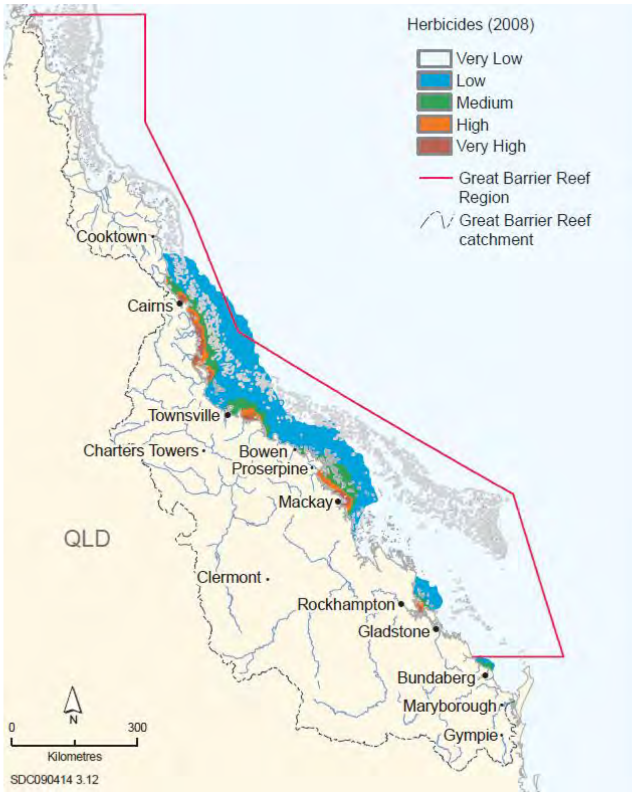


Figure B.24.5 Sites of Herbicide Detection in Great Barrier Reef Sediments (GBRMPA, 2009)

Increasing atmospheric carbon dioxide affects the acidity of the ocean, measured by its pH, showing a decrease in oceanic pH of 0.1 units compared to the long-term average. Unprecedented declines in calcification has already been observed in Great Barrier Reef hard corals (Figure B.24.6) with both increasing temperature stress and increasing acidification suggested as the causes, both linked to climate change processes. While PEP does not threaten in this way, its activity will be undertaken against a backdrop of marine receptors, biota and ecological values, such as corals fringing Magnetic Island headlands, already under stress

The physical and chemical properties of Great Barrier Reef open waters (especially through effects of currents, temperature and acidity-alkalinity) are assessed in other sections such as Section B.24.2.3. As habitats in their own right, open water contains pelagic fish, mammals, turtles, invertebrates, plankton and microbes. Seasonally, plankton includes the larvae of the majority of marine species, so open water provides core connectivity, a critical aspect of Great Barrier Reef ecology. Collectively the Projects proposed for Cleveland Bay would not prevent natural circulation patterns and coastal processes, and only temporarily disturb water quality, other than in localised areas (including those described in Chapters B3 to B5).

Port developments will not directly load sediments or nutrients into the Great Barrier Reef; they dredging would relocate sediment to other sites. Those sediments arrive in Cleveland Bay from predominantly Burdekin-Haughton and Ross-Bohle catchment sources. The amounts of sediment, of over four million cubic metres handled by dredging, will be moved from a shallow to deeper bathymetry by means of dredge vessel to the DMPA. Other than by unplanned and very uncommon spill events, no persistent chemical is being released from this activity.

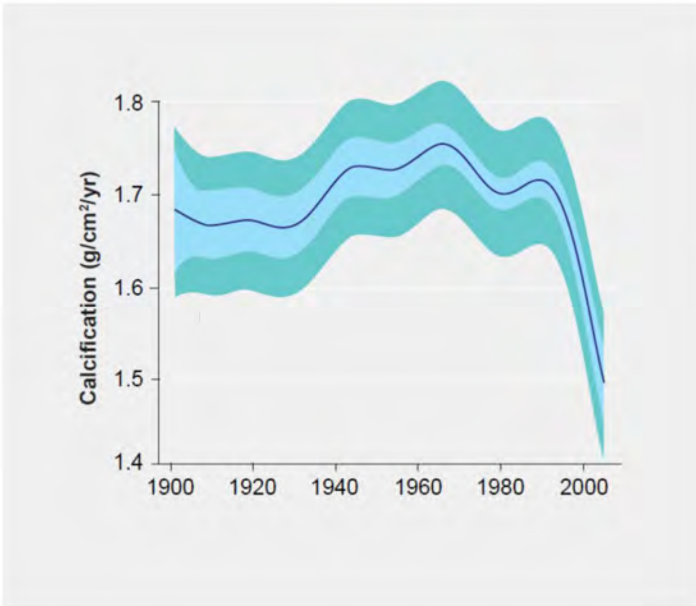


Figure B.24.6 Rates of Calcification Measured in Healthy Hard Corals (GBRMPA, 2009)

PEP channel dredging is also recommended for the winter period when favourable winds and sea state and seasonally lower primary productivity and reproduction is largely avoided, so concurrent or sequential events that result in elevated suspended sediment concentrations appear unlikely.

The set of port and coastal developments will, over a set of discrete projects and dredging campaigns, account for temporary mobilisation of sediment, but these are sediments sourced from origins other than the port. POTL's primary responsibility, which has been addressed in the marine management plans, is to manage the short-term risks of sediment re-suspension through dredge and reclamation water quality management and sediment quality testing. The residual impacts from these activities are not assessed as having a significant impact on GBRWHA values as demonstrated in Table 24.7 and Appendix W1.

In terms of overall risks and threats to Great Barrier Reef health, GBRMPA (2009) concedes that it is unlikely that the goal of halting or reversing water quality decline will be achieved to a level that would lead to the desired improvement in ecosystem health and resilience. Nonetheless, it is POTL's intention, as part of its offset package in relation to the predicted localised impacts to provide funding (Chapter B23) to address certain current limitations in monitoring, as noted by GBRMPA (2009) and to reduce sediment inputs into Cleveland Nay from external sources. The PEP design is also predicted to reduce the annual average volume of maintenance dredge material in the harbour and Platypus Channel, thereby further reducing indirect effects and to invest in programs on research aimed at improving water quality in the GBRWHA.

B.24.2.5.2 Benthic Biota

Like other nearshore environments in the bioregion, Cleveland Bay supports a range of marine habitat types, which have varying levels of connectivity. It contains a complex mosaic of coral reefs, mangroves, seagrass, un-vegetated shoals and deeper waters, all in relatively close proximity to each other. Elsewhere, this combination and diversity of habitat types represent important nursery habitat values for many fish and prawn species of commercial significance (Nagelkerken, 2009; Unsworth, McKenna, & Rasheed, 2010).

Healthy coral cover, formations and substrate are fundamental to the value of the marine park and many of its ecological processes. There is a diversity of coral reef systems and associated animals and plants in the area, with coral quality and cover varying greatly across the Great Barrier Reef reefs. Many reefs have high percentage coral cover and high species diversity. Protection of a functioning, healthy coral reef ecosystem is a major basis for protection of the marine park and for its world heritage and national heritage listings.

It is widely accepted that a diverse, resilient and productive coral reef ecosystem is the basis of most uses of the marine park (for example, research, traditional activities, collecting and tourism, commercial fishing and recreational uses).

Figure B.24.7 Cross Section of Coastal to Deep Ocean Habitats of the Great Barrier Reef (GBRMPA, 2009)

Maintaining the Great Barrier Reef as a natural, healthy and well-protected coral reef ecosystem is essential for national and international appreciation, presentation and continuing support for future protection of the Great Barrier Reef. In the situational context of Cleveland Bay, this includes marine ecological values of the Bay that are considered to be broadly representative, in certain areas, of the four natural world heritage criteria (and the examples of values/attributes identified in the GBRWHA listing document). Not all habitat features shown in Figure B.24.7 occur in Cleveland Bay and, where they do, they are often in discrete or small areas or situations distant from PEP.

In Cleveland Bay, ecological values relate to the management and protection of key marine habitats:

- seagrass meadows and mangrove ecosystems, dominant in southern and eastern parts of Cleveland Bay
- large areas of inter-reefal and lagoonal benthos across the seafloor of Cleveland Bay
- coral reefs at discrete locations including Middle Reef, Cockle Bay and fringing headlands of Magnetic Island
- along with the above biota, seabed areas and structures that provide habitats for threatened species and various macroscopic species of algae, crustaceans, polychaetes, sipuncilids, ascidians, molluscs and fish
- open expanses of marine waters with good quality for the ready movement and migration of plankton and vertebrates such as iconic species – cetaceans, dugongs, certain fish, birds and turtles.

Seagrass is not known to be present in or adjacent to the Sea Channel to be disturbed by dredging although dredging will almost certainly lead to changes in benthic habitats, communities and biomass in the shipping channels, and is given a medium risk rating (Chapter B6 Marine Ecology). Existing benthic habitats including macro-invertebrate assemblages in the navigation channel are highly simplified and have low diversity compared to adjacent undredged areas. The navigation channel is subject to ongoing disturbance as a result of maintenance dredging campaigns. While in a modified condition, it would be expected benthic habitats and communities in the navigation channel will continue to support similar benthic communities and ecological functions as found in the existing channel. Seagrasses are only occasionally recorded at depths greater than 6 m – as they are recognisably ephemeral in nature – and deep-water seagrasses are not currently known to occur near the port channels or DMPA. They were last recorded in the DMPA in 2008.

The turbid plumes generated from dredging works at Platypus and Sea channels for PEP have the potential to impact upon nearby sensitive benthos by reducing light levels required for photosynthesis. Based on the results of the PEP receiving water quality model, channel dredging work has the potential to expose sensitive ecological receptors to turbid plumes that include:

- seagrass areas mapped in the inner portion of central Cleveland Bay
- seagrass meadows and rocky reefs at the Strand and Cape Pallarenda

- Magnetic Island corals and seagrass (including in certain bays zoned as marine national park)
- extensive eastern Cleveland Bay coastal seagrasses.

The placement of sediment at the DMPA will not have the same potential effect, as seagrass meadows and corals are not present in the DMPA.

The soft sediment habitat in the reclamation footprint and outer harbour basin is well represented in the nearshore Cleveland Bay environment. The soft sediment in the reclamation footprint and harbour basin do not represent high quality habitats, being structurally simple, in a moderately modified condition (primarily by existing port operations), and are not known or likely to support seagrass, macro-algae or diverse/abundant sessile epifauna assemblages (e.g. soft corals, sponges etc.).

The outer harbour basin development would result in the direct disturbance of approximately 50 hectares of soft sediment habitat. Once operational, the values and condition/integrity of benthic habitats in the outer harbour basin will recover to be similar to those presently found at existing operational port areas (e.g. inner harbour). These operational port areas will continue to provide a range of ecological functions (e.g. fish feeding habitat, habitat for soft sediment benthos etc.), despite being in a modified condition. In the context of soft sediment habitat loss as part of PEP, as outlined in Section 23.2, POTL has committed to offsetting localised benthic habitat loss through extension of the Cleveland Bay Fish Habitat Area to similar benthic habitat at a ratio of 12 to 1 from loss to reclamation.

The infrastructure projects currently underway that will be completed when PEP commences include:

- TPAR, including the construction of a bridge across the Ross River near the port
- Berth 12 development adjacent to the Port Expansion Project
- Berth 8 expansion and Berth 10A upgrade in the inner harbour of the port.

These projects will produce a range of impacting processes similar in the marine environment as PEP, albeit resulting in different and smaller areas of marine effects. Collectively these will result in the irreversible removal of soft sediment habitat and increase hard substrate habitat, and cause short-term changes to water quality and disturbance of marine flora and fauna associated dredging and construction operations. Once the new port facilities are operational, vessel traffic, maintenance dredging requirements in the harbour and potentially pollutant loads will continue pressure on the marine ecological values in the vicinity of the port and the Ross coastal plain.

In terms of the cumulative loss of benthic habitat (and associated communities), the above potential future projects are all located in existing operational port areas and are subject to ongoing disturbance associated with day to day port operations. The subtidal benthic habitats in these areas are also structurally simple and contain habitat types that are widely represented throughout the nearshore areas of Cleveland Bay.

Potential future Port of Townsville developments are not known in areas that support extensive seagrass or other high quality foraging habitat for marine megafauna, fish or shellfish of economic or conservation significance. Previously mapped, extensive (albeit patchy) seagrasses may occur adjacent to navigation channels and the DMPA, which have the potential to be adversely affected by port operations. Rasheed and Taylor (2008) suggest that the structure of seagrasses communities in Cleveland Bay adjacent to port infrastructure are a product of high turbidity levels generated by natural processes (i.e. primarily wind-induced sediment re-suspension) and port activities (e.g. dredging and vessel movements). In the context of long-term impacts to key Cleveland Bay benthic habitats, Port of Townsville Limited (POTL) has committed in its offsets package (refer section B.23) to support an ecosystem health monitoring programme to detect the health of seagrasses and corals to facilitate management of Bay-wide cumulative effects.

The potential risk of harm to corals from capital dredging aspects of projects is greatest along the eastern coastline of Magnetic Island. With dredging controls, mitigations and monitoring, significant indirect effects on hard corals on Magnetic Island, from light deprivation (turbidity) and sedimentation, are not predicted to occur with dredging of the access channel. While direct and indirect seafloor disturbances cause effects, benthos is known to recover. Experimental evidence indicates that lagoon floor habitats have the potential to recover strongly after disturbances such as trawling (Pitcher, CSIRO, & GBRMPA, 2008).

In addition to individual biological components, the listing criteria also refer to the values provided by the interactions among habitats and species, and the underpinning biological processes. Known as ‘ecological integrity and resilience’ this characteristic is considered more fully in Section B24.6.

B.24.2.5.3 Marine Vertebrates

Mammals and Turtles

All marine mammals are species of conservation concern. More than 30 species of marine mammals (dugongs, whales, dolphins) occur in the Great Barrier Reef. Some species are frequently seen, such as humpback and dwarf minke whales and bottlenose dolphins. Other species, such as killer whales and common dolphins, are known to occur in the Great Barrier Reef but are seldom seen or perhaps seldom recognised. Others have stranded on the adjacent Queensland coast and so are believed to inhabit Great Barrier Reef waters occasionally.

Most whales appear to be maintaining intact populations. Humpback whales (Group V) are recovering strongly after their population was severely reduced by harvesting. There is limited information about most dolphin populations, GBRMPA (2009) report that the two inshore dolphin species are known to be at risk.

Numbers of dugongs have declined drastically in recent times along the central Queensland coast.

GBRMPA (2009) reported that the loggerhead, flatback and green turtle nesting populations appear to have stabilised or are now increasing across the Great Barrier Reef region. At a local scale, nesting activity is sporadic on nearby Strand beaches and on Magnetic Island, so the series of port development proposals would not compromise turtle reproduction habitats locally. Sea turtles have been noted to forage (in low numbers) along the existing rock walls of the port, and it is therefore possible the creation of new rock walls will form habitats leading to a localised increase food availability for some turtles, but this will not change local turtle abundances.

The subtidal soft sediment habitats in these potential future development areas occur in and adjacent to important feeding areas for nearshore dolphin species (Australian snubfin dolphin, Indo-Pacific humpback dolphin) at a Cleveland Bay-wide scale. Ongoing studies demonstrate that the Ross Creek and Ross River mouths, together with the Platypus and Sea channels, represent locally important foraging area for both of these species, despite these waters also being used by existing port operations. Also multiple vessel transits associated with port and non-port vessel traffic can be expected to result in an accumulated duration of time of aquatic noise. This effect would occur, if dolphins are foraging close to vessel pass-bys, so they may experience a reduced efficiency of bio-sonar function. Trade shipping traffic would increase over the life of PEP from one to two ship movements per day initially to approximately seven movements per day from the PEP outer harbour at capacity, compared to existing non-port ferry traffic amounting to approximately 52 movements per day. Past analysis of potential noise masking indicates the possibility of behavioural displacement during foraging and communication for the period of rock-tipping works at distances less than 2 km.

The cumulative effects associated with the loss and degradation of subtidal soft sediment habitats due to potential future port developments is not expected to result in the loss of any species (and therefore local diversity) from Cleveland Bay. However, measurable adverse impacts to biomass in feeding areas at localised spatial scales are expected over nearshore parts of Cleveland Bay. Other pressures and effects on mammals and turtles are examined further in section B24.5.

Fish

Only a small proportion of non-commercial bony fish species are monitored and these the populations appear stable across the Great Barrier Reef, although exceptions may include groups of species that are influenced by decreases in predator numbers and groups of species influenced by the effects of declining water quality (Preen A. , 1995). Approximately 55 to 60 species of fish, such as coral trout and mackerel, are targeted by commercial and recreational fishing. GBRMPA (2009) goes on to report that this has resulted in fewer fish in the regularly fished areas when compared to zones closed to fishing. Also fishing from the large recreational fleet is likely to exert pressure on fish stocks in Cleveland Bay and around Magnetic Island.

As a result of little long-term trend information on which to base decisions for fisheries management, Fish Habitat Areas (FHA), managed under the Queensland *Fisheries Act 1994*, provide a form of multiple use marine protected area that limits certain activities that may affect fisheries habitat values. The closest FHA to the Project area is the Cleveland Bay Fish Habitat Area, which extends across the eastern half of Cleveland Bay. The closest marine works area to the Cleveland Bay FHA is PEP, which is located approximately one kilometre to the west of the boundary. Turbid suspended sediment ‘plumes’ generated by dredging and dredged material placement are not typically predicted to enter into the FHA (to the east and south-east of the Channel), except under rare wind and tide conditions. Modelling has predicted that such occurrences would not be of sufficient duration and intensity to impact on fisheries values supported by the FHA.

Similar to existing rock walls created as part of the Eastern Reclamation area and Marine Precinct developments, establishment of extensive subtidal rockwalls by the PEP will also have a beneficial impact by creating new fish habitat.

Fish of conservation significance are not known or likely to use habitat in nearshore Cleveland Bay waters. GBRMPA (2009) reports that sharks and rays have come under serious pressure on the Great Barrier Reef as a result of some fishing activities (including targeted fishing, illegal fishing and as bycatch). In late 2008 the Queensland government approved a number of changes to fisheries management arrangements that limit the recreational and commercial shark catch, as well as protecting some shark species more at risk by making them no-take and protecting some critical habitat areas. While there is no apparent mechanism between port development and shark ecology, the flow-on ecosystem effects of losing predators, such as sharks and coral trout through other pressures, as well further reducing populations of herbivores, such as the dugong and fish, are largely unknown but have the potential to alter food web interrelationships and reduce resilience across the ecosystem. Effects from fishing (commercial and recreational) on fish stocks and predator / herbivore interactions already causes pressure to sustainable fisheries and fish ecology. Foreseeably, the temporary additional effect from dredge re-suspended sediments may add stress to benthic habitats that form part of a mosaic of seabed benthos although the quantum of that effect would be small in both time period (less than a year for recovery) and space (limited soft bottom benthos, and not seagrasses nor corals).

The PEP and future port development projects will increase the amount of artificial hard substrate on the seafloor in the port. Artificial rock walls presently represent a dominant habitat type in the nearshore areas and coastline around the port, and provide a range of ecological values for reef-associated species. As reef fish populations are not thought to be habitat limited, the increase in hard substrate habitat is not expected to increase fish population sizes in the region. However, the new (and existing) hard substrate will function for fish aggregation, which is expected increase recreational fishing opportunities in the area.

B.24.2.5.4 Avifauna

Birds are an important part of the nature conservation values of the marine environment. Seabirds are an integral component of marine ecosystems, and especially essential components of the ecology of islands and cays. Some of the species of birds that roost or nest on islands and cays are important to the values of the world heritage property. Fifty-two species of shorebirds that migrate through parts of the GBRWHA feed and roost near the Ross River in the vicinity of the port.

Migratory birds and their successful co-existence with port activity of the Ross complex are considered more fully in Section B.24.5.

B.24.2.5.5 Scenery, Natural Beauty and Aesthetic Qualities

The EIS assessment considers the potential impacts of the PEP both during the day and at night and also considered longer term cumulative effects that may arise due to other projects that are proposed in the surrounding landscape (Chapter B17).

Through the assessment, various viewpoints were selected for PEP to illustrate the potential effects of the proposals on residents and tourists in Townsville and on Magnetic Island with views to the GBRWHA. Due to the prominent location of the port at the boundary of the World heritage property and national heritage place and the functional requirements of land backed port related infrastructure, there is limited opportunity to mitigate the change to scenic amenity. However, it was concluded for PEP that the port expansion activities would be seen as an extension of land use in the context of the existing port activities and infrastructure. Most day time views show a change due to intensification of industrial infrastructure, however the PEP would not fundamentally change the character of the existing views. Some neutral changes were judged to be likely at longer distance, such as from Magnetic Island to the mainland across the expanse of Cleveland Bay, where the proposed infrastructure would be viewed against an existing industrial landscape backdrop. Night time views were assessed to experience an incremental increase in existing light levels of neutral effect due to the existing lit situation.

The cumulative effect of port and coastal development is that the near-pristine scenic values of the Great Barrier Reef would be maintained more broadly and comprehensively beyond Cleveland Bay. The ‘bowl shaped’ arena of Cleveland Bay, combined with the two key headlands (Cape Pallarenda and Cape Cleveland) and Magnetic Island contains, or limits, the scenic amenity effects from the wider region of the GBRWHA and those areas of the GBRMP inside the Bay. The natural character of the inshore part of the Great Barrier Reef is already interspersed with the existing urban architecture and industrial development which consequently lowers the magnitude of proposed future development alterations and planned change, as it keeps ‘like with like’. As a result, the proposed PEP situation is optimal as it is an augmentation of development with incremental scenic effects, so containing potential new incursions on alternate coastlines.

B.24.2.6 Social and Cultural Heritage Considerations

The following appraises social and cultural heritage values and their management frameworks that relate to heritage values of the GBRWHA and national heritage place. The Great Barrier Reef was listed on the Register of the National Estate, though the register was closed in 2007 and removed from the EPBC Act in 2012, and was replaced by the National Heritage List and the Commonwealth Heritage List. While the world heritage property and national heritage place is recognised, the Great Barrier Reef does not have specifically stated heritage values for assessment.

B.24.2.6.1 Australian Natural Heritage Charter

The *Australian Natural Heritage Charter: For the conservation of places of natural heritage significance* was specifically developed to provide ethical and practical approaches to assist in the conservation of heritage values. It was first adopted in December 1996 and was revised and updated in 2002. The charter offers a framework for making decisions for managing and restoring natural heritage places including those based on ecological processes which occur in natural systems.

Some heritage values may be interpreted as either ‘natural’ or ‘cultural’ and the concept of ‘natural heritage’ recognises the role Indigenous people have played in using and shaping Australian landscapes. The charter relates closely to the general structure and logic of the Burra Charter, which focuses on historic values (*Heritage Strategy*; GBRMPA, 2005).

B.24.2.6.2 Cultural Heritage Items

No known shipwrecks have been reported in the PEP Project or Study Areas. The broader Study Area does not include any historic lighthouses. Five Commonwealth heritage places are listed in the GBRWHA, although all of these are located over 20 km from the port’s outer harbour and will not be impacted either directly or indirectly.

For identifying and assessing places for Indigenous values, the process that GBRMPA follows is set out in its Heritage Strategy (GBRMPA 2005).

B.24.2.6.3 The Burra Charter

The Burra Charter has been adopted by the Queensland Heritage Council as the best practice for managing Queensland’s heritage places, including the GBRMP (noting that the Council has no direct jurisdiction in the GBRWHA). The charter sets out the basic principles and procedures to be observed in the conservation of important heritage places and urges consideration of the aesthetic, historic, scientific, social and spiritual values of places in the past, present and in the future (Marquis-Kyle & Walker, 1994). The following definitions are central to the charter:

- *Conservation* means all the processes of looking after a place so as to retain its cultural significance.
- *Place* means site, area, land, landscape, building or other work, group of buildings or other works, and may include components, contents, spaces and views.

Table A5 (**Error! Reference source not found.**) summarises the potential impacts of the PEP and other regional projects to cultural and social values of the Great Barrier Reef national heritage place.

None of the known port and coastal developments of the Ross River coastal plain will cause an unacceptable impact on heritage matters, specifically on listed or well-characterised sites or objects such as shipwrecks and lighthouses. The level of effect is low, and of the following nature:

- Wider aesthetic appeal – there will be localised effects from a series of commercial, industrial and public uses such as activity at ports, dredging and placement of dredged material and increased presence of shipping. This includes ships in transit in designated shipping lanes and in anchorages (from Magnetic Island vantages), numerous recreational vessel movements and aircraft, all in proximity to natural and/or protected areas. In addition, existing coastal urban and tourist developments outside the port (including that on Magnetic Island), while enhancing opportunities for further appreciation by humans, currently also impinge on natural aesthetic values..
- Increased port bound shipping traffic (set to double by 2040) may decrease the area available for recreational use and enjoyment.
- Visual effects, especially at night, from the port being constructed and a myriad of contributory operations part of modern, functional and safe port operations. This type of land use and activity is consistent with its history and built European heritage.
- Heritage effects need to be identified individually based on Project footprints and zones of influence.
- Ongoing consultation with representatives of the Aboriginal parties will identify traditional use of resources in the vicinity of the port and coastal developments.
- Tourism operators who display and extend world heritage values, will focus, as they do now, on natural experiences away from built up or industrial land uses.
- Cumulative effects to cultural heritage sites and objects in the greater Cleveland Bay are not evident.

B.24.3 Protected Areas

Cleveland Bay includes the GBRMP, a Commonwealth marine area (commencing three nautical miles beyond the territorial baseline), Bowling Green Bay wetland - a wetland of international importance- a FHA and Dugong Protection Area. The latter two zones are gazetted as areas under Queensland's fisheries and nature conservation legislation and discussed more completely in Chapter B6. Matters relating to fish and dugongs are also considered in relation to those taxa in other sections of this chapter.

The marine and coastal habitat types that predominantly comprise these areas are discussed in the preceding section (B.24.2) and in Chapters B6 and B7.

B.24.3.1 Great Barrier Reef Marine Park and Commonwealth Marine Area

GBRMP is managed under the *Great Barrier Reef Marine Park Act 1975* and the GBRMP is also a stated MNES under ss. 24B and 24 of the EPBC Act. Marine national park (several bays around Magnetic Island) is proscribed under Queensland's *Marine Parks Act 2004*. Otherwise, the General Use zone commences due east of the limit of the state's territorial waters and coincident with the Commonwealth marine area.

Under the existing zoning plan, Cleveland Bay contains the following management zones:

- Habitat Protection: the north-eastern and eastern coast of Magnetic Island
- Conservation Park: coastal areas between Cape Pallarenda and Magnetic Island, and the eastern section of Cleveland Bay
- Marine national park: several bays around Magnetic Island
- General Use.

The Commonwealth marine area is any part of the sea in Australia's exclusive economic zone and/or over the continental shelf of Australia outside state or territory waters. The Commonwealth marine area stretches from 3 to 200 nautical miles from the coast and is a MNES under ss. 23 and 24A of the EPBC Act. The PEP area, offshore DMPA and navigation channels are located wholly in state waters. The closest portion of the Commonwealth marine area to Cleveland Bay is located approximately 6 km north-east of the north-eastern tip of Magnetic Island, and approximately 3 km from the nearest portion of the channel extension area.

In terms of meeting environmental outcomes, the port and PEP (landside) operational areas are not directly in the GBRMP; which is both a legacy of purposeful planning and historical chronology with the port preceding the park by over a hundred years.

To the extent that they comprise values of the marine park, listed threatened and migratory species are considered more completely in Chapter B.6 on marine ecology, Table B.24.4 and Sections B.24.4 and B.24.5.

B.24.3.1.1 Direct effects on Great Barrier Reef Marine Park

Most Port of Townsville infrastructure, which includes large areas such as the outer harbour and DMPA, is located outside the GBRMP. All POTL infrastructure is outside the Commonwealth marine area. A small proportion of the current Sea Channel (adjacent to Bremner Point and Florence Bay) will intersect with the marine park in an area zoned as habitat protection. PEP proposes deepening of that portion of the Sea Channel in the GBRMP. Based on the implementation of appropriate mitigation strategies, the PEP is not likely to have a significant indirect impact on the environment in the GBRMP, outside of the small section of channel to be dredged. That portion of the channel, adjacent to Bremner Point, may have been subject to maintenance dredging in the past, so capital dredging will not lead to major changes to the functional or biodiversity values presently supported by in this portion of the channel. It is also proposed that the Sea Channel be dredged seaward, which will extend into the General Use zone of the GBRMP. The channel extension in the GBRMP has a total length of 2.7 km (with only 900 m in the Habitat Protection Zone) and total area of 24.8 ha.

GBRMPA (2009) reports that the impacts of dredging and construction of port facilities – such as seabed disturbance, transport or re-suspension of contaminants, alteration of sediment movement and changes in coastal processes – can be significant, but are localised. In the contextual setting of PEP, it is evident from specific factorial assessments, that re-suspension of contaminants, alteration of sediment movement and changes in coastal processes will not be significant for PEP as a result of application of reliable mitigations. Seabed disturbances, as well described in other sections of the EIS, will similarly be localised.

For future port operations, inclusive of PEP infrastructure, only parts of the extended Sea Channel described above and the associated trade shipping that generally moves through shipping lanes across the continental shelf will be in the GBRMP. Potential cumulative impacts are shown in Table B.24.4, after consideration of the significance guidelines stated criteria.

B.24.3.1.2 Shipping in the GBRMP

There are 11 ports operating adjacent to the Great Barrier Reef, accounting for some $17 billion of trade and in excess of 8,000 ship movements each year (AMSA, 2010b). Ships visiting north Queensland ports, including Townsville, transit the marine park and waters of Australian jurisdiction. For determination of the significance of effects in the GBRMP it is valid to consider marine ecosystem health, water quality, persistent contaminants and introduced marine pest species (Table B.24.4). The following information is provided for context of that comparison.

The number of trading cargo ships visiting the Port of Townsville is projected to increase from 675 ships per annum in 2010 to 1,008 ships per annum in 2025, and 1,338 ships per annum in 2040. Shipping can potentially damage the Great Barrier Reef by collisions, groundings, introduction of invasive marine pests, cause oil and chemical spills, introduction of anti-fouling paints, waste disposal and anchor damage.

Almost all ships travel safely along the designated shipping routes of the Great Barrier Reef with little if any impact (GBRMPA, 2009). In the last 10 years there have been three or fewer major shipping incidents each year. Despite the increase in shipping traffic, the number of major incidents has been stable and declining (Figure B.24.8). In addition to numerous minor oil spills, there has been only one major oil spill (25,000 L) in the last 20 years in the Great Barrier Reef region (in Gladstone Harbour and most of the oil was quickly recovered). POTL has developed and presented a *Vessel Management (Construction) Plan* and *Maritime Operations Management Plan* for incorporation for use by its contractors and port operators for safe, routine and reliable vessel activity into and out of Port of Townsville in the future. This has adopted a balanced risk management approach to aid the excellent record of industry in its collective maritime operations in Great Barrier Reef and Port of Townsville waters.

Introduced marine pests have been detected in ports along the Great Barrier Reef coast, both in port areas in the Great Barrier Reef region and in nearby harbours. For example, the Asian green mussel was detected in Cairns port on occasions during the past ten years, as well as in Gladstone port in 2009. The Asian bag mussel was detected in Cairns port in 2007. No introduced species have been detected in marine areas outside the ports in Great Barrier Reef waters, so the vector link between vessel translocation and introduced marine pests occurrence is strong. There is no evidence of any marine pest species occurrence in Port of Townsville waters, now or in the past. To maintain this enviable position, POTL is committed to ongoing work with Biosecurity Queensland to extend key messages for Biosecurity Queensland requirements in Australian and Queensland territorial waters.

Continued careful management of shipping activity is encouraged by GBRMPA (2009) in order to reduce the risk of major incidents, as the predicted increase in shipping will increase the likelihood of a major incident, as well as increasing the potential for more introduced species to occur. POTL has devised a series of marine-side management plans for its contribution to continued careful management, based on a system of navigation aids, communications, incident response plans and environmental management plans for port facilities that clearly demonstrates risk management in the adjacent Great Barrier Reef. Beyond these measures, the responsibility for sustainable shipping operations in the GBRMP lies with owners and masters of vessels and the relevant Australian regulatory authority.

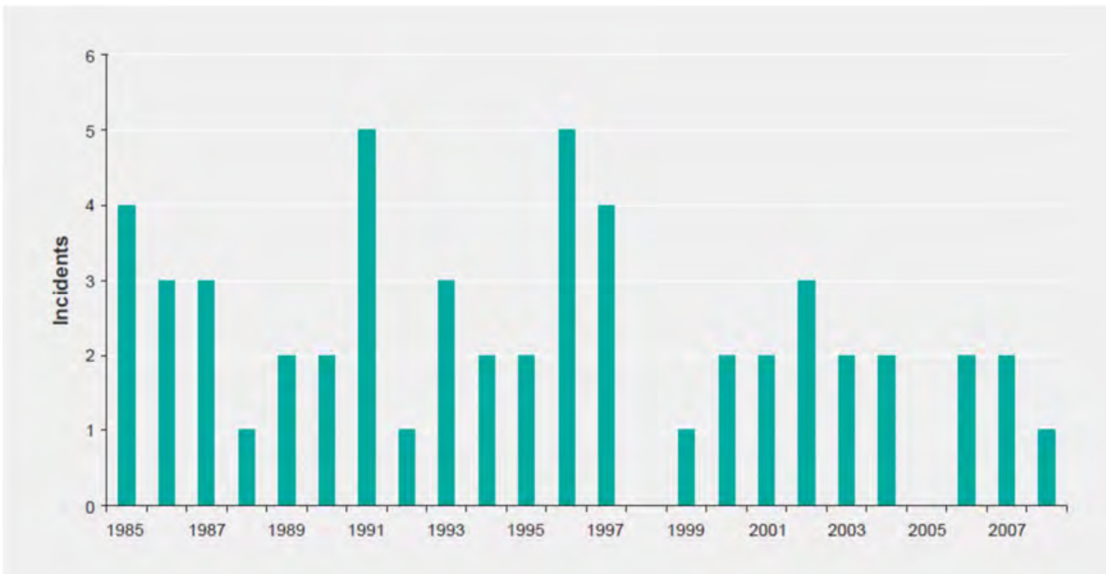


Figure B.24.8 Number of Reported Shipping Incidents in GBRMP over a 20-Year Period (GBRMPA, 2009)

North Queensland Bulk Ports, as part of the Port of Abbot Point proposal, because it is one of three existing coal ports in Queensland, is conducting a Cumulative Environmental Impact Assessment process. As part of that assessment, BHP Billiton has carriage of a reef-wide study of shipping looking at current and potential shipping movements through the reef and, in consultation with ports, maritime safety organisations and the shipping industry will examine future management arrangements to ensure protection of the Great Barrier Reef. That study will:

- outline the international, national and regional controls relating to shipping
- outline current shipping management arrangements in the Great Barrier Reef
- analyse current and future shipping activities in the Great Barrier Reef
- identify potential environmental implications at a reef-wide level
- determine and articulate likely shipping environmental risks
- analyse likelihood and consequence of ship groundings and collisions
- identify risk management measures.

Statements made in this EIS may need to be updated depending on findings and outputs of that study which was not available at the time of drafting.

Table B.24.4 EPBC Act Criteria for 'Significant Impact' to GBRMP Values

GBRMP Significance criteria	Presence near PEP	Potential Impact to GBRMP Values from PEP and Other Regional Projects		
		Direct	Indirect	Cumulative Effect
Modify, destroy, fragment, isolate or disturb an important, substantial, sensitive or vulnerable area of habitat or ecosystem component such that an adverse impact on marine ecosystem health, functioning or integrity in the GBRMP or Commonwealth marine area results.	Hard corals and associated benthos on fringes of Magnetic Island in the GBRMP are recognised as being sensitive. The nearest PEP infrastructure is the dredged Sea Channel in and adjacent to habitat protection, Conservation and Marine national park zones of Florence and Gowrie Bays, including adjacent to Bremner Point.	Port and coastal development is located in nearshore state waters of Cleveland Bay and will not directly affect Commonwealth Marine Areas. Dredging for PEP would occur in the existing Sea Channel which has a section located in the GBRMP. This area is representative of soft sediment habitat elsewhere in Cleveland Bay, so will not result in impacts to the broader values and functions of the GBRMP.	Sedimentation and turbidity from dredging and sediment placement will, given stated mitigations, not permanently adversely impact on ecosystem health on species or habitats in the boundaries of the GBRMP including the live hard coral habitats of Florence and Gowrie Bays. Furthermore temporary or sub-lethal effects are not predicted at the live hard coral habitats of Florence and Gowrie Bays. Vessels using the port and PEP would move through the GBRMP and Commonwealth Marine Areas.	None of the identified set of projects and proposals occurs substantially in GBRMP or Commonwealth Marine Areas. Vessels using Port of Townsville will move through the GBRMP and Commonwealth Marine Areas, as they do today. There will be intensification of future shipping use of designated lanes and anchorages. Vessel movements will not modify, destroy, fragment, isolate or disturb important, sensitive or vulnerable areas of habitat or ecosystem. Spills or unplanned emissions from vessels using the port may potentially modify, destroy, or disturb sensitive or vulnerable areas of habitat or ecosystem such as offshore or fringing intertidal and subtidal reefs, so appropriate controls and maritime operations planning (for risk prevention) and response plans are critical.
Have a substantial adverse effect on a population of a species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution.	Populations of dolphins occupy Cleveland Bay, and occasionally move through GBRMP waters to nearshore state waters near the port at the mouth of Ross River to be occupied by PEP. Humpback whales occasionally occur during their northern migratory season.	Significant impacts to populations and the spatial distribution of cetaceans are not expected as result of the Port Expansion Project in the GBRMP.	Noise generated by construction activities at the port could lead to the avoidance by cetaceans (ie. dolphins) of the immediate area around the land side construction footprint in waters outside the GBRMP. Furthermore, dredging may lead to a short-term loss of food resources for marine vertebrates in the dredging footprint (and DMPA),	The identified set of projects and proposals may lead to a short-term loss of food resources for marine vertebrates in the disturbance footprints (including DMPA), which are located outside the GBRMP and Commonwealth Marine Area. In concert with PEP, none is sufficiently large to cumulatively risk a substantial adverse effect on a population of a species or cetacean.

GBRMP Significance criteria	Presence near PEP	Potential Impact to GBRMP Values from PEP and Other Regional Projects		
		Direct	Indirect	Cumulative Effect
			which are located outside the GBRMP and Commonwealth Marine Area.	
Result in a substantial change in air quality or water quality ...which may adversely impact on biodiversity, ecological health or integrity or social amenity or human health.	Hard corals and associated benthos on fringes of Magnetic Island in the GBRMP are recognised as being sensitive to water quality changes. The nearest PEP infrastructure is dredging to extend Sea Channel in and adjacent to habitat protection, Conservation and Marine national park zones of Florence and Gowrie Bays. Air quality will not impact on the ecological health or human health in any parts of the GBRMP.	PEP would result in localised, short-term water quality changes in the vicinity of the navigation channels and outer harbour as a result of dredging, reclamation and placement but this would not lead to water quality changes to the Commonwealth Marine Area. Human health is not affected but social amenity may vary in the short term due to the visible presence of turbid plumes in parts of the GBRMP from channel dredging.	Turbid plumes generated by dredging of the Sea Channel are predicted to extend into sections of the GBRMP surrounding Magnetic Island. Mitigation strategies will be adopted to reduce the generation of turbid plumes, and to amend dredging practices should turbidity reach levels where unacceptable impacts to adjacent marine environments (including corals and seagrass) could occur. Through the implementation of appropriate mitigation strategies, adverse impact on biodiversity, ecological health or integrity of marine ecological values of the GBRMP are not expected to occur.	The temporary water quality disturbances of each Project's maritime development will be short lived (weeks to months) and not result in a substantial change in regional water quality that adversely impact on biodiversity, ecological health or integrity. The effect of the set of projects will be apparent as an effect on social amenity of coastal waters due to suspended sediment events associated with each discrete development campaign. There is potential for acute spillage events associated with loss of fuel oils from vessels which may adversely impact on biodiversity, ecological health.
Result in a known or potential pest species being introduced or becoming established in the GBRMP or Commonwealth marine area.	Dredge vessels may be sourced from other Queensland ports. Vessels will be subject to Biosecurity Queensland requirements. Trade vessels will enter the port, as they do now, from overseas ports of origin.	No direct effect.	There is potential for international ships to incidentally introduce marine pests which, depending on the pest species under consideration, could affect communities in Cleveland Bay. Potential introductions would likely occur in the port's outer harbour, initially well beyond the GBRMP and Commonwealth Marine Areas.	The growth in the number of trade vessels entering from overseas ports to Port of Townsville with expanded capacity will increase the risk of non-endemic species including potential invasive pests being inadvertently introduced. Mitigation strategies are in place to reduce the risk of introducing marine pests.
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity,	Sediments and biota are generally prone to contaminant accumulation. Hard corals and associated benthos on fringes of	Known contamination is limited to small areas of sediment associated of existing port berths that will be land disposed appropriately.	Accidental releases of hydrocarbons (e.g. during refuelling) and other contaminants (e.g. during product transport and handling) during construction and operational	An intensification of the risk of accidental releases into marine waters. Such events are typically very infrequent and episodic. Shipping management procedures

GBRMP Significance criteria	Presence near PEP	Potential Impact to GBRMP Values from PEP and Other Regional Projects		
		Direct	Indirect	Cumulative Effect
ecological integrity, social amenity or human health may be adversely affected.	Magnetic Island in the GBRMP are recognised as being sensitive. The nearest PEP infrastructure is extended Sea Channel in and adjacent to habitat protection, Conservation and Marine national park zones of Florence and Gowrie Bays.	No ocean disposal of contaminated sediments would occur. Prospective contamination in and around Port of Townsville will be routinely investigated in accordance with the NAGD (DEWHA, 2009a) prior to each maintenance dredging campaign.	phases. Mitigation strategies will be implemented to reduce this risk and appropriately respond to an incident in port waters.	will be adopted for commercial vessels in the region via Maritime Safety Queensland and RHM. Traded product shipment from port activity would be undertaken requiring site management to control fugitive emissions (such as covered storage sheds).
Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.	Port and coastal infrastructure is not situated in an area that puts heritage values of the GBRMP or Commonwealth marine areas at risk.	Nil	Nil	Nil

B.24.3.2 Wetlands of International Importance

The northern extent of the Bowling Green Bay wetland is located more than 9 km to the east of the closest port development. From its north-western boundary, it extends the length of Cleveland Bay to Cape Cleveland and beyond towards the south. The Bowling Green Bay wetland was designated in 1993 because of the diverse complex of coastal wetland systems that occur. A management plan provides guidance on the management of terrestrial portions of the site in the national park. The Bowling Green Bay wetland will not be affected directly or indirectly by the PEP as explained.

Wetlands of international importance are listed as MNES under ss. 16 and 17B of the EPBC Act. Currently, there is no publically available ecological character description for this site. The most up to date published Ramsar information sheet for the site (Blackman & Spain, 1999) indicates that the key values of the site are based on habitat provisioning for migratory and resident waterbirds, marine megafauna (turtles, dugong) on its northern fringes, and a range of other natural resource values supported by the diversity and extent of wetland types. Based on Blackman (1999), there are various components, processes and services that are likely to be critical in the context of maintaining the ecological character of the site. The identified values are shown in Table B.24.5.

Table B.24.5 Bowling Green Bay Ramsar Listed Wetland Values and Potential Indirect Impacts

Wetland Feature	Description of Natural Features	Potential Indirect Impact
Diversity of wetland types	A total of 14 wetland physiographic types were identified by Blackman (1999), with the largest by area being tidal mud flats (Ramsar wetland Type G), mangrove/tidal forest (Ramsar wetland Type I) and saltmarsh/saltpan (Ramsar wetland Type H). The site includes terrestrial areas, as well as freshwater and marine environments. Extensive areas of forest and woodland are also present (mountainous and coastal sand dunes), before giving way to brackish and freshwater communities on the low lying coastal plain (including both stream and marsh habitats). Saltmarsh and saltpans occur landward of mangrove forests, before giving way to intertidal flats associated with the prograding spit of Cape Bowling Green.	Only those marine waters and elevations in the site below high water mark on the southern fringes of Cleveland Bay would potentially physically inter-connect with waters interacting with those of the port. Mixing afforded over nine linear kilometres would diminish re-suspended sediment loads to negligible levels at the margins including the wetland's tidal mudflats.
Hydrological conditions	The site is drained by the Haughton River, together with several major creeks (Barramundi, Barratta and Sheep Station creeks) and smaller drainages. Groundwater is stored in two main aquifers that are recharged mostly by stream flows. These hydrological processes ultimately control freshwater ecosystems in the site, as well as representing a key control on marine communities during significant flow events.	Port and coastal development is well beyond the sphere of hydrological influence on the Ramsar site and vice versa, so no effect will arise.
Provision of feeding grounds for threatened marine megafauna species	Blackman (1999) found that the seagrass meadows of the site, together with those at nearby Cleveland Bay outside the site, provide an important food resource for dugongs and green turtles.	Sediments temporarily re-suspended by port development (i.e. dredging and placement) will not enter the feeding grounds of these fauna in the Ramsar site. Sparse, ephemeral seagrasses adjacent Sea Channel and DMPA form a mosaic of connectivity with more abundant and biomass-rich meadows of the southern parts of Cleveland Bay on the fringes of the Ramsar site remaining undisturbed.

Wetland Feature	Description of Natural Features	Potential Indirect Impact
Provision of nursery areas for species of economic importance	A mosaic of habitat types present in close proximity to each other, together with the presence of extensive seagrass meadows, mangrove forest, saltmarsh and freshwater marshes, represent high quality fisheries habitat. Key fisheries groups include prawns, crabs (including the mud crab), baitfish and finfish (including barramundi) species. Blackman (1999) noted that these habitats are used by a wide variety of life-stages for species of economic importance, particularly as a nursery habitat.	Sediments, temporarily mobilised by port and coastal development (i.e. dredging and placement) will not alter or affect the mosaic of habitat types in the Ramsar site that form fisheries habitat and nursery areas.
Provision of breeding and feeding areas for waterbirds	Blackman (1999) noted that the site is important for post breeding groups of brolga, magpie geese and various other species of Anatidae (ducks, geese and swans). The brolga and magpie geese are mainly associated with shallow sedge swamps and marine plains of the site, where they undertake breeding during late summer. The site also supports a wide range of migratory shorebirds, with approximately 50% of the species listed under Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) recorded in the site. Little tern can reach high numbers (1,000 individuals), and is known to breed on Bowling Green Bay spit. At least 103 bird species (including terrestrial birds) breed at the site.	No direct physiographic connection exists between port development footprints and Ramsar site bird habitat. Development footprints would not sever interconnections between feeding or roosting areas of bird habitat such as Townsville Town Common or Ross River southbank and Cleveland Bay eastern mudflats. Existing port reclaim provides for opportunistic foraging for birds as part of the Ross coastal plain.
Ecosystem services	The site also supports a range of benefits including sediment trapping, control of coastal erosion, and maintenance of water quality.	Predicted zones of influence (by turbidity/sedimentation effects) do not extend into or near the Ramsar site.

GBRMPA (2009) reports that, historically, the most significant impacts from coastal development on coastal ecosystems in the Great Barrier Reef catchments has been the loss of wetlands, such as those presently afforded protection as Ramsar listed and Directory of Important Wetlands in Australia sites. It has been variously estimated that 70 to 90% of coastal wetlands have been lost and many vegetation types on the remaining dune systems are now rated as 'of concern' or 'endangered'. At the same time, extensive areas of habitats that support the Great Barrier Reef ecosystem have been infilled, modified or cleared.

Wetland habitats are also important as feeding and breeding grounds for aquatic species, and as sediment traps and nutrient filters for water entering the Great Barrier Reef. Although the matter of wetland health and connectivity is an important one, port developments would be located more than nine kilometres from the Bowling Green Bay Ramsar site and other developments around the Ross River coastal complex practically as far. While there is a functional biological connectivity between it and the port, shipping channels and DMPA in greater Cleveland Bay, particularly for species that are migratory or have large home ranges, the linkage is not strongly supported by direct physical hydrodynamic surface water cycles. Of particular relevance are dugong, turtles and nearshore dolphin species, which are likely to move regularly around Cleveland Bay and other coastal areas in the wider region. The productive and relatively remote regions of southern and eastern Cleveland Bay with conservation and habitat protection zonings provide valuable refuge for iconic marine vertebrate species particularly during short periods when dredging activity may dissuade them from habitation in the particular parts of the Bay where works occur.

Potential cumulative impacts are shown in Table B.24.6 after consideration of the significance guidelines stated criteria.

Table B.24.6 EPBC Act Criteria for 'Significant Impact' to Bowling Green Bay Ramsar Wetlands

Significance Criteria	Presence Near PEP	Potential Impact to Ramsar Site Values by PEP and Other Regional Projects		
		Direct	Indirect	Cumulative
Areas of the wetland being destroyed or substantially modified.	Bowling Green Bay wetland is at closest point 9 km away across the open water expanse of Cleveland Bay.	No direct effects will occur as result of port expansion.	The reclamation footprint and dredge areas are located 9 km from the Ramsar wetland, so highly improbable for any substantial modification.	Threats to Bowling Green Bay wetland are not exacerbated by port development.
A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and in the wetland.	Port and coastal development will not alter the hydrological regime of Cleveland Bay nor the hydrology of Ross floodplain estuaries.	PEP will not affect fluvial flow regimes entering Cleveland Bay nor the Ramsar wetland.	Port development will have highly localised effects to hydrodynamics in the vicinity of the outer harbour and channels in the immediate vicinity of the reclamation footprint, which will not alter hydrology of the Ramsar wetland.	
The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected.	Fish that may occupy Bowling Green Bay habitats may move through the PEP development area as part of their life cycle. Dugongs and turtles and to a lesser extent dolphins are known to occur in southern and eastern Cleveland Bay waters near the Ramsar wetland.	Port development will lead to modifications to benthic community structure as a result of dredging and reclamation. This is expected to result in highly localised impacts (i.e. in the construction/dredging footprint) to benthic assemblages.	Major flow-on effects to marine fauna are not expected due an interruption to lifecycle of fauna. Marine megafauna known to inhabit the near subtidal waters adjacent to Bowling Green Bay wetland may be subjected to noise disturbance as a result of construction activities leading to avoidance of the immediate area of construction (piling) but these species will not be seriously affected.	There would be a temporary reduction in the biomass of soft bottom benthos because of PEP seabed disturbances that will slightly reduce the food available for species such as turtles, dugongs and dolphins, known to inhabit Bowling Green Bay marine and estuarine areas. This is contributed to by regional developments other than PEP but not to the extent that a serious affect would be predicted.
A substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature - which may adversely impact on biodiversity, ecological integrity, social amenity or human health	PEP dredging and sediment placement will result in a measurable change in water quality around the outer harbour, Platypus and Sea channels and DMPA during construction.	Port development would have localised, short-term effects to water quality in the vicinity of the navigation channels and the outer harbour. This is not expected to lead to water quality changes anywhere near to the Ramsar site.	Turbid plumes generated by dredging of the Sea Channel would not occur close to the boundaries of the Ramsar site adjoining the southern shores of Cleveland Bay. Accumulation of fine sediment loads from coastal catchments are prone to re-suspension and mobilisation during storm and cyclone events.	Threats to Bowling Green Bay wetland water quality are not exacerbated by port developments.

Significance Criteria	Presence Near PEP	Potential Impact to Ramsar Site Values by PEP and Other Regional Projects		
		Direct	Indirect	Cumulative
An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.	Trading vessels from international origin may, during the port's operational life, risk the translocation of marine species into endemic waters.	No direct effect.	There is potential for international ships to incidentally introduce marine organisms which, depending on the species, could affect ecological communities in Cleveland Bay. Potential introductions would likely occur in the harbour, well beyond the shores of the Ramsar site or the GBRMP. Mitigation strategies are in place to reduce the risk of introducing marine pests with existing legislated requirements with controls to reduce the risk of introduction.	Threats to Bowling Green Bay wetland from invasive species are not exacerbated by port developments.

B.24.4 Listed Threatened Species and Ecological Communities

Listed ecological communities will not be affected by PEP nor by a cumulative impacting mechanism by the set of regional coastal development projects.

B.24.4.1 Threatened Marine Species

One threatened marine plant species (frogbit, *Hydrocharis dubia*) was identified as potentially occurring. It is restricted to freshwater lagoons, a habitat type that is not supported in the Study Area.

The listed marine fauna species that may occur or have been confirmed to occur in Cleveland Bay waters include (Table B.24.7):

- one threatened marine mammal (cetacean) species
- two threatened marine reptile (turtle) species.

Table B.24.7 Potential Cumulative Impacts on Threatened Marine Fauna Species

Species Name	Common Name	EPBC Act	NC Act*	Potential Impact	
				Direct	Indirect
Mammals					
Megaptera novaeangliae[1]	humpback whale	V	V	Potential shipping strike rate may increase due to increased traffic. Increased occurrence of noise in shipping channel	Sea Channel and DMPA may disturb possible habitat areas.
Reptiles					
Caretta caretta	loggerhead turtle	E	E	Loss of seabed habitat under PEP reclamation	Risk to habitat located at reef and seagrass areas of Cleveland Bay (forages on marine invertebrates).
Chelonia mydas	green turtle	V	V	No impact	Risk to suitable benthic habitat located at reef and seagrass areas of Cleveland Bay. Low density nesting occurs in parts of Cleveland Bay.

1 Considered further in Section B.24.5 with other cetaceans
NC Act *Nature Conservation Act 1992*

Marine turtles are known to use Cleveland Bay as a feeding ground. Turtle species, which are considered threatened under the EPBC Act and NC Act, are described more completely in Chapter B6. Of those species, green turtles are most common in Cleveland Bay. Turtle species have, at some time, been recorded in offshore, nearshore and intertidal habitats in Cleveland Bay. Survey undertaken by Preen (2000) reports the average total abundance of turtles in Cleveland Bay at 416 individuals. This is likely to be an underestimate the true local number of animals due to bias inherent in the aerial survey methodology.

Current cumulative pressures on marine turtles in the Great Barrier Reef include incidental capture in some fishing gear (e.g. nets, crab pots), boat strike, ingestion of and entanglement in marine debris, illegal hunting, unsustainable traditional hunting, coastal development impacting nesting beaches and hatching success, and disease. Future loss of habitat for nesting sites from predicted sea level rise poses an extreme risk to nesting species. Significant nesting beaches do not occur near the port. The PEP and future port operations can address the known threats by reducing boat strike risks. Dredging activities would have minimal effect on seagrass meadows, which is the key feeding habitat for green turtles. Marine megafauna management (Section C2.1, Dredge Management Plan) is proposed for dredging activities to reduce impacts on turtle species including mandating the use of turtle exclusion devices on the dredge head and other operational matters.

Turtles are known to feed around the rock walls and in dredged channels in the port. Turtles are likely to exhibit a different response towards noise than marine mammals. Turtles often remain stationary for long periods (feeding and resting), and based on observations of turtles exhibiting negligible response in close proximity to marine piling, GHD (2011a) suggested that turtles may not voluntarily move away from a piling operation; furthermore GHD (2011a) posed that turtles are less likely to be sensitive to noise than marine mammals.

As acknowledged in GBRMPA (2009), 'integrated planning knowledge and compliance in managing coastal development are highlighted as requiring improvement' so, through the mechanisms provided in the series of PEP management plans (Section C2) observations, monitoring reporting and feedback are to be used for adaptive management of construction and operational activities, including by vessel operators, specifically for megafauna risk management.

B.24.4.2 Threatened Terrestrial Species

A number of threatened flighted terrestrial species listed under the EPBC Act have been identified in the area adjacent to the port. The various habitats in the surrounding area, including extensive wetlands, mudflats, estuaries, sandbanks, rock breakwaters, vine thickets and forests are suitable for a range of threatened terrestrial flora and fauna. Thirteen terrestrial fauna species, five terrestrial flora species and no ecological communities listed under the EPBC Act potentially occur in the surrounding area. An assessment of the likelihood of these species to occur in the Study Area was undertaken based on their habitat requirements (Chapter B7, Terrestrial Ecology). Six threatened bird species and one microbat species are known to occur in the Study Area (Table B.24.8).

There is a very low risk of the PEP resulting in significant indirect effect to coastal habitat potentially used by those threatened fauna. Given that species habitats are located outside the PEP Study Area and that the Project will undertake measures to manage and mitigate indirect effects to terrestrial ecology, it is highly unlikely that the port expansion will directly or indirectly or in concert with other developments:

- lead to a long-term decrease in the size of any population
- reduce the area of occupancy of any species
- fragment an existing population into two or more populations
- adversely affect habitat critical to the survival of any species
- disrupt the breeding cycle of any population
- modify, destroy, remove, isolate or decrease the availability or quality of terrestrial habitat to the extent that any species is likely to decline
- result in invasive species that are harmful to a listed species becoming established in any listed species' habitat
- introduce disease that may cause any species to decline
- interfere with the recovery of any species.

Table B.24.8 Potential Cumulative Impacts on Threatened Terrestrial Fauna Species

Species Name	Common Name	NC Act Status¹	Potential Impact	
			Direct	Indirect
Birds				
Ephippiorhynchus asiaticus	black-necked stork	NT	No impacts to known habitat at the mouth of the Ross River	Elevated noise and vibration during the construction phase may potentially disturb foraging and roosting on the sand spit on the eastern side of the Ross River but evidence is that populations coexist with port activity and current construction of TPAR bridge in immediate vicinity. The potential impact from light spill on terrestrial fauna will be
Esacus magnirostris	beach stone-curlew	V		
Haematopus fuliginosus	sooty oystercatcher	NT		
Numenius madagascariensis	eastern curlew	NT		
Sterna albifrons	little tern	E		

Species Name	Common Name	NC Act Status[1]	Potential Impact	
			Direct	Indirect
				greatest during port operations, as these operations will be lit by night, and lux levels will be low at known natural roosting sites (such as the sand spit) on the eastern Ross River.
Aerodramus terraereginae	Australian swiftlet	NT	Species occurs as a flyover; no impact	May be affected behaviourally by light spill in very localised areas while foraging near shores
Mammals				
Taphozous australis	coastal sheathtail-bat	V	Species occurs as a flyover; no impact	May be affected behaviourally by light spill in very localised areas while foraging near shores

1 The threatened terrestrial fauna species are not listed under the EPBC Act
E Endangered
V Vulnerable
NT Near Threatened

As the birds listed are also part of the avifauna of the region, they are also considered in the Section B.24.5.

B.24.5 Migratory Species

The list of migratory species established under s. 209 of the EPBC Act comprises:

- migratory species which are native to Australia and are included in the appendices to the Bonn Convention
- migratory species included in annexes established under the JAMBA and the CAMBA
- native migratory species identified in a list established under the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Several bird, mammal and reptile marine migratory species are known to occur in the Study Area.

B.24.5.1 Migratory Marine Mammals

Five migratory marine mammal species may occur or have been confirmed to occur in the Study Area, including dugong, whales and dolphins (Table B.24.9).

Table B.24.9 Potential Cumulative Impacts on Migratory Marine Mammals

Species Name	Common Name	Potential Impact	
		Direct	Indirect
Dugong dugon	dugong	Shipping strike rate expected not to increase due to vessel traffic. Potential increased noise in shipping channel.	Risk of temporary reduction of deepwater and nearshore habitats in Cleveland Bay and the Strand and seaward of port.
Orcaella heinsohni	Australian snubfin dolphin	Shipping strike rate expected not to increase due to slow moving traffic using the port. Potential increased noise in shipping channel. Loss of seabed habitat under PEP reclamation area.	No impacts to the broader habitat at the mouth of the Ross River or nearshore waters of Cleveland Bay.
Sousa chinensis	Indo-Pacific humpback dolphin	Shipping strike rate expected not to increase due to vessel traffic . Potential increased noise in shipping channel. Loss of seabed habitat under PEP reclamation	No impacts to regional feeding and nursing areas in Cleveland Bay, particularly in the vicinity of the mouth of the Ross Creek and Ross River.

Species Name	Common Name	Potential Impact	
		Direct	Indirect
		area.	
Balaenoptera edeni	Bryde's whale	Shipping strike rate expected not to increase due to vessel traffic. Potential increased noise in shipping channel and DMPA.	Possible transient visitor; no impact.
Orcinus orca	killer whale	Shipping strike rate expected not to increase due to vessel traffic. Potential increased noise in shipping channel and DMPA.	Possible transient visitor; no impact.

* Humpback whales are described in Section B.24.4.1

B.24.5.1.1 Dugongs

The largest global populations of dugong live in Australian waters. Waters of the Great Barrier Reef provide habitat for many dugong populations. Dugongs are also known to occur in Cleveland Bay, particularly in the conservation park zones of southern and eastern Cleveland Bay. The entire area of Cleveland Bay is located in the Cleveland Bay Dugong Protection Area (Zone A). As such, the port expansion, channels and DMPA (with the latter two of use by other Ross River coastal plain developments) are all located in the Dugong Protection Area. Declared in legislation under the NC Act and as special management areas under the *Great Barrier Reef Marine Park Zoning Plan 2003*, fishing activities in Dugong Protection Areas are managed under the *Fisheries Act 1994*. Certain forms of netting are prohibited in Dugong Protection Areas; however, there are no restrictions on port related activities. POTL and general vessel activities have coexisted with the Dugong Protection Area for many years. Vessel management, including slow and/or constant speeds and movement constrained to the shipping channels, is key to successful ongoing operations. PEP and other development proposals are not expected to result in long-term direct changes to seagrass habitat. Nor are construction activities or increased vessel activity expected to lead to significant changes to the values of the Dugong Protection Area or the populations of animals in it.

There is concern for the dugong as its Australian east coast population has declined drastically in areas from Cooktown south, known as the ‘urban coast’. GBRMPA (2009) reports that, historically, this results from commercial hunting and incidental bycatch in large mesh nets. More recently, it is likely to be caused by the cumulative pressures of habitat loss, incidental capture in gill nets, boat strikes, illegal hunting (poaching), unsustainable traditional hunting, disease and ingestion of marine debris, it is estimated that the ‘urban coast’ dugong population has drastically declined to be approximately 3% of its size approximately 40 years ago, although numbers may now be stabilising at that low level.

There is a greater density and number of dugongs in the remote coast (northern third of the Great Barrier Reef). Estimates of loss from human activity (principally traditional hunting and incidental capture in large mesh nets) indicates the potential for a declining population so it is vital that cumulative effects from added pressures such as habitat loss are managed or prevented. Specific management plans for PEP are aimed to manage direct effects on dugongs requiring:

- vessel operations (navigation strategies for controlling vessel interaction)
- avoidance of seagrass meadows and minimal temporary sedimentation (in relation to risk of habitat loss)
- waste management (arising from marine debris).

Management of indirect effects, arising on water quality and sedimentation effects on seagrass health, are also important, so stormwater and dredge management practices would be implemented. The offsets package as described in Chapter B23 and assessed in Section B.24.7 also provides further information on marine mammal and habitat management.

B.24.5.1.2 Cetaceans

The marine park is known to be an important breeding and feeding ground for several species of whales and dolphins, some of which are rare. Migratory species of whales breed in the tropical waters of the

Great Barrier Reef during the winter months. Humpback whales may calve in Cleveland Bay waters. Two threatened species of dolphins occur in Cleveland Bay as described in Table B.24.9.

Cetaceans may be disturbed by human boating activities, resulting in interruption of mating or reproductive events, noise induced effects, separation of calves and mothers, collisions, or displacement from area due to high vessel traffic. Shipping ‘strike’ potentially mortally affects individual marine vertebrates directly or indirectly, or more frequently, increased noise in shipping channels which may dissuade marine animals from their usual patterns of habitation.

In terms of matters directly influenced by port operators, management controls are proposed as part of the Project in relation to marine piling to limit the impact of noise on nearshore marine mammals. While vessel strike in Cleveland Bay historically has not been identified as a critical issue, controls are proposed for the construction phase of projects, where a larger number of smaller vessels may also be present.

An increase in vessel traffic around the port area during various elements of port construction would increase the likelihood of marine animals and vessel co-occurrence, or the avoidance of the area by some shy or sensitive species including cetaceans. A Vessel Management (Construction) Plan and Dredge Management Plan will be developed for each Project that takes into consideration of relative impacts of port construction activities. Plans will include strategies relating to vessel speed limits, fauna observers and other strategies to avoid and report interactions with marine megafauna.

The number of trading cargo ships visiting the Port of Townsville is projected to increase from 675 ships per annum in 2010 to approximately over 1,000 ships per annum in 2025 and approximately over 1,300 ships per annum by 2040. This is still small in the context of 8,000 ships per annum transiting Great Barrier Reef waters. Humpback whale and trade vessel co-occurrence rates were estimated as extremely small using empirical data for the Group IV humpback whale population (Collie, 2011). As a comparison in West Australian ports, where there are over 11,000 vessels per annum and more humpbacks in the migratory whale population, the reported International Whaling Commission 2009 strike rate equates to 0.0003 cetaceans per vessel annually all of which traverse the route of the Group IV herd; this equates to approximately one animal strike every three years for a movement of one thousand vessels. In busy ports, such as Dampier in WA (with over 4,000 vessels per annum), it was noted that whale-vessel interactions have not been reported, even though many thousands of humpback whales move past twice each migratory season.

The increase in ship movements, particularly of faster moving ships, increases the potential for collisions between ships and cetaceans. At most risk is whales, due to their slow speed and habit of ‘milling’ near the water surface. As the management of issues relating to vessel strike are outside the control of Port of Townville, and management actions at a state and Commonwealth level to mitigate risks have not been fully developed, the residual risk level is considered to be the same as the unmitigated risk level. The Townsville region is not known to represent a key humpback whale habitat so, that based on no known whale co-occurrence for ships visiting Port of Townsville, impacts to any of the whale species would not occur at the level of a viable population.

The marine megafauna species most likely to be encountered directly adjacent to piling operations are turtles, dolphins and possibly sharks, and far less likely dugongs and whales. The cetaceans are highly mobile and can travel large distances in a 24-hour period, particularly dolphins, whales and dugongs (GHD, 2011a). These species may also exhibit avoidance behaviour to high noise levels.

The most likely impacts of construction noises to most cetacean species results in the temporary avoidance of affected areas which could result in the following effects:

- *Dolphins* - the area around the Ross River and Creek mouths (i.e. areas in and adjacent to Project Area) is a locally important feeding area for nearshore dolphin species. Nearshore dolphins are wide ranging species that also feed and calve elsewhere in Cleveland Bay, and it is unlikely that temporary avoidance of feeding areas near port and coastal construction activities would result in major, long-term impacts to the populations of these species. Disruption to communication between individuals could also occur in close proximity to construction sites; there is insufficient information to quantify the impacting mechanisms and extent of population decline.
- *Whales* – During migrations, humpback whales commonly occur in offshore waters off Cape Cleveland and GHD (2011a) concluded that peak noise pressures from development works would be of minimal significance greater than directly near coastal piling activities.

Further assessment of the integrated management of risks to megafauna from port and coastal development of the Ross River coastal plain is given in Section B.24.7.

B.24.5.2 Migratory Birds

The wetland and mudflat habitats associated with Ross River, parts of Magnetic Island, Bowling Green Bay National Parks and Townsville Town Common Conservation Park provides foraging and roosting habitat for migratory shorebirds. The shorebird habitat located on the eastern side of the Ross River has been identified as a significant roosting and foraging site for migratory birds. Several other locations to the north and south of the Port of Townsville support migratory bird populations.

Fifty-one migratory and/or marine bird species protected by one or more of JAMBA, CAMBA and ROKAMBA have been identified as likely to occur in the PEP Study Area. Twenty-six species were either directly recorded or predicted to occur during site surveys as shown in Chapter B7.

The Project will not result in direct impacts to migratory and/or marine birds or their habitat and measures will be implemented during construction to avoid any potential indirect impacts. PEP will not:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles, altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory bird species

Based on work by NRA (2005; 2008) and Driscoll (2009) it is known that, at high tide, shorebirds and various other waterbirds move to the sand spit in the Ross River mouth to roost. This site is an ideal roost because it is located near suitable foraging habitat, provides unobstructed visibility of potential predators, isolated from the mainland at high tide. Isolation may be important because may afford roosting birds a degree of protection from land based predators and human disturbance. Areas like this are uncommon along the Queensland coastline and very uncommon in the Townsville region. As the tide recedes, shorebirds move off the sand spit to forage on the surrounding intertidal banks. The majority of birds use the banks to the south-east of the river mouth, especially the area near Sandfly Creek, with smaller numbers venturing farther south into Cleveland Bay (Driscoll, 2009; NRA, 2005; NRA, 2008). While the common pattern is for most shorebirds to move south-east of the river mouth to forage in large numbers, on occasion they use the intertidal banks in the river mouth.

Impacts that may act cumulatively on birds and their habitat on the shores of Cleveland Bay would be particularly near the Ross River east bank including:

- a risk of changed accretion and erosion forces, at the sand spit, which is rated very low for PEP
- increased noise and lighting sources along newly formed transport corridors (TPAR) and future rail movements in the EAC, potentially disturbing roosting shorebirds, especially at night time, in that locality
- more frequent noise and vibration events from combined emissions from the different Project development and operations perhaps concurrently
- dispersion of weeds and incursion of wild domesticated animals into the supra-littoral zone as encroachment from newly-developed coastal areas and access to areas becomes readily available to people, vehicles and domestic animals.

The potential risks are greatest on shorebird roosting and foraging areas, which can be reduced through appropriate mitigation measures and avoidance of direct impacts, such a light spill, onto known habitats. The PEP is unlikely to contribute significantly to the risk of cumulative impacts on migratory birds.

B.24.5.3 Migratory Reptiles

There is one migratory reptile (other than turtles) known to occur in the Study Area (Table B.24.10). Crocodiles will move through near coastal waters from time to time including into and out of the Ross River coastal complex although they inhabit more substantial mangrove habitats north and south of Cleveland Bay (the Bohle and Haughton systems respectively).

Table B.24.10 Potential Cumulative Impacts on Migratory Reptiles (Other than Turtles)

Species Name	Common Name	Potential Impact	
		Direct	Indirect
Crocodylus porosus	saltwater crocodile	None	No impacts to potential habitat in the Ross River estuary

B.24.6 Ecosystem Integrity and Resilience

The offshore and coastal marine environments of central Queensland are part of the Inner Mid-Shelf Lagoon and high nutrients coastal strip bioregions shown in Figure B.24.5. Cleveland Bay is a relatively small part of the bioregion. The integrity of the ecosystem is a pivotal function that provides resilience to events such as forceful cyclones and sediment re-suspension events.

Ecosystem resilience is a measure of an ecosystem's ability to recover to a healthy state after a disturbance, and derives from elements such as:

- species abundance and recovery rates of dominant taxa
- functional recovery so that chemical, physical and biological processes are completely restored.

It is related, in part, to an ecosystem's size and extent as well as intactness, function and connectivity and needs to be examined to determine whether the ecosystem is at risk from a combination of events and effects. The concept of ecosystem 'resilience' is the ability of a system to resist, reorganise and recover from a disturbance (Nyström, Folke, & Moberg, 2000). Resilience depends on biological or ecological characteristics that may promote resistance or restoration after disturbances. For example, a biological resilience characteristic may include the ability to produce dormant seeds/larvae that can survive through a disturbance and recruit successfully once conditions improve.

The importance of ecosystem resilience in the Great Barrier Reef – its ability to absorb or recover from threats – is an important part of predicting its likely outlook (GBRMPA, 2009).

B.24.6.1 Cleveland Bay: Integrity, Resilience, Function and Recovery

Ecosystem resilience is complex to understand and assess because a number of factors can affect it (GBRMPA, 2009).The existing integrity of marine habitats varies throughout Cleveland Bay. Nearshore areas around Townsville, particularly those closest to the operational port areas, are generally already in a modified condition as ascribed by Draft Queensland Water Quality Objectives category for most of Cleveland Bay as 'moderately disturbed'. Construction of the present day port facilities, starting over a hundred years ago, most notably by reclamation of intertidal and dredging of subtidal areas, has resulted in alteration to benthic habitat patterns at the mouth of Ross Creek and Ross River. Furthermore, ongoing port related pressures may continue to affect the environmental values of nearshore seabeds, including from maintenance dredging of berths and channels, and general disturbances from sediment mobilisation and wash from day to day vessel movements. The port facilities are situated between the mouths of Ross Creek and Ross River, which deliver freshwater flows and inputs of sediments and contaminants derived from human activities in the catchments (i.e. urban development, agricultural and industrial land uses from the Ross coastal plain and Burdekin-Haughton complex). Typical inputs were previously characterised in Section 24.3.3.1.

The state and condition of Cleveland Bay is already slightly modified because of population pressures (boating and fishing), catchment runoff (loading sediments and contaminants from developed catchments) and climate-induced species effects (from sea temperature, acidity and sea level changes). Yet coastal development and port operations collectively play a role in coastal catchment areas concentrated around ports. GBRMPA (2009) goes further to explain these processes:

> *There are concerns about aspects of the ecosystem's health. Sea temperature, sea level and sedimentation are all expected to increase because of climate change and catchment runoff, causing deterioration to the ecosystem. At the same time, reductions in some predator and herbivore populations may have already affected ecological processes, although the specific effects remain unknown. Outbreaks of diseases appear to be becoming more frequent and more serious. The vulnerabilities of the ecosystem to climate change, coastal development, catchment runoff and some aspects of fishing mean that recovery of already depleted species and habitats requires the management of many factors. In some instances, the ecosystem's ability to recover from*

disturbances is already being compromised with either reduced population growth or no evidence of recovery. The independent assessment of existing protection and management found that management is most challenging for those topics which are broad in scale (often well beyond the boundaries of the Great Barrier Reef) and complex. For example addressing climate change impacts requires global responses; coastal development and water quality require coordinated actions throughout the catchment. The management of fishing is socially and biophysically complex. Notwithstanding these challenges, many of the management measures employed in the Great Barrier Reef region and beyond are making positive contributions to resilience (as evidenced by recovery of some species and habitats).

Marine ecosystems show resilience in that they can resist or recover from certain disturbances. This resilience depends on site specific processes, which may buffer against disturbances and promote ecological stability and ongoing productivity. Both bottom-up and top-down ecological processes are responsible for patterns in community structure on reefs in marine landscapes (Menge, 2000). For instance, on reefs, recruitment and abundance of algae and corals can upwardly affect grazer and predator abundances. Equally, abundance of grazers and predators can have the top-down effect of altering the cover of algae and invertebrates on the seabed substrate.

Resilience also depends on characteristics of the physical environment, such as bathymetry and currents which influence rates and stability in biological processes. These physical effects typically control functions such as settlement and interaction of terrigenous, organic and biological materials (for example, availability of substrates and recruitment), or aid flushing of pollutants and/or toxicants (for water quality stressors).

Exposure to natural disturbances and features of the nearshore marine environment typically include high insolation, high temperatures, sudden variations in salinity and wave energy, as well as a high degree of land/ocean interactions including terrestrial runoff and sedimentation. One theory is that naturally-disturbed communities may already exist at the limit of their environmental tolerance and may be vulnerable to further disturbances. Repeated weather-induced disturbances may account for ongoing cycles typical of local seagrass types, waxing and waning in extent and biomass including reductions after unfavourable seasons such as cyclones, floods with sediment inflow and / or bayside sediment re-suspension from strong winds. These influences will be more prone to occur due to effects from climate change.

Table B.24.11 summarises trends in recovery of certain habitats and species. The lagoon floor of the Great Barrier Reef is relatively biodiverse with more than 5000 species found in shallow benthic areas. Over the past 40 years, major impacts to the lagoon floor have included trawling and catchment loading of nutrients and pesticides. The observable impacts from trawling have been quantified for a portion of the Region, whereas the effects of broadly degraded water quality are more difficult to identify because of natural variability (GBRMPA, 2009).

Table B.24.11 General Trends in Great Barrier Reef Ecosystem Recovery after Disturbance (GBRMPA, 2009)

Assessment Component	Summary Of Evidence Of Recovery	Level of Impact			
		Very Low	Low	High	Very High
Coral reef habitats	Coral reef habitats are recovering from multiple short-term disturbances. Predicted increases in frequency and severity of disturbances will likely reduce the capacity for coral reefs to recover.		√		
Lagoon floor habitats	Some lagoon floor habitats previously at risk are recovering from disturbances. Full recovery will take decades.		√		
Loggerhead turtles	Trawl turtle excludes devices have arrested the decline in loggerhead turtles but other pressures will influence their recovery.			√	
Urban coast dugongs	The urban coast dugong population may take more than a century to recover and is subject to many continuing pressures.				√
Humpback whales	Humpback whales appear to be recovering at their maximum population growth rate 45 years after whaling stopped.	√			

The resilience of an ecosystem – its ability to recover through space and time from disturbances - is also influenced by other natural supporting characteristics, such as intactness/integrity, connectivity and function which provides for recovery through recruitment and functional redundancy.

- Intactness

  ‘Intactness’ assesses whether ecological communities have retained their historically natural composition. It is a good indicator of biological balance in ecological systems.

  The coast of the high nutrients coastal strip bioregion is settled and developed by humans and the inshore waters are ‘moderately disturbed’ (DEHP, 2012a). These waters have a propensity for sediment accumulation including for particles of small, partly ‘unnatural’ size fractions, physically prone to ready mobilisation and re-suspension. The situation presents a risk to marine ecosystem resilience, as flora and fauna populations may become isolated, and the current low population sizes can increase the risk of extinctions (Harris, 1984; Soule, 1987). Information generally indicates that there has been widespread regional change over time, and the presence of substantial human influence makes it likely that the changes will be persistent.

- Connectivity

  ‘Connectivity’ is used to describe the links between habitats, communities, species and functional processes at multiple spatial and temporal scales (Noss, 1991). Linkages across distances and areas (spatial) and in time (temporal) have consequences on the growth, survival and distribution of marine species.

  Understanding connectivity is important when assessing the potential for marine ecosystems to recover from disturbances. Lack of connectivity among populations of a species also constrains genetic divergence. This means that, depending on connectivity, species can recover from disturbances (where it is high) or, if they have substantially diverged with limited connectivity, they may suffer localised extinction. Cleveland Bay is a large semi-circular Bay with wind fetch, wave transmission and sediment transport over large distances providing physical pathways. Connectivity of animal and plant populations is rated as strong for biota ranging from the plankton to vertebrates. This feature may account for ongoing, widespread growth and senescence cycles of the seagrasses during favourable growth seasons where they may recruit from other undisturbed Bay environs.

- Function

  This pertains to productivity and inter-related connections of the food-web and also natural functioning of an ecosystem’s physical, chemical and ecological processes that result in a resilient ecosystem that absorbs stress and rebuild after disturbances. For example, coral recruitment is likely to be strong on reefs with intact herbivore populations because the ecological equilibrium between corals and algae is largely determined by the ecological process of herbivory. Fecundity rates may increase in response to stress. Ecosystem function may be compromised if an activity reduces the capability of an ecosystem to support and maintain key ecological processes and organism abundance, so that the species composition and functional organisations it supports are as comparable as possible to those occurring in natural habitats in the region.

  The stressors contemporarily at play in compartments of the nearshore Cleveland Bay may mean its function is sub-optimal, as it is modified and lacks functional redundancy, although connectivity exists.

B.24.6.2 Cumulative Effects and Their Relationship with Ecosystem Resilience

Key elements of the Great Barrier Reef’s ecosystem function and resilience are depicted in the diagram (Figure B.24.9) from GBRMPA (2009). It summarises typical physical and biological processes that have major influences of ambient conditions. The overall health of the ecosystem requires all aspects to be in good condition and in balance for a high level of resilience to provide functional redundancy when additional pressure is applied such as by coastal development.

Not all pressures or stressors act equally in all marine situations. GBRMPA (2009) specifically listed stressors that result in declines in biodiversity, biomass and species that play key Great Barrier Reef ecological roles have been mainly due to:

- direct use of the marine ecosystem

- land management practices in the catchments
- declining environmental variables because of climate change.

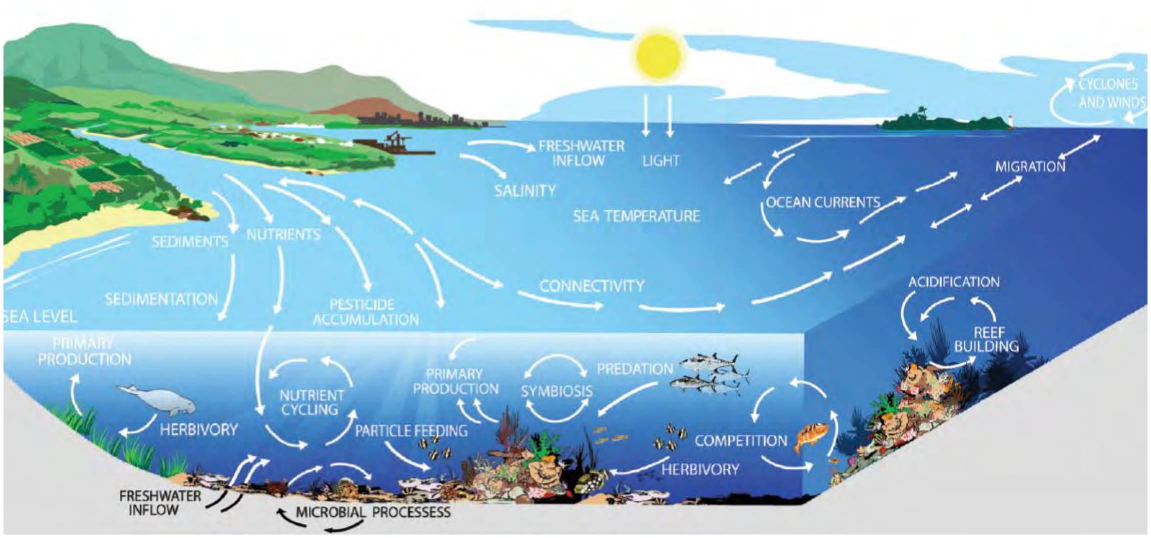


Figure B.24.9 GBR Ecosystem Functions (GBRMPA, 2009)

Nearshore Cleveland Bay environs have a relatively high exposure to both natural and man-made disturbances including fluctuating insolation rates, sediment loads, bed stress, wave energy as well as extractive pressures (such as fishing) and catchment sediment discharges. Yet ports and coastal developments have a contribution, especially where it relates to the temporary re-suspension of marine sediments and potential loss of benthic habitat. An interpretation of cumulative effects on Cleveland Bay ecosystem resilience is given in Table B.24.12.

The resilience of specific values and qualities such as benthos, coral and seagrass health as described specifically in Chapter B.6 on marine ecology. Timing of dredging, dredging mitigations, reactive monitoring findings and offsets package elements aim to collectively build resilience to the range of cumulative impacts from PEP and other projects.

Table B.24.12 Summary of Key Resilience Characteristics in Cleveland Bay

Ecosystem Resilience Characteristics	Summary of Current Status	Comments on Ross River Coastal Plain and Cleveland Bay Resilience
Intactness	Cyclones and severe weather events remobilise entrained catchment sediments. These episodically stress natural marine populations, benthic communities and habitats especially in high energy inshore waters such as Cleveland Bay. Few natural communities other than those in the southern and eastern fringes of the Bay probably remain intact.	The staging and conduct of the set of developments requires careful environmental health monitoring and post development assessment on potential incremental cumulative effects. Consideration must also be given to the occurrence of cyclones that disturb and depress natural resilience of biota and communities in nearshore waters.
Connectivity	Cleveland Bay is a large semi-circular Bay with wind fetch, wave transmission and sediment transport over large distances by physical pathways. Connectivity of animal and plant populations using the Bay is rated as strong for biota ranging from plankton to vertebrates.	Development does not sever connectivity between Halifax Bay to the north and southern and eastern parts of Cleveland Bay. Natural bay-wide water circulation and vertebrate movement patterns would not be impeded by port and coastal developments. At the littoral zone interface, migratory birds are known to move through the coastal plain to long term foraging and roosting sites.

Ecosystem Resilience Characteristics	Summary of Current Status	Comments on Ross River Coastal Plain and Cleveland Bay Resilience
Function	Various stressors contemporarily at play may mean nearshore Cleveland Bay function is sub-optimal, as it has relatively low benthic diversity, variable water and sediment quality, and modified from its undeveloped state.	Past port and coastal catchment development (including runoff) has contributed to modified marine conditions. Future development in the Ross coastal plain will concentrate use in an inshore GBR bioregion (NA3) and Cleveland Bay known to be 'moderately disturbed', so avoiding coastal expansion elsewhere.

B.24.7 Proposed Management of Regional Pressures and Cumulative Impacts on Great Barrier Reef

The management of risks and effects arising from PEP not only has to be considered within the context of other regional projects but also should be cognisant of the magnitude and extent of other types of environmental pressures and ecological impacts.

B.24.7.1 Port and Coastal Developments of the Ross Coastal Plain

GBRMPA (2009) describes the views of key stakeholder groups which reinforces scientific evidence on threats and pressures to the Great Barrier Reef (Table B.24.13).

Table B.24.13 Community Views on Threats Facing the Great Barrier Reef Ecosystem (GBRMPA, 2009)

Community group	Ranking of perceived risk					
	First	Second	Third	Fourth	Fifth	Sixth
Queensland community	Climate change	Rural and agricultural development and catchment runoff	Fishing pressure	Urban and industrial development and runoff	Too many tourists	Introduction of exotic pests and diseases
Scientific community	Climate change	Rural and agricultural development and catchment runoff	Urban and industrial development and runoff	Fishing pressure	Governance and resources	Broad global and national issues
Local marine advisory committees	Climate change	Rural and agricultural development and catchment runoff	Urban and industrial development and runoff	Governance and resources	Fishing pressure	Introduction of exotic pests and diseases
Reef advisory committees	Climate change	Governance and resources	Rural and agricultural development and catchment runoff	Community awareness	Fishing pressure	Boating and recreation

Stakeholders represented in Table B.24.13 expressed quite similar views on the most serious threats to the Great Barrier Reef ecosystem. Of primary concern were climate change, rural and agricultural development and catchment runoff, urban and industrial development and runoff, and fishing pressure. Interestingly, urban and industrial development and runoff – which includes port activity – was rated third to fourth in rank of the top six threats.

A summary of the actions proposed to be implemented in response to cumulative pressures arising from port and coastal development of the Ross coastal plain is outlined in Table B.24.14.

Table B.24.14 Summary of Key Controlling Factors for Management of Cumulative Impacts

Controlling Factor	Controlling Influences and Management	Actions to Broadly Address Risks of Cumulative Impacts	Actionee
Mitigation measures	Construction and Operational management plans	Project site management plans provide mitigations to specific development aspects during landside and berth construction and operations.	POTL; Developers
	Dredge management plan	Sediment re-suspension is a repeated bayside event driven by natural forces but also influenced by berth, harbour and shipping channel developments and sediment placement. Dredge management plans will not prevent this effect, but they will provide ways to minimise the effect from specific development campaigns. The cumulative residual impact may be from the sequence of repeated sediment mobilisation events from natural causes and development, as a worst case in a short time period (less than three years).	POTL
	Maritime operations management plan; Vessel management plan (Construction)	These plans account for typical operating conditions for vessel operations and a strategy for shipping to and from Port of Townsville to maintain its excellent safety and marine transport record. The risk of unplanned events cannot be eliminated, but there is little residual cumulative risk evident.	POTL; Maritime Safety Queensland, GBRMPA, Biosecurity Qld; Australian Maritime Safety Authority
Staging and sequencing	Weather events and cyclones	Weather related catchment runoff and wind-wave sediment re-suspension may cause inshore water decline of benthic habitat, reduced productivity that is beyond the control of port and coastal developers of the Ross River complex. Climate change will exacerbate the effect of sediment re-mobilisation and ecosystems may not be 'reactivated' through resilience.	All resource managers; Developers
	Periods for recovery between projects and weather events	Condition of marine ecosystem health and its status and /or 'recovery' ability would be re-evaluated after the passage of time (including weather and Project effects), so the period of time between construction stages enables 'recovery' and the occurrence of natural events would be important too. The interaction between ecosystem condition, resilience and Project development may result in development delays because of the cumulative effects or uncertainty induced by poor quality or highly variable information.	All resource managers
Monitoring	Habitat quality assessments	Pressure and receptor monitoring will provide clear and specific information on marine health indicators including those proposed for reactive monitoring in the Dredge Management Plan. Port and coastal developments of the Ross coastal plain are straightforward for impact monitoring in terms of water and sediment quality, benthic ecology and marine vertebrate abundances.	POTL
		Additionally, a framework for information gathering and exchange with government, researchers and industry can address the main pressures relating to catchment runoff, urban development and fishing pressures for more intricate Cleveland Bay ecosystem health determinations.	All resource managers
	Evidence based decision making	Stakeholder commitment to acquire and share empirical data that enables a programme for holistic environmental health assessment. Port and coastal developments contribute to Bay-wide pressures so broad based participation is encouraged.	All resource managers

Controlling Factor	Controlling Influences and Management	Actions to Broadly Address Risks of Cumulative Impacts	Actionee
Operating licences	Open and transparent community engagement	Stakeholder views considered when investing in mitigations and actions to optimise responses to residual cumulative effects. These are explained further in Section B.24.7.2.	All resource managers
	Environmental performance and regulatory compliance	Governments are encouraged to require contributions and actions such as those listed above. Proponents to adopt site specific conditions and monitor effects as part of an adaptive feedback for their own development's performance.	All decision making authorities All developers

What is evident is that there is opportunity to address 'gaps' in responding to management the dominant contributory pressures on Cleveland Bay's marine ecosystem health, including from stressors other than port and coastal development. In fact, the dominant regional contributory human influences on the Great Barrier Reef in relation to Cleveland Bay are:

- rural and agricultural catchment development and its runoff
- urban development and its catchment runoff
- fishing pressure from recreational and commercial activities
- growing levels of recreational boating (GBRMPA, 2009).

The port and coastal developments of the Ross coastal plain form only part of that wide mosaic of contributing factors, even in the setting of Cleveland Bay, where other threats also exist - arguably to a greater extent - because of climate change and urban catchment runoff characteristics of the Ross River floodplain.

Against the backdrop of various marine pressures and stressors, an effective target would be of those that are most prevalent – such as those listed – especially where action is taken collectively and collaboratively with the support of other parties, community and government stakeholders.

B.24.7.2 Holistic Marine Resource Management

Specific design allowances, mitigation measures, plans, actions, adaptive management (inspired by conservatively derived monitoring triggers), offsets and regulation collectively provide a comprehensive series of relevant responses to potential Project specific risks and impacts.

Each past recent and likely future approval will require these to be implemented as essential development and operating requirements contemporarily made for development approvals. The opportunity now is to optimise both:

- the way that the series of Project commitments inter-relate to each other for an integrated and unified approach to Cleveland Bay marine resource management
- the benefit that is derived long term in relation to the state of health of Cleveland Bay's Great Barrier Reef environment.

It is no longer adequate not to adopt and implement a management response to an ecosystem stressor, simply because it does not strongly or directly relate to an aspect of the proposal at hand. With that in mind, ports and shipping do not necessarily factor heavily in relation to the key stressors risking broad-scale Great Barrier Reef ecological values and ecosystem function, for the reasons shown above. So it is reasonable that matters of an offsets package, presented in Section 23.2, would:

- specifically, devise a number of elements to meet the offset requirements for irreversible Project related loss and/or reduction in marine environmental values
- yet more broadly:
  - provide a holistic response for better community and stakeholder knowledge and attainment of outcomes, including by enabling practical on-ground actions (inc relation to fisheries, sediment and catchment management);
  - provide a working framework for others to use in the future.

GBRMPA (2009) states that building ecosystem resilience and maintaining marine ecological values by improving water quality, reducing the loss of coastal habitats and increasing knowledge about fishing and its effects, will give the best chance of adapting to and recovering from the serious threats on the Great Barrier Reef, especially from climate change. In that regard, it is POTL's intention to create and support a number of initiatives, presented in an offsets package, which respond to the series of Great Barrier Reef-wide threats in the greater Cleveland Bay coastal and lagoon bioregions.

While environmental offsets are specifically used to replace the value of environmental features irreversibly lost in development that supports a growing economy and population, they are only considered once environmental impacts have first been avoided, then reduced. In this case, they can be used for investment in matters of higher importance or cumulative impact, such as catchment development and runoff and fishing.

In summary, the offsets help to address known main threats to the greater Cleveland Bay region, by:

- directly, facilitating regulation over coastal habitats to protect benthic producers to enhance fish habitat and fisheries values through an extension of the Cleveland Bay Fish Habitat Area (FHA) including:
    - protection of benthic habitat of approximately 1,240 ha, which is very similar to that being removed or modified by marine developments, so FHA extension responds to known cumulative Great Barrier Reef threats by certain types of fishing and promotion of sustainable fisheries by building ecosystem resilience
    - FHA extension area is likely to include marine areas that are used as habitat by inshore dolphin species, as well as areas traversed by dugong and turtles to nearby permanent seagrass meadows in south-eastern Cleveland Bay. It is also likely to include intertidal areas used by foraging migratory birds, so protects and presents greater connectivity
    - an increase of hundreds of hectares of intact open water (due east from the port) to inside a protected area (that is, into the FHA), that currently is outside the protection of the adjacent FHA or GBRMP
    - provides direct connectivity to tidal unallocated state land and the state's biodiversity reserve established as an offset for the TPAR and future development through the EAC
    - a close adjacency to the port and coastal developments of Ross coastal plain which promotes a strong spatial framework for Project governance and environmental performance management for the collectively known and likely future developments.
- indirectly, investing in the management of:
    - threatening processes from wider set of catchments including:
        - on-ground actions to reduce sediment inputs to Cleveland Bay
        - research that seeks to better identify the source of sediments and geological origins in catchments.
    - Cleveland Bay Ecosystem Healthy Monitoring Programme with contributions to:
        - integrated water quality health monitoring
        - seagrass health assessment and seagrass research
        - coral and fish health assessments
        - megafauna survey assessment
        - baitfish schooling for dolphin food resource.

There are a number of other key features of offsets that should be fully considered by referring to Chapter 23. Importantly, key features of the offsets package advocate the findings of GBRMPA (2009), as POTL commits to make positive contributions to build the management and practical knowledge of natural resource resilience in the Great Barrier Reef ecosystem in greater Cleveland Bay.

Port Expansion Project EIS

Part B

Section B25 – Concluding Statement

B.25 Concluding Statement

The Port Expansion Project (PEP) has considerable benefits, not only for the economy and community of Townsville, but also for the North Queensland region, Queensland and Australia. The positive flow-on economic impacts resulting from the Project will support employment in a number of industries and associated service providers, both at the port and further afield in transport and mining sectors. This will lead to positive social benefits, increasing population growth, quality of housing, services and revenue for government to place into public assets.

The PEP was founded from comprehensive master planning for the port and surrounds. It responds to the need for additional berths to accommodate trade increases, as well as allowing for incremental growth of the port over the foreseeable future. The PEP concept design recognises both existing port infrastructure and future port activities. It would facilitate the development of port components, while allowing spatial and capacity requirements of cargo handling facilities, road, rail and shipping to facilitate the future throughput of goods and trade. Significant port operations relate to shipping, road and rail, while the above-wharf development of cargo handling facilities would be by the port's as-yet-unidentified tenants who would lease POTL land and berth facilities.

The PEP encompasses:

- development of a new harbour (the outer harbour) enclosed in a new breakwater (north-eastern breakwater) and land perimeter revetments
- dredging to deepen the bathymetry of existing channel alignments, together with minor channel widening near the outer harbour entrance
- construction of a new reclamation to the north-east of the existing port area based on re-use of over 4 million m^3 of dredged material, faced by port infrastructure including new wharves and backing land.

The PEP has been declared a 'significant project' under the *State Development and Public Works Organisation Act 1971*. The location of the PEP in the Great Barrier Reef World Heritage Area and its relationship with other matters of national environmental significance under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* led to the Project being determined a 'controlled action' by the Minister for Sustainability, Environment, Water, Population and Communities.

As a result of these decisions, the PEP Environmental Impact Statement (EIS) has been prepared to address two separate regulatory requirements required by the state and Commonwealth governments being:

- Coordinator-General's *Townsville Port Expansion Project: Terms of Reference for an environmental impact statement* (Terms of Reference) (Appendix A1).
- Department of Sustainability, Environment, Water, Population and Communities and the Great Barrier Reef Marine Park Authority *Guidelines for an Environmental Impact Statement for the Port of Townsville Port Expansion Project, Queensland (EPBC 2011/5979/GBRMPA G34429.1)* (EIS Guidelines) (Appendix A2).

The EIS has investigated potential environmental impacts including social, economic and cultural effects that could result from the construction and operation of the PEP. Detailed consideration has been given to the need for alternatives to the Project. Literature reviews, database searches, baseline site surveys and original marine and atmospheric numerical models and calculations provide quantification and context to the assessment of impacts and identification of relevant mitigation and management measures.

Based on analysis and assessment, a range of potential impacts from the PEP were identified in Part B of the EIS. For the most part, these can be managed through the adoption of recommended mitigation measures and monitoring. Key environmental factors include marine ecology and water quality; noise; air quality; land use and scenic amenity; transport and social matters.

Construction and operational impacts, including potential cumulative impacts, have been identified for specific biophysical, socio-economic and cultural factors. Relevant mitigation and management strategies are described in a series of management plans in Part C of the EIS. These have been put forward, in response to Terms of Reference and EIS Guideline stipulations, having assessed the likelihood and consequences of the set of development aspects and potential impacts. A detailed set of mitigation measures have been formulated and compiled into succinct outcome-based environmental management plans to guide implementation, monitoring and corrective actions throughout the construction and operation of the PEP.

Potential indirect effects such as on coral health on Magnetic Island fringing reefs and marine megafauna, such as dolphins, dugongs and turtles, will be managed in frequency, extent and magnitude through the adoption of mitigations that reduce the effect of noise, vessel activity and re-suspended sediments in turbid plumes in the open expanses of Cleveland Bay. In particular, a detailed Dredge Management Plan and reactive monitoring program are proposed to ensure effects from dredging on marine habitat areas are detected and managed to avoid long-term impacts.

Due to PEP's maritime setting, few landside biophysical effects would eventuate. There is no evidence, after consideration of potential risks, that matters such as migratory birds and acid sulfate soils would be significantly affected.

Air and noise effects would arise during the PEP's construction phases. Monitoring systems and predictive tools will enable adaptive management of landside development activities. This would both control the emission levels and manage potential exposures at sensitive locations. Further environmental assessments will precede industrial port side development through the *Sustainable Planning Act 2009* and other approval mechanisms. When the nature of potential emissions associated with the series of potential trade products is known, detailed analysis and validation will be given to those derived developments.

An overall assessment has been made in relation to risks of cumulative impact on significant factors and values. In particular, for matters of national environmental significance, it is concluded that effects from ports and shipping play only a modest part in the context of cumulative impacts on Great Barrier Reef values. The assessment has concluded that there are no significant cumulative impacts on the Great Barrier Reef World Heritage Area and other matters of national environmental significance.

Certain detailed mitigation and monitoring programs are also proposed to be undertaken either preceding or alongside the PEP construction; in order to contemporarily characterise the existing natural condition, verify predicted effects and to provide information on the longer-term condition of key factors of Cleveland Bay's coastal environment. Monitoring programs to be adopted include (but are not limited to):

- marine water quality monitoring
- marine habitats and megafauna monitoring
- noise monitoring
- air quality monitoring (ambient, construction phase and operational phase).

Residual impacts that require consideration of an offsets package include effects on the seabed of Cleveland Bay. These impacts relate to the permanent reduction in the seabed area inhabited by soft bottom benthos and a temporary reduction in the occurrence of the same benthos types on seabed that would be disturbed by shipping channel augmentation.

Specifically, the following can be concluded about key factors in relation to PEP development.

Marine Environment

Effects on marine and coastal biological, ecological and physical values can be considered in relation to matters of national environmental significance.

World Heritage and National Heritage

PEP is situated entirely within the Great Barrier Reef (GBR), which is both a World Heritage property and National Heritage place. Key impacts (as outlined above) relate to the irreversible loss of marine soft sediment habitat due to PEP reclamation. Temporary impacts may occur to other benthos as a result of the short dredging campaigns. Noise generated by maritime activities such as piling and construction is also likely to result in temporary effects on marine fauna. As evidenced by information assessed in Part B of the EIS, the contribution from ports and shipping is relatively concentrated and generally less, overall, on world heritage values when compared to the collective effect of threats facing the Great Barrier Reef including climate change, runoff from rural, urban and coastal catchment development, fishing and boating.

Adverse short term impacts to ecological values would be expected to occur at localised spatial scales (measured in hundreds of metres in the vicinity of the construction/dredging footprints) and, with the exception of reclamation, expected to occur only in the short to medium term (measured in months to years). A wide range of mitigation measures and strategies would be adopted to reduce harm to marine ecological values supported by the Great Barrier Reef in the Cleveland Bay setting.

The most important designated natural landscape is the GBR and both the construction and operational activities of the PEP change its scenic values of natural views. The construction and operational activities associated with PEP would be viewed in the context of existing industry and shipping. Great Barrier Reef views are already affected by the existing development which consequently lowers the magnitude of perceived change and is only a small part of the GBR landscape. Its broader scenic values would be maintained beyond Cleveland Bay. PEP development and infrastructure is entirely consistent with port development, first installed on nearby coastline almost 150 years before now.

Residual impacts in the marine environment would be met with a series of elements in an offsets package. This relates to the permanent reduction in the seabed area inhabited by soft bottom benthos and a temporary reduction in that benthos' occurrence that would be disturbed by shipping channel deepening. Other than at those localised spatial scales, PEP is not expected to result in the loss of or have major impacts on any of the environmental values that contribute to the 'outstanding universal value' of the GBRWHA. In relation to the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DEWHA, 2009), PEP would not result in world heritage values being lost, degraded or damaged; or notably altered, modified, obscured or diminished.

Wetlands of International Importance

PEP is located 9 km from the Bowling Green Bay Ramsar listed wetland, which would not be directly affected by the Project. Indirect effects from turbid plumes generated by the Project, due to the dominant winds and currents, would not be likely to occur into southern Cleveland Bay waters nor near the Ramsar site. Even in unusual wind conditions, modelling predicted minimal movement of dredging 'plumes' to the east and south from the channel alignment. Given this, PEP is unlikely to affect populations of marine fauna that inhabit the broad Cleveland Bay region, which inter-connects with parts of the Ramsar site.

Threatened and Migratory Species including birds

Cleveland Bay supports habitats for migratory or transient threatened or protected marine fauna including whales, dugongs, dolphins and marine turtles. These animals have different likelihoods of occurring throughout the bay and within the Project area. The species with the highest likelihood in the Project area are green turtles (*Chelonia mydas*). Loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*) and flatback turtles (*Natator depressus*) are not common in Cleveland Bay inshore waters (GHD, 2008a; GHD, 2011). Two dolphin species are relatively common in and adjacent to the PEP footprint and the nearshore environments throughout Cleveland Bay: Australian snubfin dolphin (*Orcaella heinsohni*) and Indo-Pacific humpback dolphin (*Sousa chinensis*) (GHD, 2011). These two dolphin species are likely to feed near port areas (including over the PEP seabed) as both species have feeding and nursing areas in and around Ross River.

Most other listed marine species tend to favour offshore waters (e.g. whales, turtles), and could potentially occur at the Dredge Material Placement Area from time to time. Humpback whales (*Megaptera novaeangliae*) have been observed in the waters of Cleveland Bay (October to January) as they undertake their annual migration.

Dugongs (*Dugong dugon*) are relatively abundant in Cleveland Bay, particularly over the seagrass meadows nearest Cape Cleveland. They occur throughout Cleveland Bay as they move between seagrass meadows in and outside the bay. As there is no seagrass in PEP areas and sparse sporadic seagrasses at the DMPA and adjacent to dredged channels, it is most likely that dugongs only pass through these Project areas.

For migratory birds, recent studies by NRA (2012) showed that sooty oystercatcher (*Haematopus fuliginosus*), among other species, use existing breakwaters and revetments for roosting and other migratory birds use the eastern reclamation area from time to time for foraging. No significant adverse impacts are expected to arise on bird populations. In the years soon after its development and through its staged completion, the PEP reclaim areas are likely to enhance opportunistic foraging in emplaced marine sediments and roosting along greater lengths of breakwater and revetments.

An increase in vessel traffic during port construction increases the probability for megafauna interactions, particularly green turtles, or the potential avoidance by some mobile species such as the dolphins. A Vessel Traffic Management Plan (Construction) will be implemented for construction plant used for PEP works, which will include strategies such as speed limits, fauna spotters and other strategies to avoid interactions with megafauna.

By 2025, cargo ship numbers to the Port of Townsville are projected to increase to just over 1,000 per annum from the current base of 675 per annum which equates to the current average rate of 2 ships per day increasing to an average of less than four 4 ships per day by 2040. Increased ship movements would also increase the probability for interaction with megafauna although, by virtue of the small incremental change in shipping numbers, only very marginally. In the context of its role and responsibilities within Port Limits, POTL intends to implement the Maritime Operations Management Plan which outlines measures that should be adopted by ships entering the port.

Great Barrier Reef Marine Park and Commonwealth Marine Area

PEP is largely located outside the Great Barrier Reef Marine Park (GBRMP); however, the existing Sea Channel (adjacent to Bremner Point) intersects the GBRMP in an area zoned as Habitat Protection. The deepening of the Sea Channel will extend into the GBRMP General Use Zone. After dredging and a direct impact from disturbance, no major changes to the functional or biodiversity values presently supported in this portion of the Sea Channel are predicted.

Based on the implementation of appropriate mitigation strategies, the Project will not have a significant impact on the GBRMP when assessed against the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DEWHA, 2009).

Social and Built Environment

Stakeholders and respondents through feedback after surveys generally believed that the PEP would potentially have mixed effects with positive impacts on the local economy and employment opportunities, neutral impacts on lifestyle and community aspects, and negative impacts on the environment. The two main potential environmental impacts noted in feedback were noise and dust. Other community concerns raised included the impacts on roads and rail, the potential increase in traffic, products to be transported through the Port and the potential impacts on the Great Barrier Reef. Consideration of these community concerns is reflected throughout this EIS with attention paid to those factors of most concern in order to minimise potential impacts from PEP through its assessment and identification of mitigation measures.

Further stakeholder engagement would inform people about the status of PEP assessment, timetables for construction works, environmental management practices, further approvals including legislative and statutory requirements affecting decision making, safety, workforce participation opportunities and opportunities for businesses and residents.

PEP will result in the extension of the existing port boundary, approximately one kilometre northwards from the mainland, through reclamation of subtidal land forming a prominent peninsular. Cleveland Bay itself provides visual containment of the port from the wider maritime landscape through two key headlands (Cape Pallarenda in the west and Cape Cleveland in the east). Construction and operations are likely to affect several near and distance ‘receptor’ groups and the scenic values associated with the World Heritage Area designation of Cleveland Bay.

Landside, in line with DTMR’s intention to manage non-port related traffic on the Townsville Port Access Road (TPAR), road network options would be considered in detail during the ensuing design phase. Upon completion, TPAR will link Flinders and Bruce Highways directly to the Port of Townsville to provide more direct access to the port from the west and south, as well as reducing heavy vehicle traffic on the local road network and residential areas of Townsville. TPAR will provide the long-term strategic highway connection to the Port of Townsville; providing direct access to the port from the west and south, as well as reduce heavy vehicle traffic in residential areas to the south.

The adjoining port land has been highly modified through previous dredging and reclamation activities over decades, therefore the risk of disturbing or destroying items of indigenous cultural significance is low. Also, it is very unlikely that any place or site of non-indigenous heritage significance would be directly affected during the construction or operational phases, however appropriate controls are identified in management plans.

Shipping movements into Port of Townsville by third party vessel owners and masters are regulated by state and national legislation and regulations and international codes, and that activity would be complemented by POTL's vessel and maritime plans presented in Part C of the EIS.

Conclusion

Townsville is located in Queensland's Northern Economic Triangle supporting the local, regional and state economy where the port must ensure capacity meets demand to provide Queensland producers and industries with access to international markets. The economy of Townsville performs well, shows strong population growth, enjoys incomes on par with Queensland and is well-diversified. The main competitive advantage of this region and particularly Townsville, as the main urban centre in the Northern Economic Triangle, lies in its skilled population, diversified and growing economy and existing infrastructure linking major resource centres in North West Queensland.

Given the pivotal nature of the development, POTL, as a port authority under the *Transport Infrastructure Act 1994*, will continue to be responsible for a progressive expansion of existing port infrastructure and operations. PEP operations would be conducted using established road and rail networks and shipping channels. In addition, road and rail as part of the Eastern Access Corridor (EAC) will also service the PEP as they come online, accounting for PEP planning and design with broader port operations.

For key factors and aspects, controls and mitigation measures are summarised in **Error! Reference source not found.**Chapter B23 showing clear means to address potential effects on Cleveland Bay, the Great Barrier Reef and the broader Townsville community.

In conclusion, the EIS shows that development and operational requirements for Port Expansion Project described in Part A would be managed through the adoption of the stated requirements, as detailed and summarised in Part B chapters and management plans in Part C of this EIS.

Port Expansion Project EIS

Part C

Section C1 – Overview of Environmental Management

AECOM BMT WBM

(C1) Overview of Environmental Management

This chapter describes the environmental management framework that has been developed to manage the potential environmental effects and risks associated with the Port Expansion Project (PEP). A robust environmental management framework is a pivotal feature of the EIS.

(C1)1.0 Framework for PEP Performance Assessment

Port of Townsville Limited (POTL) aims to achieve high standards of environmental performance for port operations. To achieve this, environmental management initiatives are incorporated into the overall management of port operations and are an integral part of port development considerations. To help achieve high performance standards for the PEP, a framework for performance assessment has been developed.

Previous chapters in this EIS identified the predicted effects and risk events for the PEP and outlined management and mitigation measures that would be undertaken during the construction and operational phases of the Project. Where possible and practicable, environmental risks and effects have been designed out of the PEP and management and mitigation measures have been built into the Project design process. Management measures to reduce the impact on the environment are described in Chapter B23 (Summary of Key Risks, Impacts and Mitigations).

Consideration of environmental impacts resulted in:

- selection of best practice dredge timing and methods, including a dredging strategy responsive to ecological and social issues
- identification of best practice management methods for port construction
- identification of predicted effects and risk events that warrant management or mitigation through environmental controls, or other processes.

A framework has been developed to deliver the successful implementation of management and mitigation measures, and appropriate monitoring and assessment of onsite environmental management. The intent of the framework is to achieve successful whole-of-project environmental performance.

This approach starts with POTL's Environmental Policy and commitment to manage activities with concern for people and the environment (outlined in Section (C1)1.1). The policy sets the framework for POTL's environmental management system (EMS), and forms the basis upon which the PEP's environmental objectives have been determined.

The EMS outlines the environmental management principles and practices that will be implemented during PEP construction and operations (outlined in Section (C1)1.2). Works conducted by POTL and in the common areas must comply with POTL's EMS.

To deliver on commitments in the EMS, and to confirm that the commitments in the EIS are implemented during construction and operation, guidance Environmental Management Plans (EMPs) have been prepared. The EMPs are the conduit by which the EIS management and mitigation measures are translated into onsite actions. The EMPs identify the environmental areas of concern from the EIS, and provide strategy and actions to manage potential environmental risks. From this the Contactor develops detailed activity specific EMPs which further apply environmental practices to onsite construction. (EMPs are outlined in Section (C1)1.3).

To deliver on of the EMP actions, a series of system procedures (such as risk management, training, auditing, and management review) and site specific operational procedures will be developed by either contractors during the construction phase, and POTL, and POTL tenants through the development and operational phases.

POTL's Environmental Policy and EMS, the PEP and Contractor EMPs, and the site procedures, collectively form the environmental management framework for the Project. The framework is illustrated in Figure 1 below. The diagram also shows the sequence of progression as PEP moves into construction.

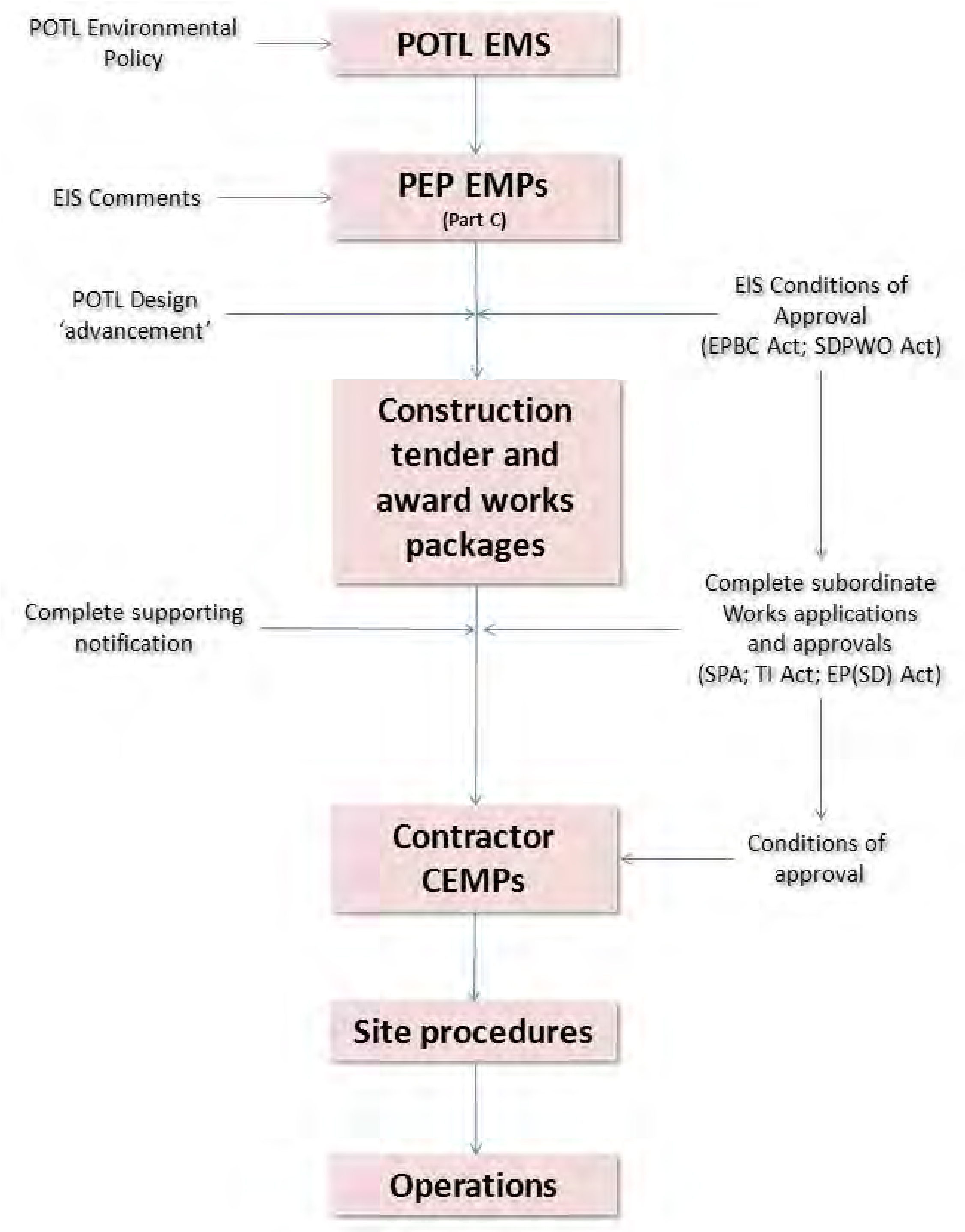


Figure 1 Progression of planning and execution stages for environmental management outcomes

POTL has identified environmental performance as a key result area for the organisation and the Port as a whole. POTL is committed to protecting the environment for a sustainable future. Performance assessment for the PEP will be achieved through the identification of environmental objectives which are included in the EMPs.

To assess onsite environmental performance, check that the management and mitigation measures are appropriate and the environmental outcomes are being achieved. Objectives will be checked and tracked through regular onsite monitoring and reporting, initially by the construction contractor and then by POTL (for POTL controlled and common areas) during operations. If performance objectives are not being met, corrective actions will be undertaken so the Project can be delivered with no greater than the residual predicted effects and risks set out in the EIS.

In addition to being a mechanism to monitor and manage performance, the EMPs are also a key mechanism to manage contractual compliance with environmental management practices. The Contractors' EMPs detail their environmental management commitments (consistent with the PEP commitments), and are to be embedded in the contractual engagement of the Contractor.

Before work can commence on the PEP, further (subordinate) approvals and/or permits must be obtained. A list of subordinate approvals that must be obtained for the PEP is provided in Section (C1)2.1. There is also a legal requirement for notification and liaison with some authorities and stakeholders prior to undertaking certain PEP activities. The notifications required to be made are detailed at Section (C1)2.2. The additional approvals/ permits and notifications may result in further environmental requirements being applied to the PEP. The Contractor must comply with these requirements. Management actions resulting from the subordinate approvals and notifications will be incorporated into the Contractors EMPs.

An outline of POTL's environmental policy, EMS and EMPs is provided below.

(C1)1.1 Environmental Policy

POTL Environmental Policy applies to POTL lands, including the common user areas of the Port of Townsville. It is:

- displayed at prominent locations in the workplace of POTL employees;
- communicated to POTL employees during induction and training;
- located on POTL website for viewing by the public, and
- reviewed regularly.

POTL personnel, contractors and visitors must comply with the spirit and intent of the policy. POTL's Environmental Policy (POTL, 2011a) states:

> *Port of Townsville Limited (the Corporation) and its senior management are committed to the protection of the environment and considers it as critical corporate value in the delivery and maintenance of port infrastructure and services and in planning for the future development of the Port of Townsville and Port of Lucinda.*
>
> *The Corporation is committed to sustainable development and operation through responsible environmental management and continual improvement of environmental performance and the effectiveness of its Environmental Management System.*
>
> *To achieve corporate performance consistent with this policy, the Corporation will employ the following principles:*
>
> - *Integrate environmental considerations into decision making and work practices related to the Corporation's core functions.*
> - *Maintain a high level of environmental awareness throughout the Corporation and the wider port community.*
> - *Implement systems which act to minimise the risk of environmental harm through the identification, reporting, assessment, monitoring and control of environmental risks.*
> - *Establish a framework for setting and reviewing environmental objectives and targets and measuring the Corporation's performance.*
> - *Establish and maintain systems for assessing the environmental impacts associated with the Corporation's activities, identifying and acting on opportunities for improvement.*
> - *Compliance with all relevant legislation, codes of practice and standards.*

- *Core functions to be conducted in a manner that will minimise waste, prevent pollution, promote efficient use of resources, reduce environmental impacts, and continually improve environmental and management system performance.*
- *Providing adequate resources including finances, to facilitate the fulfilment of the Corporation's environmental responsibilities.*

Senior Management is responsible for providing the leadership to support the development and implementation of this Policy and for ensuring it is effectively applied.

This policy will be regularly reviewed following legislative or organisational changes, or as a minimum, every three years.

(C1)1.2 Environmental Management System

POTL's EMS provides a framework for environmental management at the Port of Townsville. The certified EMS is integrated with POTL's quality, occupational health and safety, and Information Security Management System ISO27001 (ISMS) systems to deliver effective management of the Port.

The EMS consists of the policies, plans, procedures and activities that together form a systematic method of managing the predicted effects and risk events in regards to current operational risks.

POTL takes a proactive approach to environmental protection of the port by ensuring sustainable environmental management is a core component of port operations and development. The EMS identifies key objectives to be achieved with regard to environmental performance throughout the port in relation to POTLs activities only.

POTL's EMS is certified and compliant with AS/NZS ISO 14001 2004 and aims to facilitate the continual improvement of environmental performance by:

- Integrating environmental considerations into decision making and work practices related to the Corporation's core functions;
- Maintaining a high level of environmental awareness throughout the Corporation and the wider port Community; and
- Utilising systems which act to reduce the risk of environmental harm through the identification reporting, assessment, monitoring and control of environmental risks.

The EMPs have been prepared to be consistent with POTL's EMS and include the additional elements necessary to satisfy POTL's environmental requirements. Management responsibilities, incident management, emergency responses, non-conformances, environmental training, monitoring, reporting, auditing and complaint handling in the common user areas of the Port of Townsville will be controlled in accordance with POTL's EMS and other integrated management documents.

Continuous improvement of the EMS is a mandatory requirement. As part of the continuous improvement of the EMS, the operational EMPs may be updated or amended as required, which may include being merged with other documents to streamline EMP documentation. Any future amendments will take into account the intent of this document and the conditions of the existing approvals and legislation applicable at the time of review.

(C1)1.3 POTL Environmental Management Plans

EMPs are primarily an implementation phase management measure. They describe the processes for planning, implementing, evaluating and improving the environmental performance of PEP activities and provide direction to detailed procedures.

EMPs have been prepared for the PEP in accordance with the Great Barrier Reef Marine Park Authority (GBRMPA) guidelines for EMPs, Queensland Environment and Heritage Protection *Guideline: Preparing Environmental Impact Statements*, and POTL policies and guidelines.

EMPs have been developed to address the key environmental values highlighted in the EIS and to manage the risks of impacts resulting from the core PEP activities:

- Construction of the breakwater and land perimeter revetments;
- Dredging works for augmentation of channels and development of outer harbour;

- Development of Port land and reclamation;
- Port Infrastructure and ancillary services; and
- Maritime operations.

Each EMP has been prepared as a stand-alone document and details the environmental management measures to be undertaken during these key activities. Table 1 shows the phase of the PEP relevant to each EMP, and whether the EMP covers marine or land issues and this is laid out in Figure 2.

Table 1 Set of inter-related EMPs

	Construction Phase	Operational Phase
Land	▪ PEP Construction EMP (1)	▪ PEP Operational EMP (common port areas) (2) ▪ Tenant EMPs (by others)
Marine	▪ Construction Dredge MP (1) ▪ Vessel Management Plan (1 and 3)	▪ Maritime Operations Management Plan (3)

(1): POTL as principal awarding works to Contractors.
(2): POTL assets and its operational activities.
(3): To the extent it applies to third party vessels.

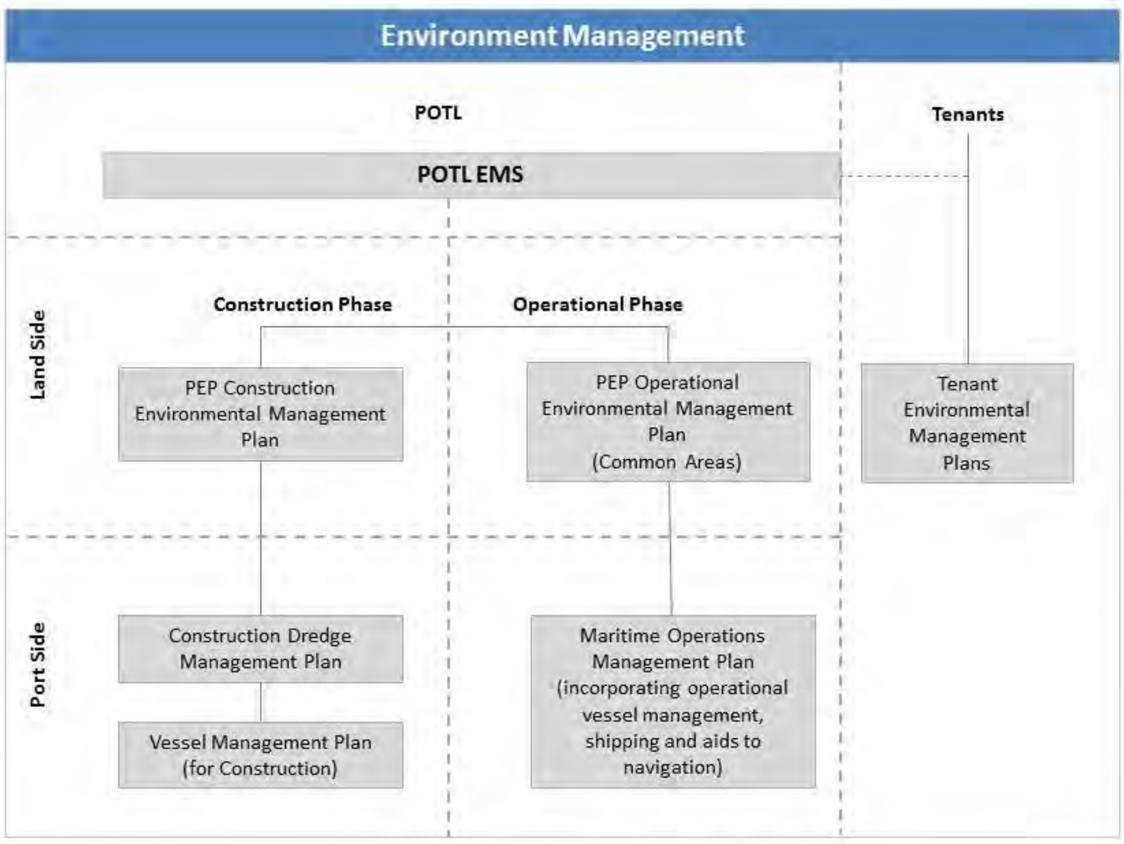


Figure 2 Interaction of set of environmental management plans

In each EMP is a suite of management strategies and mitigation measures to reduce the effects and risks of impact of the PEP on the environment. Together, the EMPs cover PEP activities and operations for the implementation phase of the Project.

Table 2 shows the activities and design elements of the PEP that are covered by each EMP.

Table 2 EMP by PEP Activity / Design Element

EMP	PEP Activity / Design Element
Construction Dredge MP (Refer C2.1)	▪ Preparing the seabed for breakwater and revetments (dredging select soft marine sediments in the bunded reclamation area footprint and beneath the breakwater structure and perimeter revetment structures). ▪ Constructing a new north-eastern rubble mound breakwater with rock armouring approximately one kilometre seaward of the existing eastern breakwater. ▪ Contingent upon detailed analysis, construction of a new western breakwater for additional outer harbour protection. ▪ Dredging marine sediment to deepen and strategically widen existing port access channels. ▪ Dredging marine sediment to extend the Sea Channel seaward. ▪ Placing material from the channel dredging in the existing offshore Dredged Material Placement Area (DPMA). ▪ Dredging in-situ marine sediment to create a new outer harbour basin. ▪ Placement of dredged marine sediment from the outer harbour basin in bunds in tidal waters as part of land reclamation activities. ▪ Placement of sediments unsuitable for land reclamation (due to incompressibility or other poor geotechnical qualities making it unsuitable for use in reclamation) will be placed in the DPMA. ▪ Dredging of berth pockets.
Construction EMP (Refer C2.2)	▪ Dewatering and ground improvement of emplaced sediments used for reclamation. ▪ Development of a reclaimed area on tidal lands eastward of the existing harbour. ▪ Construction of bunds. ▪ Retention of select ponds for the long-term treatment of stormwater. ▪ Application of surface capping layer and pavement layer over land-sourced fill material. ▪ Construction of up to six berths in the outer harbour to support import and export trades and cargo handling requirements. ▪ Development of approximately 100 ha cargo operations area. ▪ Constructing an internal circulation and access roads, and necessary turning areas. ▪ Construction of the rail reserve. ▪ Connection of the rail track to the Eastern Access Corridor and existing rail network. ▪ Possible construction of port administration facilities. ▪ Installation of services infrastructure relating to stormwater, water supply (including for fire fighting), power supply, waste water reticulation and telecommunications. ▪ Provision of port security infrastructure. ▪ Provision of area and road lighting.
Vessel Management Plan (Construction). (Refer C2.3)	▪ Assignment of berth access to multi-purpose berths for certain cargoes and trades. ▪ Refuelling by road tanker (may occur as a requirement vessel operators). ▪ Direction and control of vessel movements with vessels under pilotage (by MSQ).
Maritime Operations Management Plan (Refer C2.4)	▪ Installation of aids to navigation to mark extended Sea Channel dredge extents and navigable basin, relevant to each development stage. ▪ Use of channel beacons (piled channel markers similar to the existing Sea Channel beacons). ▪ Relocation of existing buoys marking the outer harbour basin to mark boundary of expanded extent of the newly dredged basin. ▪ Removal of two existing leads (used to assist vessel turning for Berth 11). ▪ Movement, anchorage and berthing of vessels.
Operational EMP(1) (Refer C2.5)	▪ Site environmental management for POTL operational areas, activities and controlled common areas once the PEP is operational.

(1): The Operational EMP does not address operational (maintenance) dredging. Maintenance dredging will be addressed as part of amendments to the port's existing Long Term Dredge and Dredge Material Disposal Strategy and approvals in place at the time.

The key environmental values and environmental management risks likely to be affected by the PEP were identified in the EIS (specified in Part B). For each value identified, the EMP provides an environmental management strategy to address potential issues.

The management strategy is the delivery mechanism which synthesises the management and mitigation measures established during the environmental impact and risk assessment process and translates them into a set of required performance standards for PEP implementation.

The management strategy for each value has been developed to enable the PEP to be delivered with no greater than the level of residual predicted effects and risk events set out in the EIS, and to enable the management and mitigation measures to be delivered in accordance with applicable legislation and policy. The management strategy for each value in the EMPs follows the structure outlined in Table 3.

Table 3 EMP Management Strategy Structure

Management Strategy Component	Description of EMP Content
Environmental value	The environmental aspect of construction or operations requiring management consideration.
Environmental Performance Objective; Policy	The guiding performance objective that applies to the element.
Management Actions and Strategies	The strategies, tasks or management actions through which the performance objective will be achieved.
Performance Criteria	Requirements and measurable performance criteria sought for each element to be managed.
Monitoring and Reporting	The process of measuring actual performance, or how well the policy has been achieved, including format, timing and responsibility for reporting of the monitoring results, observations and findings.
Corrective Action	The action to be implemented and by whom in the case where a performance requirement is not met.

Each management strategy has stated performance objectives, management actions, performance criteria, and monitoring, reporting, and corrective actions. The management strategy components will play a pivotal role in governing the actual work method undertaken with respect to key PEP tasks. Further detail on some of the components is provided below:

Management Actions

For each environmental value, the management strategy states the management actions required to support achievement of the objective during the implementation of the Project. The assessments in Part B identified the management and mitigation measures that are additional to those that evolved through the Project development process and were incorporated into the Project description. Management and mitigation measures include:

- identifying and implementing environmental controls
- setting performance criteria (a numerical standard) in which the Project must remain
- supporting processes such as communications, training and awareness, and emergency preparedness.

The management or mitigation of a predicted effect or risk event may incorporate a number of the above measures.

A complete list of management controls for each value is contained in the management strategies in the EMP. Implementation of environmental controls will be monitored and evaluated through the monitoring, and reporting stated for each value.

Performance Criteria

Environmental performance criteria were identified in the EIS and establish specific numerical performance standards in which the PEP must remain. The process for assigning performance criteria was based on:

- an examination of the pathway between the Project activity and the environmental or social value or that may be potentially impacted;
- identification of a suitable indicator (this requires an assessment of whether the Project activity, the environmental value or a surrogate can be monitored); and
- an assessment of the practicality of the indicator.

Performance criteria are practicable where:

- the cause-effect pathway between the Project activity and the potential impact is well characterised;
- the Project activity can be directly monitored during project construction;
- the potential impact can be monitored directly, or a surrogate can be monitored;
- the expected change in the indicator is rapid and responsive to project activities; and
- the potential impact can be distinguished from natural variability.

Performance criteria can be set at a number of intervention points ranging from the activity through to the environmental value that may be potentially impacted. The preferred approach is to set the performance criteria at an intervention point where the activity can best be managed through day to day control. The preferred approach must also be practicable as described above.

Compliance with the performance criteria will be evaluated through the management strategy's environmental monitoring program.

Monitoring and Reporting

The purpose of environmental performance monitoring is to measure conformance with, and the effectiveness of, established performance criteria, management actions and processes identified in the EMP. In doing this, opportunities for continual improvement will be identified. PEP environmental performance will be monitored via three mechanisms:

1) Environmental monitoring – monitoring of environmental conditions. Environmental monitoring data informs operations. Management actions that may be adopted if performance criteria are reached or may be reached (as indicated through response levels) are identified in contingency plans.
2) Process monitoring – monitoring of operational activities (e.g. equipment tracking, monitoring of bund and cap construction). Monitoring data informs operations.
3) Management performance monitoring – monitoring of the implementation and effectiveness of the relevant EMP (e.g. nature of complaints, number of corrective actions completed). Monitoring data informs the overall management of the Project. It does not directly inform operational aspects, but may indirectly through the management review process.

The objectives of the PEP environmental monitoring programs are to:

- facilitate management and mitigation of the Project's predicted effects and risk events;
- enable compliance assessment of the Project's implementation; and
- enable improvement of the Project's environmental performance.

Environmental monitoring programs have been established where the predicted effect or risk event is assessed as significant, or there is an established permit limit for an identified risk event or predicted effect that has been identified as being relevant to the Project and, under certain circumstances, could be exceeded. In addition, environmental monitoring data must be able to inform operations in a timely manner and monitoring practicable. The preference is to monitor as close to the source of the effect as practicable (i.e. monitoring where it is specific and sensitive to dredging activities and relevant to the assets being protected).

A graduated process to management is provided through reporting. Reporting provides an early warning to enable management action to be taken in order to remain in the level of risk or predicted effect set out in the EIS.

Corrective Action

Corrective actions have been identified as a contingency. The corrective actions identified in the are not an exhaustive list but tangible responses that the Project will implement if required. The most appropriate action will be selected on a case by case basis.

(C1)1.4 Contractor EMP

Contractor EMPs must be consistent with the PEP EMPs where applicable. All Contactor EMPs will be reviewed and approved during the permit assessment process in place at the time of application for subordinate approvals. Implementation and compliance with the Contractor's Construction EMP will form part of the contractual relationship between POTL and the Construction Contractor.

The implementation of the Contractor CEMP will be monitored during the Project by POTL to manage contractual compliance.

(C1)2.0 Subordinate and Associated Works Approvals

(C1)2.1 Subordinate Approvals and Permits

In addition to approval of this EIS (by the Commonwealth Government under the *EPBC Act* and the Queensland Government in accordance with the *State Development and Public Works Organisation Act*), the PEP requires further works approvals to undertake construction. These approvals were detailed in Chapter A2.6 (Project Approvals and Legislative Framework).

The Queensland approvals process is currently under review at the time of writing this EIS. But in summary, and based on current legislative requirements, approvals or permits may be required for the following activities:

- A Marine Park Permit for dredging and navigation infrastructure works (pursuant to the *Marine Parks Act 2004*).
- Undertaking tidal works (including the removal of material under tidal water for reclamation purposes, and placing dredged material at sea (pursuant to the *Coastal Protection and Management Act 1995*),
- Disturbing/removing marine plants, if any are located at the time of construction activities in the dredge footprint (pursuant to the *Fisheries Act 1994*).
- Leasing the reclamation area.
- Capital dredging (removal of material from the bed of waters) (pursuant to the *Environmental Protection Act 1994*).
- Altering, connection, or impacts to state-controlled roads (pursuant to the *Transport Infrastructure Act 1994*).

A 'map' of the additional approvals with responsibilities and timing is provided at Table 4. Information regarding application forms and detail on individual approvals is provided in Chapter A2.6.

Table 4 'Map' of Key Subordinate Approvals

PEP Activity	Approval Required	Agency	Who is the Applicant / Approval holder ?	Timing
Placing dredged material at sea	Sea dumping permit under the *Environmental Protection (Sea Dumping) Act 1981.* *LTDMS*	DSEWPAC	POTL.	Required prior to placing dredged material at sea. Pursue the application following Commonwealth Government approval of the EIS.
All relevant assessable development listed under Schedule 3 of the Sustainable Planning Regulations: ▪ Works in the tidal zone (including quarrying of material and reclamation) ▪ Environmentally relevant activities; ▪ Waterway barrier works (if works are in a waterway); ▪ Interruption of watercraft navigation or access to land ▪ Disturbance of marine plants (if required). ▪ Operational works coastal management.	IDAS Approval under the *Sustainable Planning Act 2009, Fisheries Act 1994, Environmental Protection Act 1994 and Coastal Protection and Management Act 1995.* ▪ Resource allocation ▪ Tidal works permit ▪ Preparing a water allocation plan for tidal works ▪ Disposing of material in tidal water	POTL, MSQ, Department of Environment Heritage and Protection, Fisheries,	POTL.	Required prior to the commencement of marine works, or environmentally relevant work on land.
To create reclamation area.	Application to lease Unallocated State Land under the *Land Act 1994.*	Department of Natural Resources and Mines.	POTL	Prior to application being made for resource quarry for the reclamation area. Once the land is reclaimed, the port can apply for ownership of the land.
▪ Storage of chemicals or other substances or practices that may cause environmental harm.	Approval and Registration Certificate for Environmentally Relevant Activities including ERA 16 - extractive and screening activities - and others for necessary activities such as storage of chemicals, fuels or other substances or materials that may cause environmental harm. *Sustainable Planning Act 2009* and *Environmental Protection*	Department of Environment and Heritage Protection or Townsville City Council where the Council has delegation to determine applications	POTL or contractor	Prior to undertaking the specified ERA activities.

PEP Activity	Approval Required	Agency	Who is the Applicant / Approval holder ?	Timing
	Act 1994			
▪ Disturbance of marine plants ▪ Construction of temporary or permanent waterway barriers	If required, under the *Sustainable Planning Act 2009* and the *Fisheries Act 1994:* ▪ Operational work that is the removal, destruction or damage of marine plants ▪ Waterway barrier works	Department of Agriculture, Fisheries and Forestry concurrence required.	POTL or contractor	▪ Prior to disturbance of marine plants. ▪ Waterway barrier works approval will only be required if the works are affecting fish passage in a waterway (inclusive of an inlet or estuary)
Where construction activities may result in risk of impact to, fauna or habitat of species listed by this Act.	If required, under the *Nature Conservation Act 1992:* ▪ Damage mitigation permit (removing or relocating wildlife)	Department of Environment and Heritage Protection	Contractor	In the event marine fauna requires relocation

(C1)2.2 Notifications

In addition to obtaining approvals and permits, notice must be made to some authorities and groups regarding certain PEP activities. A summary of responsibilities and timing for the notifications is provided at Table 5.

Table 5 Summary of Notifications

PEP Activity	Type of Notification	To which Agency	Who is Responsible?	Timing
Proposed use of land that is still potentially subject to a Native Title claim	There is a mandatory requirement to notify under section 24KA of the *Native Title Act 1993*	National Native Title Tribunal (NNTT); Department of Natural Resources and Mines (DNRM)	POTL	After PEP approval by State Minister
Potential discovery of remains	There is a duty to notify under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1994*	Notification to the Commonwealth minister Department of Sustainability, Environment, Water, Population and Communities	POTL	Notify if there is potential that remains will be discovered
Potential harm to Aboriginal Cultural Heritage.	There is a legislated Duty of Care and a Duty to Notify under the *Aboriginal Cultural Heritage Act 2003*	Notify the Department of Environment and Heritage Protection. Consultation with the Traditional Owners is required.	POTL	Notify if there is potential harm to Aboriginal Cultural Heritage.
Impact on listed places or buildings, or potential heritage items or places	There is a Duty to Notify under the *Queensland Heritage Act 1992*.	Department of Environment and Heritage Management	POTL	Notify if heritage items are found.
To obtain adequate power infrastructure from the nearby Ergon electrical infrastructure.	Notification to the owner of the infrastructure is required under the *Electricity Act 1994*	Ergon Energy	POTL	To be negotiated in advance of the actual demand for power supply.
To use Council controlled land including reserves and local roads	Local Law Permits or Licences required under the *Local Government Act 2009 – Local Laws and Subordinate Local Laws*	Townsville City Council	POTL	To be negotiated with the Council in advance of any major PEP activities.

(C1)3.0 Planning Phase Considerations

Mitigation measures have been identified to manage potential impacts that may arise during construction or operations phases that can be averted or reduced during the preceding time period through active and substantive planning measures. Where possible, the identified mitigation measures will use existing frameworks, plans and practices that have been adopted and implemented by the Port as proven mechanisms to achieve identified environmental outcomes.

Commitments shown in Chapter B23 will be adopted during planning, detailed design and pre-construction.

(C1)3.1 Existing POTL Policies and Networks

A pro-active approach to community engagement will be incorporated during overarching PEP stakeholder engagement programs. POTL currently engages with the community and stakeholders through a number of mechanisms (Port Community Partnership Forum, website, Port Tours, etc.). It is anticipated that these forums will continue to be used for community engagement and consultation throughout construction.

A three-tiered strategic approach to the achievement of good outcomes has been identified, with the three tiers being:

- the effective management of physical environmental impacts (through identified mitigation measures referred to in other chapters of this EIS)

- the effective management of potential adverse social impacts
- provision of support for the realisation of local development opportunities.

Activities in these three areas will be guided by policies, standards, guidelines and management plans, and the outcome will be founded on the implementation of a high quality design process that seeks to avoid impact to the maximum extent possible in the first instance where unavoidable impacts will then be mitigated.

POTL has a number of existing policies and procedures that apply to port land and which can be amended as a basis for the implementation of some of the identified impact mitigation measures. These policy documents include:

POTL Environmental Policy – a statement of commitment to the protection of the environment as a critical corporate value in the delivery and maintenance of port infrastructure and services and in planning for the future development of the Port of Townsville.

Environmental Management System – to facilitate the continual improvement of environmental performance by integrating environmental considerations into decision making and work.

Complaints Handling Policy and Procedure – a dedicated pathway and process to support an active response to community and stakeholder concerns.

Employment and Procurement Polices – As a Government Owned Corporation (GOC), POTL is required to meet the employment and procurement requirements of the Queensland Government.

(C1)4.0 Environmental Management Summary

Through the development of the PEP POTL has undertaken to:

- Design out potential impacts, where possible,
- Assess the risk of potential impacts to the community and environmental where they cannot be avoided' and
- Apply safeguards and mitigation measures commensurate with the level of potential impact.

Measures to reduce potential impacts will be applied through the implementation of EMPs as applicable to the impact generating activity. EMPs have been developed in accordance with relevant POTL policies and the results of the technical studies that accompany this EIS, to reduce the potential for negative impacts to be felt by the community and the wider environment.

As part of the implementation of EMPs community input and complaints management systems have been incorporated to allow the community to assist POTL identifying impacts which go beyond the scope of the existing mitigation measures, and apply the appropriate measure necessary to mitigate there impacts to acceptable levels.

The set of EMPs contained in Chapters C2.2 to C 2.5 has been developed to provide a plan for each discrete aspect of the construction and operation of the PEP in relation to both landside and portside management. This separation provides concise EMPs with relevance to the party who will implement them in relation to major work phases and aspects. Reducing the EMPs into relevant areas improves the efficacy with which they would be implemented, improving the ability for the implementation of mitigation measures to be maximised, thereby allowing risks to community and environmental health and wellbeing to be appropriately managed.

Port Expansion Project EIS

Part C

Section C2.1 – Dredge Management Plan

AECOM BMT WBM

(C2.1)1 Introduction

This Dredge Management Plan (DMP) outlines requirements related to dredging operations associated with the Port Expansion Project (PEP).

(C2.1)1.1 Purpose, Scope and Outcomes

Purpose

The purpose of this DMP is to identify the preferred means of addressing environmental issues associated with dredging operations for the PEP, namely: dredging of a new harbour basin seaward of the existing eastern breakwater; deepening of the Platypus and Sea channels; and widening of the existing channel at the entrance to the new harbour.

In general, the DMP reflects and/or provides a greater level of detail to mitigation and monitoring commitments discussed in the preceding chapters of the PEP EIS. This is achieved by setting out the framework for management, mitigation and monitoring of relevant impacts of the action within issue-specific management plans.

Scope

The scope of the DMP covers dredging-related works associated with the PEP as follows:

- Capital dredging activities by various plant;
- Associated placement of dredged material at sea in the dredge material placement area (DMPA);
- Placement of dredged material on land where required;
- Management of dredge tailwater at the reclamation site; and
- General operation of the dredge vessel upon commissioning, during the dredging campaign and prior to decommissioning.

The DMP does not address the construction of maritime structures such as breakwaters, marine pile driving or other land-based aspects of the reclamation as these are covered in the Construction Environmental Management Plan (Section C2.2). It also does not apply to operational (maintenance) dredging issues which will be addressed as part of amendments to the port's existing Long Term Dredging and Disposal Management Plan, and incorporated into the operational (maintenance) approvals as required.

Objectives

The principal objectives of this DMP are as follows:

- To protect environmental values from long term adverse effects due to dredging-related water quality effects;
- To reduce impacts to marine flora and fauna, and their habitats, during capital dredging and dredge material placement activities;
- To ensure that marine sediments to be dredged are tested in accordance with regulatory requirements (i.e. National Assessment Guidelines for Dredging 2009) and any contaminated sediments are managed on land and not placed at sea;
- To adopt best practice management for the handling and storage of waste materials on board the dredge;
- To manage the risk of translocation of organisms in ballast water by the dredge vessel;
- To reduce the risk of an environmental incident occurring such an oil spill, vessel collision or similar to prevent damage to the surrounding marine environment and the public;
- To reduce nuisance noise on surrounding sensitive receptors from the dredging; and
- To reduce the air emissions produced during dredging operations and thereby reduce potential effects on the natural airshed.

(C2.1)1.2 Relationship with Future Approvals

Like the Project Environmental Management Plan (EMP), the DMP is a framework document to guide future activities and decision-making associated with the PEP.

The DMP contains procedures, guidance and commitments to monitoring and other environmental management measures that will be required to be carried through into more detailed approvals (such as tidal works approvals under the *Sustainable Planning Act 2009* and sea disposal permits) and by the future dredge contractor for the works as part of the contractor's Construction Environmental Management Plan.

It is recognised that compliance with the requirements of this DMP does not remove general obligations and responsibilities under relevant legislation or for approvals or permits that will need to be obtained in the future in order to carry out the development.

(C2.1)1.3 Environmental Legislation

The DMP has been developed in accordance with, and taking into account legislative requirements set out in Acts and Regulations at Commonwealth and State level that are listed below. Further, while consents and approvals have not yet been issued for the Project, the DMP has been developed to include measures that POTL believes is necessary for protection of sensitive environments.

Commonwealth legislation considered in development of this DMP (including Acts implementing relevant international conventions) includes:

- *Environment Protection and Biodiversity Conservation Act 1999;*
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983;*
- *Environment Protection (Sea Dumping) Act 1981* and Regulations; and
- *Great Barrier Reef Marine Park Act 1975.*

The following State legislation is relevant to the dredging:

- *State Development and Public Works Organisation Act 1971;*
- *Coastal Protection and Management Act 1995* and Coastal Management Plans;
- *Environmental Protection Act 1994* and Environmental Protection Policies and Regulations;
- *Fisheries Act 1994* and Regulations*;*
- *Marine Parks Act 2004* and Marine Parks (Great Barrier Reef) Zoning Plan;
- *Transport Operations (Marine Safety) Act 1994* and Regulations;
- *Transport Infrastructure Act 1994;*
- *Transport Operations (Marine Pollution) Act 1995* and Regulations;
- *Land Act 1994;*
- *Nature Conservation Act 1992* and Conservation Plans; and
- *Sustainable Planning Act 2009* and Regulations.

In particular, the requirements of the Queensland Coastal Plan (DERM, 2012a) have been accounted for in developing this DMP. This includes the relevant Performance Outcome of the State Planning Policy for Coastal Protection[1] assessment code (i.e. Performance Outcome 60 – *Capital and maintenance dredging and material disposal is to be undertaken according to a management plan prepared for the activity*).

---

[1] State Planning Policy 3/11 Coastal Protection was replaced by the Queensland Government on 8 October 2012 by the *Draft Coastal Protection State Planning Regulatory Provision: Protecting the Coastal Environment*. The Draft SPRP will operate for 12 months unless earlier repealed. Due to the release of the Draft SPRP at such a late juncture in the preparation of the PEP EIS, the various chapters and assessments contained within the EIS address SPP 3/11 as required by the approved Terms of Reference for the Project under the *State Development and Public Works Organisation Act 1971*. If required and still in place at the time of preparation, the EIS Supplement will address the Draft SPRP to the extent required by the Coordinator General.

(C2.1)2 Plan of Operations

(C2.1)2.1 Dredging Project Description

The PEP includes the dredging of a new harbour basin seaward of the existing eastern breakwater; deepening of the Platypus and Sea channels including the seaward extension of the Sea Channel; and minor widening of the Platypus channel at the entrance to the new harbour.

The area of the new harbour basin is currently at a level of approximately 4m (below Chart Datum), and will need to be deepened to accommodate large Panamax sized vessels on a regular basis, as will the Platypus and Sea channels to improve accessibility for these vessels.

The development of the harbour basin and channel will involve dredging works to be undertaken in four stages. Two vessel design drafts (nominally 13.0 m and 14.6 m) have been adopted for the design, to reflect the ramp up of trade tonnages and the subsequent need to accommodate deeper draft vessels. The planned channel and outer harbour basin design depths for the PEP have been based on accessibility criteria for the design vessels as follows:

- Accessibility criterion for 1st stage design depth during Stage A – a minimum 3 hour sailing window is available for a Panamax vessel with a draft of 13.0m on 95% of high tides. (At this depth a 14.0m draft Panamax vessel would be able to sail on 22% of high tides).
- Accessibility criterion for 2nd stage design depth during Stage C – a minimum 3 hour sailing window available for a Panamax vessel with a draft of 14.6m on 50% of high tides. (At this depth a 14.0m draft Panamax vessel would be able to sail on 90% of high tides).

The harbour basin will be protected from waves and currents by a breakwater on the north-eastern side. The basin will be sized to accommodate six berths (Berth 14 through Berth 19) in addition to the existing offshore Berth 11 as well as the proposed Berth 12, which currently has all approvals and is to be developed prior to the port expansion and does not form part of the PEP.

Dredged material that has suitable engineering qualities will be used for land reclamation for the harbour expansion. Internal bunds will be constructed to contain the reclaimed fill and provide settlement areas for reclamation tailwater. The location of the internal bunds will be determined by the areas required to provide suitable land-based operational areas behind Berths 14 through 17, to provide a suitable foundation for heavily loaded areas (such as road and rail infrastructure) and to provide sufficient capacity and flexibility for treatment of reclamation tailwater during the harbour dredging and ongoing reclamation activities.

Material that is unsuitable for engineering purposes (soft and compressible surface material) dredged from the harbour basin and under the reclamation areas and rock walls is to be placed in the existing, approved offshore dredged material placement area (DMPA), which is located east of Magnetic Island. A mechanical dredge (backhoe or grab type) and a small trailing suction hopper dredge (TSHD) are likely to be used for dredging this material and it is estimated that 1.5 million m^3 will be dredged. Material dredged during development of the outer harbour basin that has suitable engineering qualities for reclamation will be beneficially re-used as reclamation fill for the port expansion. It is likely that a cutter-suction dredge will be used for the majority of dredging of the harbour basin and re-used as reclamation fill. The cutter suction dredge is considered the most effective and economical method of placing material in reclamation at this location. It is estimated that up to approximately 4.3 million m^3 of material will be dredged and placed in the reclamation area.

Dredged material from the channel deepening will be placed in POTL's existing DMPA using a medium sized TSHD, which is considered the most suitable type of dredge to operate over the long distances involved. It is estimated that up to approximately 4.1 million m^3 of material will be dredged from the channel deepening and placed in the offshore DMPA.

(C2.1)2.2 Dredge Plan of Operations

As outlined in Part A of the EIS, it is likely that a range of plant (mechanical dredge, cutter suction dredge and trailing hopper suction dredges) will be used to develop the Port Expansion over four stages (A – D) within a 20 to 30 year planning horizon.

The greatest level of activity will occur at the initial stage (Stage A) whereby:

- The soft surface material of the reclamation and breakwater footprints and outer harbour dredge footrprint will be removed and placed at sea (in the existing offshore dredge material placement area) using a combination of mechanical dredge and small trailing suction hopper dredge); and
- The breakwaters and revetments will be constructed so as to form the reclamation area where nearshore dredge sediments will be placed.

Once these initial works are complete, two dredging processes will occur in parallel during Stage A:

1) A cutter suction dredge (CSD) will operate to dredge the outer harbour and berth pockets. The CSD will pump the material from a floating pipeline into the bunded reclamation area. If in an area with boat traffic, the pipeline will be submerged.
2) A medium sized trailing suction hopper dredge (TSHD) will operate deepen the Platypus Channel and to deepen and extend the Sea Channel further offshore.

A construction staging sequence has been developed, based on commissioning one or two berths during each stage. In practice, future growth in trade through the Port of Townsville will dictate the preferred program for development of each stage, and a number of stages may be combined in a single phase of the port expansion. The dredging sequence is expected to be as follows:

Stage A – Early Works and Berths 14 and 15

A1 Mechanical dredge working to remove surface sediments along north-eastern breakwater, north-eastern revetment and eastern revetment alignments with a barge (barge bottom placement at the existing approved DMPA).

A2 Construction of the eastern revetment, north-eastern revetment and north-eastern breakwater.

A3 With north-eastern breakwater and revetments in place a small (shallow draught) TSHD removes the remainder of the surface sediments where reclamation and dredging is proposed (bottom placement at existing approved DMPA).

A4 Construction of the internal bunds of the reclamation adjoining reclamation cells I to X.

A5 Construction of the western breakwater (if required).

A6 Mechanical dredge widens the Platypus Channel between Markers P13/P14 and P11/P12 (barge bottom placement at the existing approved DMPA).

A7 CSD dredges harbour for Berths 14 and 15 (material placed in reclamation area).

A8 Dredged material is dewatered and treated and tailwater is discharged from the reclamation site into the sea from the eastern revetment.

A9 Medium TSHD, around 10,000m^3 capacity, deepens Platypus and Sea channels (this dredging can occur at the same time as A6 – A8; channel material placed at the existing approved DMPA).

A10 CSD is used to break up any stiff or consolidated material in the channel to allow it to be dredged by TSHD.

Stage B – Berth 16

B1 CSD dredges harbour for Berth 16 (material placed in reclamation area).

B2 Operation of tailwater discharge (dredged material placed in reclamation area, dewatered and treated, then tailwater discharged from the reclamation area).

Stage C – Berth 17

C1 CSD dredges harbour for Berth 17 (material placed in reclamation area).

C2 Operation of the tailwater discharge (dredged material placed in reclamation area, dewatered and treated, then tailwater discharged from the reclamation area).

C3 Medium TSHD deepens Platypus and Sea channels (second stage deepening including extension of the Sea Channel seaward) - material placed at the existing approved DMPA.

Stage D – Berth 18 and 19

No dredging proposed during this stage.

(C2.1)3 Dredge Mitigation and Monitoring Strategy

(C2.1)3.1 Introduction

As outlined in Chapter B6 (Marine Ecology), dredging activities associated with the PEP have the potential to impact on benthic primary producer habitats such as corals and seagrass in the marine environment of Cleveland Bay. Of the various dredging and marine construction activities, the deepening of the Platypus and Sea channels by a Trailing Suction Hopper Dredge (TSHD) is considered to have the greatest potential for environmental impacts due to the extent of suspended solids generated by the dredge's normal operation and proximity to sensitive environments.

The key impacts identified in that chapter that will need to monitored and managed include:

- Periodic light extinguishment of benthic primary producer habitat above background conditions along Magnetic Island, at Middle Reef and at or near Cape Pallarenda; and
- Sedimentation in benthic primary producer habitat at the locations identified above.

Of these two potential impacts, the extent and duration of light extinguishment during the 11 week TSHD dredging campaign in sensitive marine habitats is predicted to be greater when compared to the estimated rates of additional sedimentation generated by dredging in these environments.

It is the conclusion of that chapter that through the implementation of mitigation measures, the Port Expansion Project is not expected to have significant impacts to Matters of National Environmental Significance, or major impacts to species and features of high state conservation or fisheries significance. This strategy outlines the mitigation measures that will be implemented to ensure significant impacts are avoided.

(C2.1)3.2 Likely Dredge Operation in the Channels

In order to inform the numerical modelling assessment and as outlined in the Technical Modelling Report (Appendix H1 of the EIS), advice has been sought from experienced project dredging advisors as part of the EIS to understand how the TSHD would most likely operate in undertaking the channel deepening.

This advice is underpinned by the geotechnical characteristics of the material to be dredged, understanding of contractor methods, and selection of a 'design' vessel which is considered to be the most likely vessel to undertake the Project in terms of size and hopper volume. Consideration has also been given to the operation of a similar TSHD vessel that undertook dredging of the Platypus and Sea channels in 1993 which represents the last major capital dredging campaign undertaken in Cleveland Bay.

These assumptions have been built into the modelling of the 'expected case' as outlined in the Technical Modelling Report (Appendix H1) which identifies that channel deepening would occur by the dredge operating in four discrete dredge segments with associated trips out to the DMPA to place dredge material between segments. Figure C.2.1.1 shows the locations of the four segments (A – northernmost section of Sea Channel; B – Sea Channel along Magnetic Island; C – Platypus Channel; D – Platypus Channel nearest to harbour).

It is noted as per the dredge methodology identified in Section C1.2, there will be two campaigns to deepen the shipping channels, and these will likely be undertaken according to the need for channel deepening which could be decades (10+ years) apart. The second campaign (to be undertaken as Part of Stage C) involves a greater extent of dredging (e.g. including dredging to extend the Sea Channel) so this campaign has been chosen as the base case for modelling undertaken for the Project as it is the higher risk case of the two in terms of potential impacts.

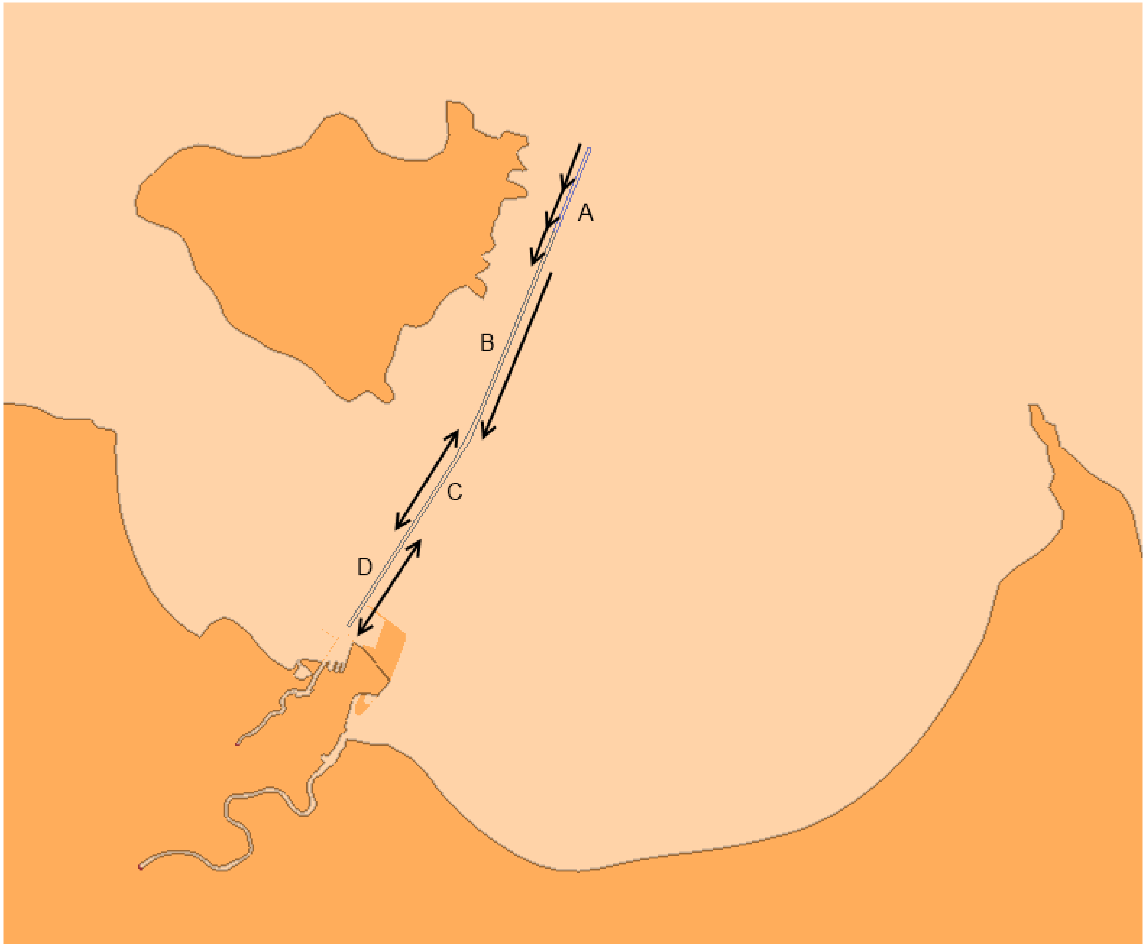


Figure C.2.1.1 Dredge Operation Plan – Segments A, B, C and D

Notes:
Segment A in the above Figure shows multiple arrows which reflect that the dredge vessel may need to undertake several runs over this segment to collect the material due to its soft compressible nature before the hopper is full and able to be placed at the DMPA. Segments C and D have dual headed arrows to reflect that the dredge may undertake runs in either direction prior to departing the channel to sail to the DMPA for unloading.

(C2.1)3.3 Standard Mitigation Measures

As the EIS indicated potential impacts could occur to sensitive receptors from unmitigated TSHD dredging of the Platypus and Sea channels, a range of 'standard' mitigation measures will be committed to and required to be undertaken by the TSHD dredge contractor from the outset of the Project. These commitments are outlined in the relevant chapters of the EIS and this DMP and are summarised as follows:

- The dredge operates in the approved dredge footprint.
- Hopper compartments are maintained water tight during dredging activities, except dredged material placement.
- No high pressure jets to be used on dragheads to loosen materials (except at DMPA).
- The dredge limits excessive overflowing (after an efficient load in the hopper is achieved).
- The top of overflow valves are not lowered during the transport component of the dredging cycle (dredging area to DMPA) to reduce spillage/overflow during transport.
- The dredge is fitted with a 'green valve' in order to reduce the spatial extent of turbidity plumes generated by dredge operation. The green valve ensures that overflow from the dredge vessel is released under the keel of the vessel rather than the surface.

- Turtle deflectors will be mounted on the draghead of the TSHD.
- Washing of the hopper compartment and pumping out of the hopper must not take place outside the predetermined cell of the DMPA.
- Ensure the two 11 week programs of capital dredging of the channels are undertaken outside of summer months (November to March) based on the following reasons:
  - November is a period of key coral spawning in the region;
  - Summer months are the key seagrass growing period in the region. While undertaking dredging in the winter is predicted to result in greater water quality impacts compared to summer (seasonal wind conditions in winter result in increased re-suspension), seagrass are in senescence in winter and therefore less susceptible to impacts from reduced light;
  - Summer months are the period when corals in the region have less resilience due to higher sea surface temperature, higher ambient suspended sediment and nutrients levels and reduced salinity from flooding/wet season. Again, while undertaking dredging in the winter is predicted to result in greater water quality impacts compared to summer, corals will generally be more resilient to impacts from reduced light during this period;
  - Dredging is avoided during the summer turtle nesting periods on coastlines in the region (although noting that the occurrence of nesting on nearby beaches is expected to be low); and
- Ensure a Reactive Monitoring Program (RMP) with appropriate triggers and corrective actions is implemented (this program is outlined below).

(C2.1)3.4 Dredged Material Placement

In addition to the standard dredging mitigation measures listed above, the following mitigation measures will be implemented to reduce impacts to marine flora and fauna from placement of dredged material at the DMPA:

- Dredged material placement in the DMPA must be carried out in a planned manner within the predetermined sub-section (cell) with the TSHD steaming at low speed or stationary to avoid causing larger plumes.
- A bathymetry survey of the DMPA and immediate surrounds will be undertaken immediately prior to capital dredging in order to optimise the dredged material relocation strategy and to describe baseline conditions.
- Dredge contractor will distribute the dredged material evenly over determined cells in the DMPA, thereby minimising high spots.
- A bathymetry survey of the DMPA and surrounds will be undertaken to confirm final depths at the completion of the capital dredging campaigns.

(C2.1)4 Reactive Monitoring Program

(C2.1)4.1 Program Aims and Design

The overall aim of the Reactive Monitoring Program (hereafter referred to as the RMP) will be to avoid or otherwise reduce impacts to sensitive marine environments that could be affected by dredging.

At this early stage, it is anticipated that the RMP will have two interlinked components:

- A water quality dredge plume suspended sediment monitoring program; and
- A seagrass and coral monitoring program.

The design of the program is similar to that undertaken in 1993 as part of the last major capital dredging campaign for the channels and will be overseen by an Expert Advisory Panel (see Section 3.4.3 below) and employs a range of trigger levels for further investigation and instigation of corrective actions. Monitoring of the two components of the RMP would be done in parallel. The approach, methodology and equipment recommended for use is discussed in Section 3.4.5.

A schematic of the RMP is shown in Figure C.2.1.2. Indicative monitoring locations under the RMP are shown in Figure C.2.1.3. These monitoring sites have been initially selected based on the location of

Benthic Primary Producer Habitat (BPPH) sensitive receptors, the location of previous data collection sites, and the outputs of water quality modelling with respect to areas of impact predicted by the McArthur Method outlined in Chapter B4 and B6.

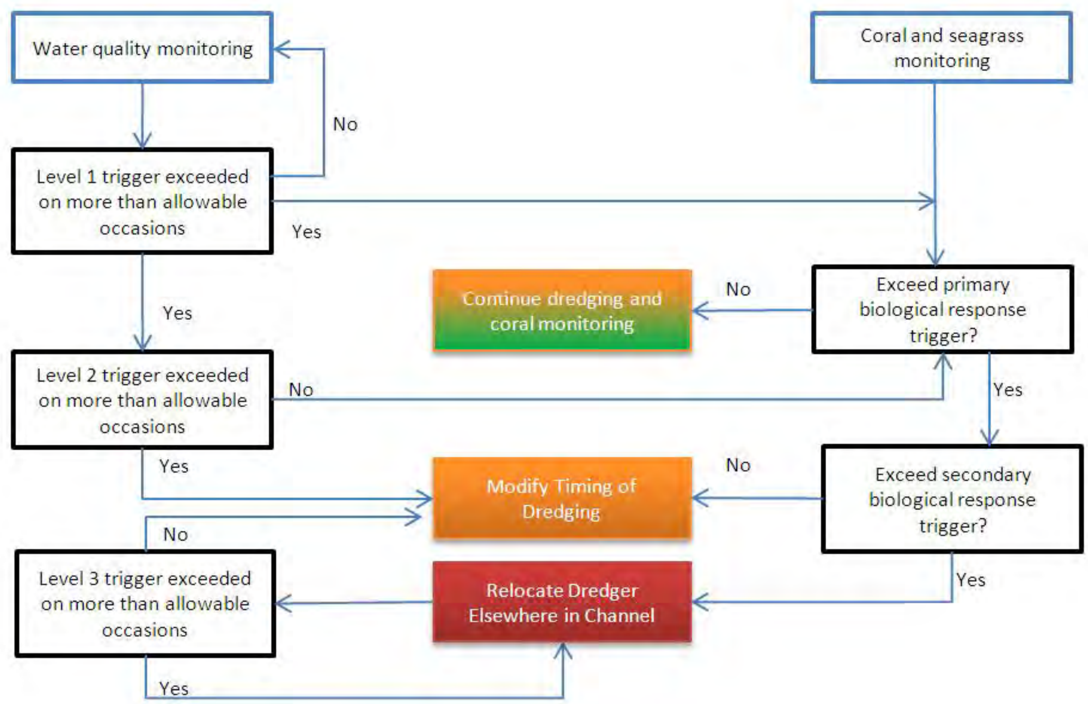


Figure C.2.1.2 Framework for RMP Trigger Levels

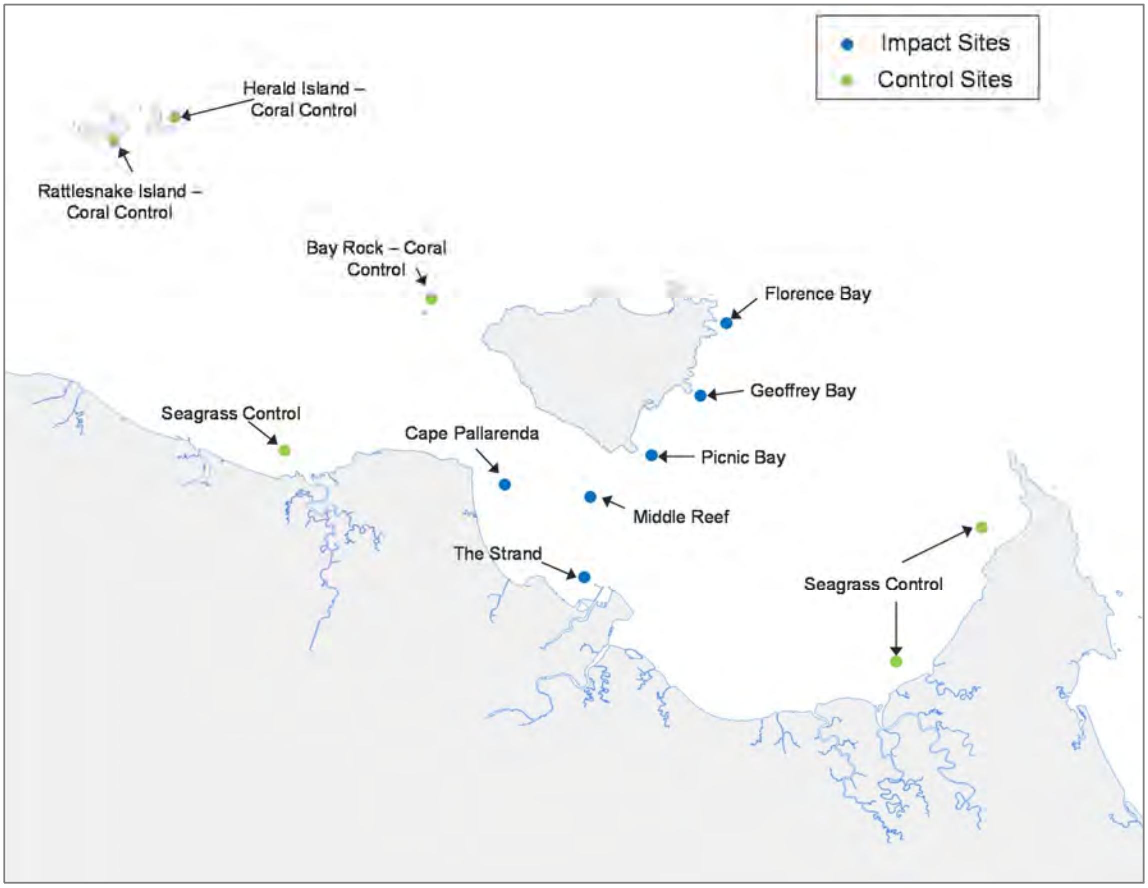


Figure C.2.1.3 RMP Proposed Impact and Control Sites

As shown in Figure C.2.1.2, the RMP will have three trigger levels which are described as follows:

- Level 1 Investigation Level (Green) – This trigger level provides for an initial water quality assessment through comparison of monitoring data to derived triggers values and background conditions. Water quality measured at putative 'impact' locations (as shown in Figure C.2.1.3) would be compared against 'control' locations to determine if increased turbidity levels are attributable to dredging or are shown to be within natural ranges for the ambient conditions. If it is determined as part of this investigation phase that the water quality is attributable to the dredging, there is a requirement to examine coral and seagrass monitoring data to determine if the detected water quality impacts are resulting in a biological response in sensitive receptors (seagrass and corals). The dredge would continue to operate during this period of investigation up until a level 2 trigger is reached.
- Level 2 Management Response Level (Orange) – Exceedance of a level 2 trigger levels means that the dredger will likely need to review its operations and/or take corrective actions to either control a water quality impact. As will be outlined in Section 3.5, there are several practical mitigation measures and corrective actions that can be employed by the dredger to reduce impacts. Water quality and biological triggers as part of level 2 will be set on the basis of known stress tolerances of coral and seagrass. Where possible, the design of the RMP will be to ensure that these trigger levels are set such as to ensure they are triggered prior to unacceptable impacts occurring.
- Level 3 Compliance Level (Red) – Exceedance of this trigger level would require immediate action by the dredger to suspend dredging or otherwise implement other mitigation measures such as moving the dredge away from the habitat where the exceedance occurs. Dredging would not be able to resume in this area until monitored water quality reduced back to acceptable levels (below level 3). Generally this trigger will be set on the basis of known impact levels for biological systems

(partial mortality of corals or seagrass) based on background data. Level 3 trigger levels would also generally be set commensurate with performance measures set in development conditions.

(C2.1)4.2 Establishing Trigger Values

While the level of data and modelling investigations undertaken as part of this EIS is considered to be robust and suitable to assess the potential impacts from dredging activities on marine environmental values, interim water quality and ecological trigger values to support the RMP are not proposed to be set in the EIS given the long lead time prior to dredging, possible changes to baseline habitat conditions over the intervening period and recognition of the need for a more comprehensive dataset in key impact locations.

Instead, an iterative approach to setting and improving water quality trigger values is proposed, with input from the Expert Advisory Panel (see below) and based on a long term deployment of in-situ data collection at strategic locations.

This includes continuous monitoring prior to and during the dredging campaign to establish trigger levels and tolerance limits for ecological assets such as seagrass and corals that are realistic for protection but avoid frequent and unnecessary stoppages by the dredge which will ensure the overall duration of impact is reduced.

The initial method that is proposed to be used to develop trigger guideline values under the RMP is to use the methodology of McArthur et al. (2002) as outlined in Chapter B4 (Water Quality). The process followed is detailed below:

- The 99th percentile TSS value is adopted as the‘Intensity Level’or highest allowable value.
- The 95th percentile TSS value is adopted as the‘Threshold Level’.
- Long term (i.e. at least 12 months) monitoring data is analysed to determine the distribution of all duration events during which the TSS Threshold Level was exceeded.
- The 95th percentile longest event is adopted as the‘Duration Guideline’

All events exceeding the TSS ‘Threshold Level’ are grouped by duration in hours, with an allowable frequency of events developed for each duration class per month. A timeframe is adopted (e.g. one month), and the 95th confidence limit is used as the total allowable frequency.

Additional metrics may also need to be derived to take into account different wind, wave and weather conditions that could occur during the campaign.

To support this approach, baseline water quality monitoring data are currently being collected over a 12 month period from six locations in Cleveland Bay - off the east coast of Magnetic Island, the Strand and Cape Pallarenda. These locations are synonymous with the proposed impact sampling locations shown in Figure C.2.1.3 (except for the Middle Reef location).

As this additional data becomes available, the intensity, threshold and duration trigger levels can be developed. Given the long term deployment, this monitoring data will also allow the generation of trigger values for different wind, wave, flow and seasonal conditions.

(C2.1)4.3 Expert Advisory Panel

The RMP development and implementation (including the review of trigger levels outlined above) be overseen by an advisory panel of experts reporting to the Environmental Supervisor for the PEP.

The advisory panel members will be appointed by and funded by the port and would likely include:

- Independent Chair;
- GBRMPA and/or DSEWPAC;
- Queensland Department of Environment and Heritage Protection (or successor in title);
- Queensland Department of Agriculture, Fisheries and Forestry (or successor in title); and
- Recognised specialists in the particular environmental fields and in dredging.

The advisory panel would also be supported by individuals with expertise on seagrass, turtles, coral health, water quality, monitoring and statistics.

The function of the advisory panel will be to provide advice to POTL in relation to the following:

1) Review the trigger values derived as part of the 12 month data capture campaign and expected tolerances of coral and seagrass to impact;
2) Endorse the control and impact site location plan and dredge mitigation strategy prior to commencement of works (Figure C.2.1.3); and
3) Review environmental performance of the dredging against criteria and triggers and evaluate corrective actions implemented.

The RMP design and triggers will be established and presented to the Advisory Panel (including regulatory agencies) well prior to dredging, with the expectation this program is approved and endorsed prior to commencement of works.

(C2.1)4.4 Management and Reporting

The implementation of the RMP will be overseen by an Environmental Supervisor for the PEP appointed by POTL.

The Environmental Supervisor's role will be to:

- Administer the dredging contract on behalf of POTL.
- Oversee the development and implementation of the RMP and other monitoring programs.
- Provide secretariat and support services to the RMP Advisory Panel.
- Liaise with Regulatory Agencies prior to, during and following the dredge campaigns including recording and actioning community and/or port users complaints.
- Prepare and review internal and external compliance reports (to be confirmed as part of future conditions and management arrangements) which are likely to include the following:
    - Compile and maintain a data register for monitoring data (updated weekly and archived for a minimum period of 5 years);
    - Prepare and submit a validation of modelling report based on validation monitoring (see below); and
    - Provide reports (likely weekly) to regulatory agencies of dredge campaign progress and environmental performance against the RMP including recorded exceedances of trigger values and corrective actions implemented.
- Undertake checks of the dredge contractor's compliance with the DMP at least once during the major (TSHD) dredging campaigns.
- Prepare specific incident reports with respect to environmental or other major incidents and/or the implementation of corrective actions to POTL and external agencies where relevant.

(C2.1)4.5 Construction Stage Monitoring Equipment and Approaches

The 12 month water quality data capture program in Cleveland Bay is currently being recorded using YSI 6600 water quality instruments. These instruments are capable of continuous logging of data for a range of parameters, with anti-fouling guards and sensor wiping apparatus to prevent interference to sensors from marine growth.

YSI instruments record measurements of turbidity, dissolved oxygen (DO), pH, salinity and conductivity once every 10 minutes. The instruments located at The Strand, Virago Shoal, Geoffrey Bay, Florence Bay and Picnic Bay also record photosynthetically active radiation (PAR) data using twin sensors on two instruments (The Strand and Geoffrey Bay) and a single sensor on the others (Virago Shoal, Florence Bay and Picnic Bay). PAR is an indicator of light available to sensitive receptors (e.g. seagrass and corals), and the twin sensors allow light attenuation through the water column to be calculated for a general area.

Similar instruments to the above would be deployed for the construction water quality monitoring as part of the RMP. Telemetry and other appropriate water quality monitoring equipment would also be installed to ensure dredging can be reactive in a timely manner and flag exceedances in real time. This data would be available to both the contractor and POTL Project Superintendent, with alerts via mobile text message or email of any exceedance under the RMP.

Ecological monitoring approaches under the RMP would be expected to consist of collecting data on the following indicators:

- Collection of data on additional physical-chemical parameters such as light, temperature and salinity;
- Coral cover and health parameters (to be determined by the expert advisory panel); and
- Seagrass cover and health parameters (to be determined by the expert advisory panel).

Baseline monitoring would occur at regular intervals (frequency to be determined by expert advisory panel) throughout the dredge campaign (to measure chronic or long term trends), supported by rapid deployments where water quality impacts are detected to try and detect acute impacts.

In this context, key constraints/issues to be considered in further developing the ecological component of the program would need to be able to:

- Cover off a large number of potential impact sites;
- Allow rapid deployment of field staff and turnaround of results;
- Be measurable in poor visibility;
- Detect acute and chronic (stress) effects; and
- Take into account differences in communities in and among sites.

(C2.1)4.6 Validation Monitoring

Separate to impact monitoring described above, monitoring will be undertaken specifically targeted at validation of the dredge plume source assumptions that underpin the water quality impact assessments. This 'validation' monitoring would be undertaken at the commencement of each phase of capital dredging that was modelled as part of the PEP.

The methodologies associated with this monitoring component will be governed by the goal of obtaining data for the dredge plume model validation. It is likely to involve a combination of vessel-mounted ADCP (or similar) and in-situ water quality measurements and sampling for laboratory analysis, specifically targeted at characterising the dredge plume intensity and spatial dimensions on top of the ambient suspended sediment climate.

The validation monitoring campaigns is to occur early on during the operation of the key capital dredging equipment, namely the:

- Small TSHD dredging the outer harbour footprint;
- CSD and associated tailwater from dredging the outer harbour footprint; and
- Medium TSHD dredging of the Platypus and Sea channels.

Outcomes of the monitoring will be spatial and temporal maps of the dredge plume during the validation exercise, quantification of the plume sediment characteristics and quantification of the range of plume generation source rates associated with the monitored dredging operations. These results will directly feed into water quality model simulations to validate the model configuration used in the EIS and to suggest any improvements to model input parameters (i.e. dredge plume source rates).

(C2.1)4.7 Further Modelling

The water quality model that has been used for impact assessment in the EIS can also be utilised as a source of hindcast and forecast suspended sediment predictions during the dredging programme. This would further inform interpretation of the reactive monitoring outputs, and allow for testing and selection of management strategies during the dredging programme. Interpretation and attribution of factors affecting measured turbidity during a dredging campaign can be a difficult task, and the additional information from the model including its ability to separate the background and dredge plume contributions can be of assistance in this regard.

Further improvement and validation of the models capabilities to predict ambient suspended sediment levels can be undertaken using the 12 months of baseline data. The model can also be extended to include prediction of seabed Photosynthetically Active Radiation (PAR) (e.g. in addition to TSS), which would allow for assessment of the light reductions attributable to the dredge plumes. This extension would assist with distinguishing potential impacts from the dredging in the context of natural background variations in PAR.

(C2.1)4.8 Adaptive Management and New Technology

With over 10 years between the major deepening campaigns of the channels, the initial channel deepening to be undertaken in Stage A will also provide a blueprint for the second stage deepening to be undertaken in Stage C of the dredge methodology.

Given this, it will be critical to ensure proper documentation of the achievement of performance criteria, monitoring data and behaviour of the plume, and dredging techniques such that the outputs and results of the initial dredging can inform future activities both in terms of capital dredging and maintenance dredging. In this context, a formal review of the RMP is recommended to be undertaken following completion of first channel deepening campaign by the Expert Advisory Panel.

While care has been taken in preparing this RMP to recommend the best current approaches to monitoring and impact detection, new or improved technology or approaches may also be available by the time the campaigns are undertaken. A performance based approach is therefore the preferred approach as it allows flexibility to adopt new or improved technology as it becomes available.

(C2.1)5 Additional Dredge Mitigation and Corrective Actions

As discussed above, the RMP will be used in'real time'to guide the dredging campaign.

If an initial/investigation (level 1) trigger level is exceeded the dredge would continue to operate while the data from control and impact sites are compared to determine if the impact is attributable to dredging and further ecological monitoring is carried out.

However, once management action (level 2) triggers are reached, the dredge contractor will be responsible for taking actions to ensure impacts are avoided at sensitive receptors and impacts are controlled prior to defined trigger level exceedance (level 3). This will occur in consultation with POTL and the advisory panel discussed in the previous section.

The sections below set out the additional mitigation measures and corrective actions that can be implemented by the dredger to reduce impacts and ensure exceedances are reduced or avoided during the campaign. As outlined above, these actions would be assessed and are intended to be implemented prior to the ultimate (level 3) exceedance levels in the RMP being reached.

(C2.1)5.1 Dredging in Flood and Ebb Tidal Currents

Numerical modelling and previous dredging activities undertaken by similar TSHD dredges in Cleveland Bay have demonstrated the behaviour of plumes under various tidal conditions. In general, dredging during a flood tide will result in the movement of plumes to the west from the dredge position while dredging during an ebb tide will have the effect of a localised plume around the dredge that will be somewhat stationary and then tend to move northward.

Advice from the Project dredging advisers is that capital dredging of the Platypus and Sea Channel in 1993 trialled an approach whereby dredging was phased with the tides and where practical, dredging in the Sea Channel and outer Platypus Channel was undertaken on the ebb tide and dredging closer to the port (e.g. the inner Platypus Channel) was undertaken on the flood tide.

This approach was employed as a means to further reduce the normal movement of the plume westward into Magnetic Island embayments and was able to be implemented by the dredge contractor without significant impact on the overall dredge programme.

As shown in the Technical Modelling Report (Appendix H1), additional numerical modelling has been undertaken to quantify if such an approach would lead to an improvement in overall water quality compared to the expected mode of operation (which does not differentiate dredging mode or direction by tide). In general, such an approach has been demonstrated by the modelling to show widespread reduction in above-background TSS levels to the west of the channel and between Cape Pallarenda and Magnetic Island which will be of ecological benefit to these environments.

Implementation of this approach can be factored into the program during each tidal cycle based on the trigger levels detected in the RMP (pending Regional Harbour Master approval and shipping schedules).

(C2.1)5.2 Preferential Movement of the Dredge to Other Segments

Similar to the approach above, the dredger will have some flexibility in terms of the sequencing of channel dredging. While a sequential, north to south, ABCD pattern (see Figure C.2.1.1) has been adopted for the EIS modelling, if impacts are detected at a particular sensitive receptor a change to this 'normal' pattern can be adopted. Particularly given that the key impacts are light deprivation, preferentially dredging other segments while allowing a particular area to settle can be an important strategy to ensure coral environments are obtaining necessary light to maintain photosynthetic processes.

The dredging in ABCD sections will be programmed in such manner that low influence sections are left until the latter stages of the work and only dredged when high influence sections need to be avoided, due to excessive plume generation during the adverse circumstances (tidal and wind driven currents).

Implementation of this approach can be factored into the program based on the trigger levels detected in the RMP (pending Regional Harbour Master approval and shipping schedules).

Opportunistically, it should also be noted that the dredge vessel will need to undertake routine maintenance, refuelling and crew changes during each of the 11 week campaigns. During these 'down time' periods of the dredge, there will be environmental benefits accrued related to settlement of fines and allowance of greater light penetration back into surrounding environments (assuming background turbidity levels are also low). To a certain extent, the dredger can plan such maintenance to maximise environmental benefits in accordance with the RMP.

(C2.1)5.3 Dredging on High Tides

A component of the overall TSS plume generated by the dredge is through the operation of the propellers. This impact is generally greater where there is less underkeel clearance between the bottom of the dredge vessel (particularly when fully laden) and the seabed that is being dredged.

Based on this principle, an additional mitigation measure that can be employed by the dredge contractor is to dredge particularly sensitive areas of the channel (e.g. near sensitive receptors) on higher tides which maximise underkeel clearance. While not as effective as limiting hopper overflow, this approach will help to reduce the amount of TSS generated by the dredge, also reducing the amount of displaced sediment that can be resuspended by natural wave and wind action.

Implementation of this approach can be factored into the program based on the trigger levels detected in the RMP (pending Regional Harbour Master approval and shipping schedules).

(C2.1)5.4 Limitation on Overflow

The normal operation of a TSHD dredge is to overflow excess water from its hopper so as to retain collected dredged material and provide the additional volume for the dredge to continue to operate and fill the hopper with sediment before sailing to the DMPA. While there are a number of controls, overflow waters invariably retain finer sediments from the dredged material in suspension leading to generation of turbid plumes from the overflow.

Operating with overflow is the normal mode of operation for a TSHD. While the dredge can be operated with no or limited overflow as part of the dredge campaign, such operations are substantially less effective and will invariably extend the overall duration of dredging and the duration of environmental impact, as well as accrue cost penalties as a result of the longer operating time.

Limited overflow will occur as a matter of course in the northern segment (segment A) of the Sea Channel as the geotechnical characteristics of the softer material present in the channel mean that less water is dredged with the softer sediments. This results in less water required to be discharged via overflow, and also a reduction in dredge loading times. As a result, a further reduction by limiting or ceasing overflow in this segment is not significant from a cost perspective but does not lead to significant water quality benefits.

Limiting overflow in the inner Sea Channel and Platypus Channel will have greater impact on production due to the stiffer clay materials present (and hence more water in the dredged material) and increased travel distances to the material relocation area (spoil ground). However, reducing overflow in these locations may be contemplated and employed to reduce monitored water quality to below trigger levels and maintain production.

Overflow strategies will likely be determined by the dredge contractor in consultation with the Port and/or advisory panel but can include for instance, placing a limit on the duration of overflow (allowing 1 hour rather than 2 hours) and the location of overflow (ensuring overflow occurs in segments where impacts have not been detected).

The extent and distance travelled by plumes from dredging are also related to the velocity of the tidal currents, which are stronger during Spring Tides and weaker during Neap Tides. Accordingly, limitation on overflowing or non-overflowing operations will be of significance during particular stages of the tidal cycle.

Overall, limitation of overflow can be factored into the program during each dredge cycle based on the trigger levels detected in the RMP and the real time stage and phase of the tidal cycle.

(C2.1)5.5 Temporary Suspension of Dredging

Suspension of dredging is generally a last resort option if all other mitigation measures and corrective actions as outlined above have been unsuccessful to control impacts and the compliance (red) trigger has been exceeded.

The work method for TSHD operations is designed to operate 24/7 so as to reduce the overall duration of the campaign which has both cost and environmental benefits compared to a longer term dredge operation or intermittent capital dredge operations that involve multiple deployments of vessels.

Notwithstanding this, suspension of dredging operations will be undertaken if compliance trigger levels in the RMP (level 3) are exceeded and dredging not re-commenced until water quality levels are within defined parameters.

(C2.1)5.6 Conclusion

A firm commitment to implementation of an adaptive management approach based on sound scientific principles and real time data is essential to confidently managing impacts from dredging and avoid significant impacts to affected marine habitats.

The process outlined in the Strategy above is seen as realistic and achievable to ensure the environmental goals of the Project are realised and impacts to the World Heritage Values of the Project Area are avoided or reduced to acceptable levels. It also allows flexibility to incorporate new technologies and apply lessons learned from dredging as part of Stage 1.

The specifics of the RMP will be determined by the expert advisory panel closer to the commencement of construction.

(C2.1)6 Structure of the DMP

The structure used for the DMP is as follows:

Item	Content
Element	The aspect of construction to be managed (as it affects environmental values).
Objective	The guiding policy of management objective that applies to the element.
Applicability	Aspect of dredging that this strategy applies to.
Performance Criteria	The measurable performance criteria (outcomes)/indicators for each element.
Implementation Strategy	The strategies, tasks or action programme (to nominated standards) that would be implemented to achieve the performance criteria.
Monitoring	The monitoring requirements to measure actual performance (i.e. specified limits to pre-selected indicators of change).
Auditing	The auditing requirements to demonstrate implementation of agreed construction and operation environmental management strategies and compliance with agreed performance criteria.
Reporting	The format, timing and responsibility for reporting of auditing and monitoring results.
Corrective Action	The action of options to be implemented in case a performance criteria is not reached and the person(s) responsible for action (including staff authority and management structure).

(C2.1)7 General Requirements – Dredge Management

This section of the document outlines the general environmental requirements of the DMP that a future dredge contractor would be expected to fulfil. POTL's role with respect to this section would be to ensure these requirements are addressed and met by the contractor as part of the contract and to ensure activities are being carried out consistently with any existing procedures or protocols in Port Limits or under relevant corporate environmental policies or strategies, and all approvals, conditions and licences.

Section (C2.1)8 (Environmental Elements) identifies particular elements or aspects of the dredging activity under which there are specific requirements that will need to be met in addition to the general requirements stated below.

General Requirements - Dredging	
Objective	To ensure dredging operations and associated activities comply with relevant environmental duties and obligations as set out in Queensland legislation and with environmental permit requirements.
Applicability	All capital dredging works and associated activities
Performance Criteria	All relevant permit and licence conditions will be met.
Implementation Strategy	The dredge contractor will need to address the following requirements: **General Method Statement** A general method statement will need to be prepared outlining the intended scope of works and methodology to be employed. At a minimum, the method statement should include the following: **Introduction** ▪ Description of the General Scope of Works (noting this may need to be by Stage only). ▪ References to International Dredging Standards. Company Standards (such as quality, OHS and environment management systems), how they apply to the current project and any other project specific document. ▪ Responsibilities of the Contractor and Key Staff (on the dredge vessel and on shore). ▪ Provide a clear map of the areas where the dredging activities are to take place consistent with regulatory approvals. ▪ Provide a general description of the dredging process and the specifics of the plant to be used in the dredging process including the dredging methods, dredging control, dredging patterns, vessel navigation routes to be used and vessel operations while at the pump out location including ancillary activities such as waste management and fuel bunkering. ▪ Include Specific Method Statements in accordance with the requirements outlined in Section C1.8 of this DMP. **Site-Based Environmental Management Plan (Dredge Operations)** Regulatory permits will likely require preparation of a site-based environmental management plan related to the dredging operation to be submitted to the relevant regulatory agencies (e.g. DEHP). The management plan (hereafter referred to as the 'Dredge Operations' EMP) must address the following: ▪ Environmental commitments – including a commitment by senior management of the contractor to achieve specified and relevant environmental goals; ▪ Identification of environmental issues and potential impacts; ▪ Control measures for routine operations to reduce the likelihood of environmental harm; ▪ Contingency plans and emergency procedures for non-routine situations; ▪ Organisational structure and responsibility; ▪ Effective communication; ▪ Staff training; ▪ Record Keeping; and ▪ Periodic review of environmental performance and continual improvement. In addition to the general requirements above, the Dredge Operations EMP must also address specific requirements (such as water quality monitoring) as outlined in Section C1.8 of this DMP. **Maintenance of Measures, Plant and Equipment** The dredge contractor must ensure that all measures, plant and equipment necessary to undertake the activity are operated and maintained in a proper and efficient condition.

General Requirements - Dredging	
	This includes appropriate servicing and maintenance of engines and emission control devices such that emissions comply with relevant guidelines and standards. **Complaint Response (General Requirements)** All complaints received by the dredge contractor related to environmental issues such as noise, air, or water quality must be recorded including investigations undertaken, conclusions formed and actions taken. Notification about the complaint and any associated response must be provided to POTL in a timely fashion. The complaint response procedure will include: (a) The time, date name and contact details of the complainant; (b) Reasons for the complaint; (c) Any investigations undertaken; (d) Conclusions formed; and (e) Any actions taken. **Reasonable and Practicable Measures** The dredge contractor must take all reasonable and practicable measures to prevent and/or minimise the likelihood of environmental harm being caused. **Notification of Environmental Harm** The dredge contractor is responsible for ceasing activities and notifying POTL and DEHP if it becomes aware of material or serious environmental harm (as defined in the Queensland Environmental Protection Act 1994) as a result of carrying out of the dredging and associated works. The contractor must also contact the relevant agencies as per approvals/legislation as soon as practicable after becoming aware of any release of contaminants not in accordance with the condition of any approvals granted. **Notifications of Commencement** The contractor must inform POTL and regulatory agencies of its intention to commence dredging in timeframes identified in any approvals granted.
Monitoring	**Record of Monitoring** The dredge contractor must keep records of all monitoring results required by POTL or as part of regulatory agency permit requirements. Specific monitoring requirements and the frequency of reporting are contained in Section 6. **Record of Dredging Volumes and Megafauna Sightings/Incidents** The dredge contractor must keep records on the volume and size distribution of material removed from the approved dredge footprint area. These records must be provided to POTL in the timeframe specified. The dredge contractor must also keep records of megafauna sighted and/or any incidents with megafauna as required in any apporvals granted.
Reporting	The documentation outlined in the Implementation Strategy above will need to be to the satisfaction of regulatory agencies. Copies of all plans will be provided to POTL for review prior to lodgement with regulatory authorities. A weekly report about dredging volumes must be provided by the contractor to POTL as outlined above. Other specific reporting requirements are outlined in Section 6 of this DMP.
Auditing	All relevant documentation outlined in the Implementation Strategy must be lodged and confirmed as approved by regulatory agencies prior to commencing work. Proof of this must be provided to POTL. Audits may be conducted by regulatory authorities periodically during any permit term. POTL may monitor contractor performance in line with DMP. Additional auditing requirements are outlined in Section 6 of this DMP.
Corrective Action	Corrective action will be required in the context of the findings of the audits or in the context of any issues raised by regulatory bodies. Corrective actions may also be required as a result of complaints from the community in accordance with the complaint response process outlined above.

(C2.1)8 Environmental Elements of the DMP

(C2.1)8.1 General

This section of the DMP identifies specific environmental strategies for each element of the DMP related to the dredging and dredge disposal (to land or the DMPA) activity that will need to be addressed by the dredge contractor.

Unless specifically stated, given the long timeframes involved and the scale of the Project over several stages, commitments to activities such as environmental monitoring may be undertaken by the contractor, by POTL or by a third party contracted by POTL depending on the procurement approach taken for the works. As such, the focus of the DMP is on outlining the management and monitoring commitments with the responsibility for implementing the commitments to be developed as part of the procurement strategy for the Project and subsequently as part of the operational dredge management plan in consultation with relevant Agencies.

The requirements in this section are intended to apply in addition to the general requirements outlined in Section C1.7 of this DMP and in most cases will need to be integrated in documentation and any conditions of approval imposed on the dredging activity under relevant legislation (including the EPBC Act, GBRMP Act, Sea Dumping Act and relevant State legislation).

POTL’s role with respect to this section would be to ensure these requirements are addressed and met by its appointed dredge contractor as part of project planning and to ensure activities are being carried out consistently with any existing procedures or protocols in Port Limits or under relevant corporate environmental policies or strategies.

(C2.1)8.2 Purpose

The purpose of the environmental strategies and DMP are to:

- Identify potential and actual environmental aspects and impacts associated with the works;
- Describe the appropriate measures to prevent, monitor and manage all possible effects; and
- Indicate the corrective action(s) to be undertaken if an undesirable impact or unforeseen level of impact occurs.

(C2.1)8.3 Elements and Structure

The following are the key elements that make up the DMP:

- Marine Megafauna Management;
- Tailwater Management;
- Sediment Quality;
- Vessel wastewater management (including washdown of plant and equipment);
- Ballast water and marine pest incursion management;
- Vessel waste management;
- Fuel management;
- Noise Quality;
- Air quality; and
- Emergency planning and procedures.

(C2.1)9 Marine Megafauna

This section outlines requirements that are to be met associated with the management of potential interactions between dredge equipment and marine megafauna. Management of underwater noise from marine piling and other construction activities associated with PEP are addressed in C2.2 – Construction Environmental Management Plan.

Element/Issue	Marine Megafauna
Objective	▪ To reduce the risk of disturbance or injury to marine mammals and sea-turtles resulting from the dredging and placement activities. ▪ Establish and maintain awareness of the importance of protecting marine mammals and sea turtles.
Applicability	All dredge vessels
Performance Criteria	▪ No incidents of vessel related disturbance to marine mammals and sea-turtles. ▪ All members of the dredging team to complete an induction, which will include information on marine mammal and sea turtle management requirements. ▪ Vessel masters and spotters trained in marine mammal and sea turtle interaction procedures.
Implementation Strategies	▪ Prior to commencement of dredging activities, employees responsible for marine megafauna spotting will receive training from a person suitably qualified in marine megafauna. ▪ A lookout will be maintained for cetaceans while the dredge sails between the dredging area and DMPA. In the event that a cetacean (except dolphins) is sighted, vessel speed and direction will be adjusted to avoid impact on the observed individual (within the safety constraints of the vessel). ▪ Marine mammals (except dolphins which are highly mobile) and turtles observation and response procedures including the application of a 300 m exclusion zone will be implemented during dredging and placement activities. Dredging operations shall be stopped where these fauna are observed within 300 m of the operating dredge until the animals have moved further than 300 m or have not been sighted for 15 minutes. ▪ Turtle deflectors will be mounted on the draghead of the TSHD. ▪ Dredge pumps will only be started when the draghead is close to the seafloor (not while lowering pipe). ▪ The dredge pump will be stopped as soon as possible after the completion of dredging. ▪ Light levels from the dredging works will be limited to those lights that are necessary for the safe operation of the vessel and the health and safety of those on board.
Monitoring	Marine mammals and turtle activity will be performed by a person at a suitable location on each vessel.
Auditing	POTL will undertake checks of the dredge contractor's compliance with the DMP at least once during the dredging campaign.
Reporting	▪ A record of sighted animals will be maintained, indicating the sighting of each individual animal and actions taken. ▪ Down-time will be reported as Environmental Delay in the equipment daily report. ▪ Immediate reporting of any incident involving injured or killed animals to POTL and regulatory agencies. ▪ Details of the incident are to be compiled into an incident report.
Corrective Action	▪ In the event of an environmental incident, appropriate emergency response measures shall be implemented to ensure environmental harm from the event is reduced. ▪ Assist in capture of injured animals per advice from regulatory agencies. ▪ Other strategies will implemented, as advised by regulatory agencies or POTL, to reduce likelihood of incident recurring.

(C2.1)10Tailwater Management

This section outlines requirements that are to be met associated with management of tailwater as a result of the operation of the Cutter Suction Dredge (CSD) in the outer harbour. The dredged material will be hydraulically placed by the CSD into the reclamation, with supernatant tailwater moving through the various cells of the reclamation to an ultimate discharge point at the mouth of the Ross River. The guidelines below identify environmental management measures and monitoring that will be undertaken by the construction/dredge contractor in undertaking this work.

<table>
<tr><th>Element/Issue</th><th>Tailwater Quality Management</th></tr>
<tr><td>Objective</td><td>To ensure discharge water (dredging tailwaters) released to the environment is of an acceptable standard.</td></tr>
<tr><td>Applicability</td><td>Tailwater from the reclamation area during operation of the Cutter Suction Dredge (CSD) in the outer harbour.</td></tr>
<tr><td>Performance Criteria</td><td>▪ Tailwater discharge is to achieve the following limit prior to release:
o TSS: 80th percentile < 100 mg/L (or equivalent turbidity level); and
o pH: between a range of 6.5 – 8.5.
▪ Specified number of exceedances of TSS/turbidity and pH trigger levels at the discharge outlet.</td></tr>
<tr><td>Implementation Strategies</td><td>▪ Cells to be established in a manner that maximises settlement of sediments and reduces further erosion and mobilisation of sediments.
▪ Development of a turbidity/TSS relationship to enable in situ turbidity readings to be taken on site and correlated to a TSS concentration. To achieve this, samples for TSS and turbidity are required to be taken at the same time, over a period long enough to provide a sufficient dataset necessary to determine a good correlation between the two parameters.
▪ If turbidity/TSS exceeds the performance criteria in the tailwater ponds, the control measures on site will be promptly reviewed to ensure that all reasonable and practicable measures are being taken in terms of both pond operation and the hydrologic and sediment loading on the tailwater ponds (refer to Corrective Actions below).
▪ ASS and PASS to be managed in accordance with the ASS Management measures outlined in Chapter B1 of the EIS.</td></tr>
<tr><td>Monitoring</td><td>Implement a tailwater monitoring program, comprising the following:
▪ Turbidity/TSS and pH monitoring of tailwater at the discharge point from the sediment ponds.
▪ Visual observations to check for scum formations, oil spills etc.
▪ Plume validation monitoring of turbidity/TSS in receiving waters adjacent to the discharge point. This monitoring is to be used to validate modelling results.</td></tr>
<tr><td>Auditing</td><td>POTL will undertake checks of the dredge contractor’s compliance with the DMP at least once during the dredging campaign. Reporting of tailwater performance to be provided to POTL regularly.</td></tr>
<tr><td>Reporting</td><td>Tailwater Monitoring Program
▪ Monitoring results to be maintained in a database within one week of each monitoring episode. On completion of the reclamation, the database is to be stored in accordance with legal retention requirements.
▪ A surveillance report is to be prepared at the completion of each monitoring episode. The surveillance report will be submitted to POTL within one week of each monitoring episode, and will identify any significant changes to tailwater discharge and corrective actions implemented.
▪ A post construction monitoring report will be prepared at the end of each stage of the reclamation process.
Incident Reporting
▪ An Incident Report is to be prepared in the event of any exceedances of performance criteria. The report will be submitted to POTL one week of the exceedance and stating corrective actions taken.</td></tr>
<tr><td>Corrective Action</td><td>If continual turbidity/TSS exceedances are observed, the following contingency actions could be implemented:
▪ Increase tailwater residence time in the tailwater pond.
▪ Redirect supernatant from the filling cells to other cells to allow further settlement before being discharged.
▪ Install additional controls (e.g. silt curtains) in the tailwater ponds.
If the pH of tailwater is outside of the specified range:
▪ Add lime or other mechanism to increase pH and monitor pH during dosing to limit risk of over dosing.</td></tr>
</table>

Element/Issue	Tailwater Quality Management
	▪ Review ASS/PASS treatment measures to ensure they are being properly implemented.

(C2.1)11 Sediment Quality

This section outlines requirements that are to be met associated with sediment quality, and outlines controls that will be implemented to reduce impacts to water quality, seabed and marine flora and fauna through the disturbance of any contaminated sediments. These are documented in Chapter B4 (Marine Sediment Quality), and are primarily designed to ensure contaminated sediments are identified through detailed sampling in accordance with the National Assessment Guidelines for Dredging and if detected, can be segregated and disposed of and at an appropriate onshore facility. The environmental commitments include the following actions:

- Development of a Sampling and Analysis Plan (SAP) and undertake sediment quality testing prior to works to characterise dredged sediments before dredge operations (note: while indicative testing has been undertaken, data is only valid for 5 years, therefore the SAP will be developed closer to the commencement of works to ensure currency of data).
- Obtain a sea dumping permit to lawfully dispose of dredged sediments offshore.
- Develop and implement procedures and arrangements to excise any contaminated materials to dedicated onshore spoil ground for treatment and dewatering before final disposal at an appropriate facility.

Element/Issue	Sediment Quality
Objective	To reduce impacts to water quality, seabed and marine flora and fauna through the disturbance of any contaminated sediments.
Applicability	All dredged material
Performance Criteria	▪ Ensure testing occurs in accordance with National Guidelines (i.e. NAGD). ▪ Ensure that material that does not meet NAGD requirements is not placed at sea. ▪ Placement to occur in accordance with future Sea Dumping Permit Conditions.
Implementation Strategies	▪ Identify materials suitable for ocean disposal, and those unsuitable for ocean disposal in accordance with the NAGD assessment framework. ▪ Only material suitable for sea disposal will be placed at DMPA. ▪ Use appropriate methods to excise any contaminated sediment hot spots identified by detailed sediment quality testing. ▪ Excised contaminated materials to be placed onshore in dedicated spoil treatment area, dewatered and treated if required, and disposed at an appropriately location, in accordance with relevant Queensland guidelines (and licensed if required).
Monitoring	**Construction Monitoring** ▪ Monitoring will be undertaken in accordance with the NAGD guidelines prior to construction as part of the SAP. ▪ Monitoring of treatment/dewatering of land based spoil disposal will be undertaken. **Long Term Monitoring** ▪ Once Stage A is constructed and operational, the existing long term sediment monitoring program will be extended to monitor operational impacts. ▪ Prior to construction of subsequent stages, further sediment testing will be undertaken to guide sediment management or disposal.
Auditing	POTL will undertake checks of the dredge contractor's compliance with the DMP at least once during the dredging campaign.

Element/Issue	Sediment Quality

Reporting	▪ Dredge volumes will be reported to regulatory agencies in accordance with any permits granted.
	▪ For any contaminated sediment excised and taken to land, report the following:
	  ▪ Volume excised
	  ▪ Treatment applied
	  ▪ Volume removed to landfill after dewatering
	  ▪ Any validation testing required
	Incident Reporting
	▪ The dredge contractor will prepare an Incident Report in the event of any corrective actions being implemented.

Corrective Action	As indicated above, corrective action will be taken where monitoring shows potential impacts to the marine environment from sediment contamination, or otherwise, where exceedances of trigger levels or permit conditions are observed. If sediments are identified that do not met NAGD guidelines, this material will be taken to land and dewatered, treated (if required) and appropriately placed.

(C2.1)12Vessel Wastewater Management

This section outlines requirements that are to be met associated with vessel washdown procedures during operations such as washdown of the decks and washdown of the dredge head and other equipment. It does not include discharge of sewage or other waste (addressed later in this document).

Element	Vessel Wastewater Management (including Washdown of Dredge Plant and Equipment)
Objective	To reduce the release of potential contaminants to the environment from washdown operations.
Applicability	All dredge vessels.
Performance Criteria	No inappropriate use of degreasers or washdown in sensitive environments.
Implementation Strategy	▪ Washdown of the deck and/or dredge head shall only be undertaken in accordance with relevant permits and approvals. ▪ Any solid waste collected on the dredge head will be washed down at the DMPA only. ▪ Degreasers only to be used if sweeping or watering the deck/equipment is not appropriate or practicable.
Monitoring	Visual inspection for contamination of waters while washing deck or equipment.
Auditing	Nil
Reporting	POTL is to be notified in the event of any unintentional spill of contaminant associated with washdown.
Corrective Action	If an unintentional release of contaminant occurs, review of procedures and rectify immediately.

(C2.1)13Ballast Water and Marine Pest Incursion Management

This section outlines requirements that are to be met by the dredge contractor associated with ballast water management before leaving the port of origin, during transit between areas of operation, during operations, and following completion of dredging activities prior to departing the Port of Townsville.

Element	Ballast Water and Marine Pest Incursion Management
Objective	To ensure risk of translocation of organisms in ballast water or on the hull of a dredge vessel is reduced.
Applicability	All dredge vessels and equipment brought in for the Project.
Performance Criteria	▪ No high risk ballast water brought into Port limits.

Element	Ballast Water and Marine Pest Incursion Management
	▪ Ensure ballast water discharge and marine pest inspections occur is in accordance with Department of Agriculture, Fisheries and Forestry (DAFF) standards. ▪ No harmful marine organisms are translocated on the underkeel hull, dredge heads or in the hopper of the dredge.
Implementation Strategy	**Port of Origin** Prior to leaving the port of origin: ▪ The dredge vessel is to be thoroughly washed. ▪ If discharge pipes have been utilised in prior operation, undertake a thorough flush of these systems. ▪ Inspect ship hull, hopper and dredge gear (especially dredge heads) to ensure that no material which may transport organisms (sediments, organic material, or waters) is retained. **During transit between Port of Origin and Port of Operations (Port of Townsville)** ▪ No deep water ballast exchanges to occur in the Great Barrier Reef Marine Park. ▪ Any ballast tanks holding seawaters to be exchanged with a minimum 150% of design volume with seawaters at a location as distant from the coastline or other shallow (<100 m) areas as possible but not less than 5 nautical miles from the coast (in accordance with IMO requirements). ▪ Any waters held in the hopper during transit to be treated as for other ballast waters. **During operation at Port of Townsville** ▪ On arriving at the port of operations, the dredge is to operate in accordance with DAFF and Australian Customs regulations. ▪ Hull inspections to be carried out if requested by DAFF for attached marine pests. Vessels to comply fully with DAFF requirements. **Leaving Port of Townsville** ▪ When leaving the port of operations, relevant DAFF rules pertaining to ballast water management are complied with.
Monitoring	Monitoring and audits may be carried out by DAFF on the dredge contractor at those agencies prerogative. POTL will assist the agency as required.
Auditing	See above.
Reporting	▪ Hopper water discharge and replacement records are to be kept in the Ship's log and made available upon request. ▪ A record will be kept of volumes, location and time of ballasting and deballasting operations.
Corrective Action	▪ If an unintentional release or exchange occurs, review of ballast and deballasting procedures and rectify immediately. ▪ If marine pests are encountered on ships hulls or other equipment, they are to be treated and removed in accordance with DAFF instruction before commencing work.

(C2.1)14Vessel Waste Management

This section outlines requirements to manage wastes generated from or incidental to the dredging operations. It is separated into three categories:

- Solid waste and garbage;
- Sewage treatment; and
- Hazardous waste management.

Element	Vessel Waste Management: Solid Waste and Garbage
Objective	To ensure that general refuse produced on-board the dredge vessel is collected, retained, and transferred to an appropriate facility without unintentional material loss.
Applicability	All dredge vessels.
Performance Criteria	▪ No loss of solid wastes material overboard during collection or transfer. ▪ No discharge other than at berth.
Implementation Strategy	▪ Vessel fitted with appropriately sized waste disposal bins. ▪ These bins are to be secured and fitted with secure lids to prevent material being blown overboard during storage or handling. ▪ Where practicable, ensure material compacted to further prevent unintentional loss. ▪ Ensure the bins are collected and emptied at appropriate intervals (e.g. emptied at 75% capacity or below).
Monitoring	Dredge crew to carry out regular visual inspections of collection points and visual inspection of on-deck bins.
Auditing	Nil.
Reporting	Dredge Contractor to report any loss of waste material or any community complaints received about solid waste management to POTL.
Corrective Action	If practicable, take measures to retrieve material that is lost. Review procedures causing material loss and take immediate action to rectify.
Element	**Vessel Waste Management: Sewage Treatment**
Objective	To ensure sewage generated on-board is appropriately treated and managed.
Applicability	All dredge vessels.
Performance Criteria	Sewage discharge to meet relevant legislative requirements (*Queensland Transport Operations (Marine Pollution) Act 1995* and regulation).
Implementation Strategy	During at sea operations: ▪ Sewage generated on-board is to be directed to the on-board treatment system. The system must be designed to meet the Queensland legislative standard for Grade A treated sewage. ▪ Effluent from the treatment system is only to be discharged in appropriate locations to ensure compliance with the *Queensland Transport Operation (Marine Pollution) Act and Regulations* (refer s.48 of the Act; Sch. 4 of the Regulations). ▪ The requirements of the legislation (including relevant maps) for treated and untreated sewage discharge are to be included as part of the dredge contractors EMP (Dredge Operations) and discussed as part of the training and induction process for relevant crew. ▪ Effluent is to be diverted to holding tanks when operating in nil discharge areas. The holding tank is to be pumped out either in accordance with untreated sewage requirements under Queensland legislation or otherwise by appropriate licensed contractors while the dredge is in port.
Monitoring	Monitoring of treatment system as required by legislation.
Auditing	Nil.
Reporting	Report about the testing and analysis of the treatment system and sewage discharge (as per monitoring section above) provided to relevant agencies including details of maintenance or corrective action. If untreated sewage is released in a nil discharge zone, the breach must be reported to Maritime Safety Queensland (MSQ) as soon as possible including estimates of the likely volume of sewage discharged and the location of the release. Depending on the volume of material discharged and the sensitivity of the location of the discharge, the dredge contractor may be directed to undertake water quality monitoring and/or clean up at its cost.
Corrective Action	Ensure regular review of sewage storage system inputs and operation. Modify procedures to meet discharge requirements.

Element	Vessel Waste Management: Hazardous Waste Management
Objective	To ensure hazardous waste generated on-board is appropriately managed.
Applicability	All dredge vessels.
Performance Criteria	No inappropriate storage or disposal of hazardous waste.
Implementation Strategy	During at-sea operations: ▪ Hazardous waste must be stored in an appropriate and secure manner and clearly marked in accordance with legislative requirements. During transfer: ▪ Where required, hazardous wastes shall be transferred to appropriate containers and transported to an appropriate facility for disposal. ▪ Collection and transport of designated hazardous wastes is to be undertaken only by a licensed contractor. Procedures to reduce spills or leakage during storage and transfer shall be followed. Spill response equipment must be easily identifiable and conveniently located so as to respond to a spill if it occurs.
Monitoring	Dredge crew to carry out regular visual inspections of hazardous waste storage containers to determine their integrity and identify if any spills or leakage has or is occurring.
Auditing	Nil.
Reporting	Incident reports to be provided to POTL detailing any spills or incidents involving hazardous waste and clean-up operations.
Corrective Action	If procedures breakdown or a spill occurs, procedures to be reviewed and staff trained about appropriate responses.

(C2.1)15 Fuel Management

This section outlines requirements that are to be met associated with the bunkering of fuel by the dredge vessel during the operation. This section deals with fuel transfer; the section below on emergency planning and procedures deals with general oil spills and response.

Element	Fuel Management
Objective	To ensure bunkering of fuel to the dredge vessel is appropriately transferred and spillage is prevented. In the event of a spill, there is a rapid response to reduce impacts on the marine environment.
Applicability	All dredge vessels that will require bunkering of fuel during the dredge campaign.
Performance Criteria	No spills or leaks during fuel transfer operations.
Implementation Strategy	During transfer: ▪ A licensed contractor is used; and ▪ Fuel levels are being monitored both by the contractor and the dredge vessel. Vessel to apply for and give notification as to the transfers of bulk liquids to Port Control as per Port of Townsville Procedures and appropriate forms.
Monitoring	Visual inspections of fuel-dispensing equipment and surrounding water are undertaken during operations and after fuel transfer.
Auditing	Nil.
Reporting	POTL is to be notified in the event of any unintentional spill of fuel or oil associated with fuel bunkering.
Corrective Action	If an unintentional release or spill occurs, review of procedures and rectify immediately. Implement contingency and clean up procedures as per relevant plans outlined in the Emergency Planning and Procedures DMP element.

(C2.1)16 Noise Quality

This section outlines requirements that are to be met with regard to nuisance noise issues from dredging operations.

Element	Noise Quality
Objective	▪ To protect the acoustic amenity and reduce nuisance noise on surrounding sensitive receivers. ▪ To respond effectively to any noise quality issues that arise during construction.
Applicability	All dredge vessels.
Performance Criteria	There are no complaints lodged from the public or port users about noise associated with dredge operations.
Implementation Stategy	▪ Ensure that engines and equipment on board the dredge are properly maintained in good working order. ▪ Maintain and operate all equipment on board the dredge in a safe and efficient manner. ▪ Carry out non-essential maintenance during day-light hours. ▪ The contractor staff are aware of noise requirements in relevant permits and/or approvals.
Monitoring	Investigation will be required in response to any noise complaints received during the dredging operation. If monitoring is necessary, it is to be conducted in accordance with the DEHP Noise Measurement Manual 2000 and AS2436-2.
Auditing	Nil.
Reporting	▪ The results of any noise monitoring are to be provided to POTL within 14 days following completion of any monitoring. ▪ In the event that the monitoring indicates an exceedance of a performance criteria set out in a permit or other statutory instrument, refer to Corrective Actions.
Corrective Actions	▪ In the event that responsive noise monitoring indicates an exceedance of the noise criteria, an investigation shall be undertaken into the noise source/s. ▪ The investigation will include, at a minimum, assessment of the layout and positioning of noise-producing plant and activities and determine actions that could be taken to reduce noise emission levels to surrounding receptors. ▪ Follow up measurements are to be conducted two weeks later to confirm whether excessive noise levels have continued. If noise levels continue to exceed criteria, the Contractor is to submit a plan to POTL indicating how noise can be further mitigated.

(C2.1)17 Air Quality

This section outlines requirements that are to be met with regard to nuisance air quality issues from dredging operations.

Element	Air Quality
Objective	▪ To protect the air quality of surrounding sensitive receivers. ▪ To respond effectively to any air quality issues that arise during construction.
Applicability	All dredge vessels.
Performance Criteria	▪ There are no complaints lodged from the public or port users about air quality associated with dredge operations.
Implementation Stategy	▪ Ensure that engines and equipment on board the dredge are properly maintained in good working order. ▪ Maintain and operate equipment on board the dredge in a safe and efficient manner. ▪ The contractor staff are aware of air quality requirements in relevant permits and/or approvals.

Element	Air Quality
Monitoring	Monitoring will be required in response to any air quality complaints received during the dredging operation.
Auditing	Nil.
Reporting	▪ The results of any air quality monitoring are to be provided to POTL within 14 days following completion of any monitoring. ▪ In the event that the monitoring indicates an exceedance of a performance criteria set out in a permit or other statutory instrument, refer to Corrective Actions.
Corrective Actions	▪ In the event that responsive air quality monitoring indicates an exceedance of the air quality criteria, an investigation shall be undertaken into potential cause/s. ▪ Follow up measurements are to be conducted two weeks later to confirm whether air quality is within performance criteria. If air quality continues to exceed criteria, the Contractor is to submit a plan to POTL indicating how air quality issues can be further mitigated.

(C2.1)18Emergency Planning Procedures

This section outlines requirements that are to be met associated with emergency planning and procedures for environmental incidents that could result from dredging and pump-out operations. This includes, but is not limited to, oil spills, ship collision, and similar incidents.

Element	Emergency Planning and Procedures
Objective	To identify and reduce the potential for an environmental incident before it occurs so as to prevent damage to the surrounding marine environment and the public.
Applicability	All dredge vessels.
Performance Criteria	▪ No environmental incidents occur during the dredging campaign. ▪ In the event of an incident, there is a rapid response to reduce impacts on the marine environment.

Implementation Strategy	▪ The dredge vessel has and maintains a shipboard oil pollution emergency plan (or equivalent) which outlines the role, responsibilities, and actions to be followed should an uncontrolled release of oils/fuels occur.
	▪ A risk assessment regarding potential environmental incidents that could occur during the dredge operation is to be prepared by the dredge contractor prior to commencing work. The risk assessment will:
	  ▪ Identify the incidents/hazards that may occur during the campaign
	  ▪ Identify the environmental consequences of the hazard occurring
	  ▪ For each hazard, identify measures that can be implemented to prevent the likelihood of the hazard occurring and/or will reduce the severity of consequences
	  ▪ Contingency measures that are to be implemented in the event of an incident occurring.
	▪ On-board procedures are to be made available to crew.
	▪ The vessel is to have at least two lines of communication (VHF and mobile phone) with port control and maintain constant contact.
	▪ Meet requirements of the Regional Harbour Master, including Notice to Mariners.
	Protocols will be developed with the Regional Harbour Master for dropping the anchor lines as part of normal operations to ensure safe passage of vessels.

Monitoring	Nil.
Auditing	POTL will undertake checks of the dredge contractor's compliance with the DMP at least once during the dredging campaign.

Element	Emergency Planning and Procedures
Reporting	POTL to be provided with copies of the following prior to the commencement of work: ▪ The shipboard oil pollution emergency plan as per Implementation Strategy. ▪ The environmental incident risk assessment as per Implementation Strategy. POTL is to be notified in the event of any incident while the vessel is operating in port limits.
Corrective Actions	If an incident occurs, review procedures and rectify immediately. Implement contingency and/or clean up procedures as set out in relevant plans.

Port Expansion Project EIS

Part C

Section C2.2 – Construction Environmental Management Plan

AECOM BMT WBM

(C2.2)1.0 Introduction

This Construction Environmental Management Plan (CEMP) details environmental management procedures to be incorporated into contractor's Environmental Management Plans (EMP) during the construction phase of the Port of Townsville Limited (POTL) Port Expansion Project (PEP).

The aim of the CEMP is to manage risk and reduce the potential for negative impacts on the environment associated with PEP construction. The CEMP has been developed from, and is consistent with, the PEP Environmental Impact Statement (EIS).

(C2.2)1.1 Project Overview

The Port of Townsville is located on Cleveland Bay, approximately three kilometres east of the city centre in Townsville, North Queensland (refer to Figure C.2.2.1). The port is situated in the Great Barrier Reef World Heritage Area and the majority of the port infrastructure is positioned in an excised portion of the Great Barrier Reef Marine Park.

The Port of Townsville is a multi-purpose port that handles predominantly bulk and general cargo. POTL proposes an expansion of the port to address current capacity constraints and accommodate the forecast growth in trade at the port over a planning horizon to 2040.

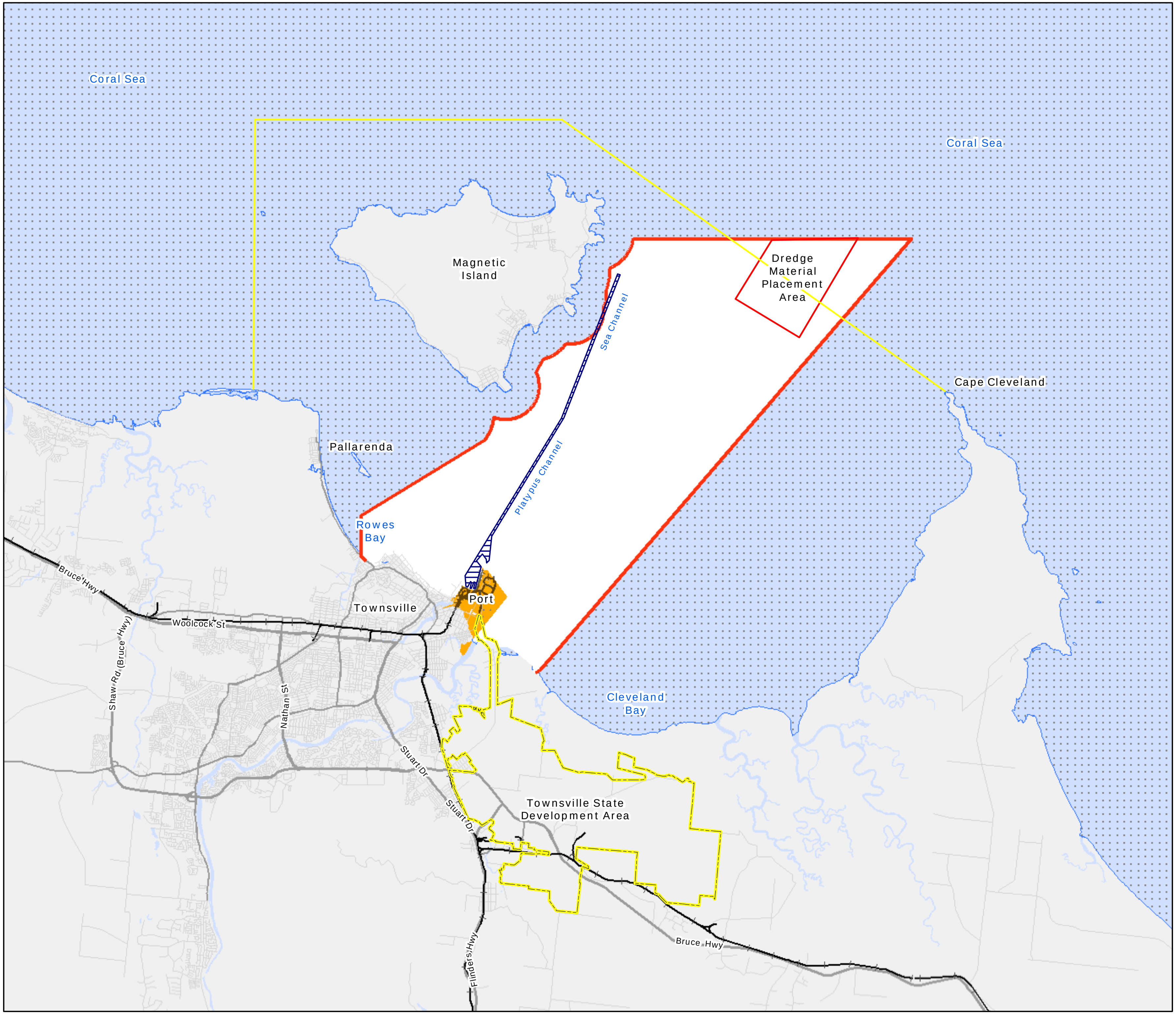
The PEP includes development of port infrastructure and work to 'top of wharf': dredging, reclamation, breakwaters and revetments, wharves, access roads, rail loop, and trunk services and utilities. The PEP does not include the development 'above wharf', which may include terminal pavements, shiploaders and unloaders, materials conveyors, storage buildings for transhipped products, rail loaders and unloaders, stacking and reclaiming equipment, storage tanks and pipelines.

As the Port develops individual Port tenant operations will be subject to separate statutory assessment and approval requirements. Operators will be required to obtain all necessary approvals and licenses in accordance with their statutory requirements prior to the start of operations or in accordance with statutory timing requirements.

PORT EXPANSION PROJECT EIS

Port of Townsville

Figure C.2.2.1



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Channel
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary
- GBRWHA/National Heritage Place

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_141

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012

(C2.2)1.2 Purpose

The purpose of this CEMP is to identify the preferred means of addressing and reducing potential adverse environmental impacts associated with the construction phase of the PEP. The CEMP:

- describes POTL's commitments regarding environmental performance and the reduction of adverse impacts
- specifies the actions that would be taken to implement the commitments (such as monitoring)
- identifies corrective actions to rectify any deviation from performance standards
- provides an action program to enable delivery of the environmental commitments so they are achieved and implemented.

The contents of this CEMP may be incorporated into either the successful construction tenderer(s) management plans or undertaken by the Port depending on ultimate contractual arrangements.

(C2.2)1.3 Scope

This CEMP only applies to the on land construction phase of the PEP.

Separate Dredge Management Plan (DMP), Vessel Traffic Management Plan for Construction (VTMPC) and a Maritime Operations Management Plan (MOMP) have been prepared to cover the in-water aspects and management associated with the dredging phase and vessel movements of the PEP and the future outer harbour operations.

A separate Operational Environmental management Plan (OEMP) has been prepared to cover operational activities associated with POTL's operation of the expanded port.

The key environmental values likely to be affected by on land construction activities associated with the PEP were identified in the EIS. These values are specified in Section (C2.2)1.8. For each key value identified, the environmental management procedures to address potential risks and impacts have been provided.

General environmental requirements for the construction phase are provided at Section (C2.2)1.7.

(C2.2)1.4 Terms of Reference

The CEMP also responds to the Queensland Government's *Townsville Port Expansion Project - Terms of reference for an environmental impact statement*, February 2012, issued by the Coordinator General (Appendix A1). Section 10 of the Terms of Reference states the detail required in the EMPs. The requirements of Section 10, and where these requirements are addressed in this CEMP, are shown in Table 1.

Table 1 Terms of Reference Section 10 - EMP Requirements

Requirement	Where addressed in this CEMP
Detail the EMPs for both the construction and operation phases of the Project.	This CEMP details the management measures for the construction phase. Separate EMPs have been prepared for operations, dredging and shipping.
The EMP is developed from, and be consistent with, the information in the EIS. The EMP must address discrete project elements and provide life-of-proposal control strategies. It must be capable of being read as a stand-alone document without reference to other parts of the EIS.	The Project elements from the EIS that require management measures are detailed in Section (C2.2)1.6 and form the basis of this CEMP.
The EMP must comprise the following components for performance criteria and implementation strategies: ▪ the proponent's commitments to acceptable levels of environmental performance, including environmental objectives, performance standards and associated measurable indicators, performance monitoring and reporting.	Refer to Section (C2.2)1.5 for an outline of POTL's environmental management system. Refer to Section (C2.2)1.8 for specific environmental commitments during construction.

Requirement	Where addressed in this CEMP
▪ impact prevention or mitigation actions to implement the commitments.	Management actions are provided in Section (C2.2)1.8.
▪ corrective actions to rectify any deviation from performance standards	Management actions are provided in Section (C2.2)1.8.
▪ an action program to ensure the environmental protection commitments are achieved and implemented. This will include strategies in relation to: ▪ continuous improvement ▪ environmental auditing ▪ monitoring ▪ reporting ▪ staff training ▪ a rehabilitation program for land to be disturbed under each relevant aspect of the proposal.	An action program is provided in Section (C2.2)1.9. Management actions are provided in Section (C2.2)1.8.
The recommended structure of each element of the EMP is: ▪ element/issue ▪ operational policy ▪ performance criteria ▪ implementation strategy ▪ monitoring ▪ auditing ▪ reporting ▪ corrective action	Refer to Section C.1.8.1.

The Terms of Reference also refer to additional information that is to be provided in the EMPs. The information required - and where these requirements are addressed in this CEMP - are paraphrased in Table 2.

Table 2 Terms of Reference - Additional EMP requirements

Section from Terms of Reference	Requirement	Where addressed in this CEMP
5. Environmental values and management impacts	*The mitigation measures, monitoring programs etc., identified in ... the EIS should be used to develop the EMP for the Project.*	The CEMP has been developed from, and is consistent with, the PEP EIS.
3.6.2 Objectives of the EIS	*The purpose of the EIS is to:... provide information to formulate the Project's EMP*	
5.3.5 Transport management strategies	*Conditions of approval for transport management impacts should also be detailed in the EMP.*	Transport impacts and transport management measures are provided in Section C.1.8.10.
5.5.1 Sensitive environmental areas	*Outline how these measures* [to mitigate impacts on sensitive environmental areas] *will be implemented in the overall EMP for the Project.*	Measures to mitigate impacts on sensitive marine and land environments are provided in Section (C2.2)1.8.
	The overall EMP for the Project should address the performance requirements of the relevant policies and regional vegetation management codes published by DERM.	There is no on-land vegetation impact by the PEP. DEHP performance requirements are not applicable. Mitigation measures for terrestrial ecology are provided in Section C.1.8.5.
5.5.2 Terrestrial flora	*Include details of any post construction monitoring programs.*	Not applicable. There is no terrestrial flora to monitor. .
	Outline how these measures [addressing harm to the ecological values of the area] *will be implemented in the overall EMP for the Project.*	Not applicable. There are no terrestrial flora impacts to mitigate.

Section from Terms of Reference	Requirement	Where addressed in this CEMP
	Discuss the [weed management] *strategies in accordance with provisions of the Land Protection (Pest and Stock Route Management) Act 2002 (Qld)...in the pest management plan in the EMP for the Project.*	Pest management element is provided at Section 8.15.
5.5.3 Terrestrial Fauna	*Outline how these measures* [for protecting rare or threatened species] *will be implemented in the overall EMP for the PEP.*	Mitigation measures for terrestrial ecology are provided in Section C.1.8.5.
	Discuss the [feral animal (including pest)] *strategies in accordance with the provisions of the Land Protection (Pest and Stock Route Management) Act ... in the pest management plan in the EMP for the PEP.*	Pest Management element is provided at Section 8.15.
5.5.4 Aquatic ecology	*Outline how ...* [aquatic ecosystem] *measures will be implemented in the overall EMP for the PEP.*	Aquatic ecology aspects are covered in the Construction Dredging Management Plan.
5.6.2 Potential impacts and mitigation measures	Incorporate strategies to enhance water resource values into the EMP. (paraphrased).	Mitigation measures for water resources are provided in Section C.1.8.3.
13 Appendices – Consultation report	*...plans for ongoing consultation to be outlined and included in the EMP.*	Refer Section (C2.2)1.10

This CEMP has also been prepared to satisfy the requirements of Section 5.11 of the *Commonwealth Guidelines for an Environmental Impact Statement for Port of Townsville Port Expansion Project*, *Queensland*, as they apply to the construction phase.

C.1.4.1 Legislation

The CEMP has been developed cognisant of legislative requirements set out in Commonwealth and State Government Acts and Regulations. Specific requirements including permits and works approvals are described in Section C1.0 – Overview of environmental management.

C.1.4.1.1 Commonwealth Legislation

Commonwealth legislation considered in development of this CEMP (including Acts implementing relevant international conventions) includes:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Great Barrier Reef Marine Park Act 1975.*

C.1.4.1.2 State Legislation

The following State legislation is relevant to the construction and has been considered in the development of this CEMP:

- *State Development and Public Works Organisation Act 1971*
- *Coastal Protection and Management Act 1995 and Coastal Management Plans*
- *Environmental Protection Act 1994*
- *Fisheries Act 1994 and Regulations*
- *Marine Parks Act 2004 and Marine Parks (Great Barrier Reef) Zoning Plan*
- *Land Act 1994*
- *Nature Conservation Act 1992*
- *Transport Infrastructure Act 1994*
- *Sustainable Planning Act 2009 and Regulations.*

C.1.4.1.3 State Policies and Plans

The following State policies and plans are relevant to the construction and have been considered in the development of this CEMP:

- Environmental Protection Policies
- Conservation Plans
- Queensland Coastal Plan
- Port notices and Port Land Use Plan.

(C2.2)1.5 Environmental Management Framework

This section describes POTL's commitments regarding environmental performance and the reduction of adverse impacts.

C.1.5.1 Environmental Management System

POTL maintains its commitment to sustainable development and operation through its Environmental Management System (EMS). The EMS provides a framework for environmental management at the port and reflects POTL's Environmental Policy and commitments to manage its activities with concern for people and the environment.

POTL's EMS is compliant with AS/NZS ISO 14001 2004 and facilitates continual improvement of environmental performance by:

- integrating environmental considerations into decision making and work practices related to the Corporation's core functions
- maintaining a high level of environmental awareness throughout the Corporation and the wider port community
- utilising systems which act to reduce the risk of environmental harm through the identification reporting, assessment, monitoring and control of environmental risks.

This CEMP includes the work elements necessary to satisfy environmental requirements in the construction phase of the PEP and generally complies with applicable elements of POTL's EMS.

Continuous improvement is a mandatory requirement of POTL's EMS. As part of the continuous improvement, the CEMP may be updated or amended as required, which may include being merged with other documents to streamline the EMP documentation or be incorporated into the contractors CEMP. Any future amendments will take into account the intent of this document and the conditions of the existing approvals.

C.1.5.2 Environmental Policy

POTL Environmental Policy applies to POTL lands, including the common user areas of the port. It is:

- displayed at prominent locations in the workplace of POTL employees and on the website
- communicated to POTL employees and contractors during induction and training
- reviewed regularly.

POTL personnel, contractors and visitors must comply with the spirit and intent of the policy.

POTL's Environmental Policy (POTL, 2011a) states:

> *Port of Townsville Limited (the Corporation) and its senior management are committed to the protection of the environment and considers it as critical corporate value in the delivery and maintenance of port infrastructure and services and in planning for the future development of the Port of Townsville and Port of Lucinda.*
>
> *The Corporation is committed to sustainable development and operation through responsible environmental management and continual improvement of environmental performance and the effectiveness of its Environmental Management System.*

To achieve corporate performance consistent with this policy, the Corporation will employ the following principles:

- *Integrate environmental considerations into decision making and work practices related to the Corporation's core functions.*
- *Maintain a high level of environmental awareness throughout the Corporation and the wider port community.*
- *Implement systems which act to minimise the risk of environmental harm through the identification, reporting, assessment, monitoring and control of environmental risks.*
- *Establish a framework for setting and reviewing environmental objectives and targets and measuring the Corporation's performance.*
- *Establish and maintain systems for assessing the environmental impacts associated with the Corporation's activities, identifying and acting on opportunities for improvement.*
- *Compliance with all relevant legislation, codes of practice and standards.*
- *Core functions to be conducted in a manner that will minimise waste, prevent pollution, promote efficient use of resources, reduce environmental impacts, and continually improve environmental and management system performance.*
- *Providing adequate resources including finances, to facilitate the fulfilment of the Corporation's environmental responsibilities.*

Senior Management is responsible for providing the leadership to support the development and implementation of this Policy and for ensuring it is effectively applied.

This policy will be regularly reviewed following legislative or organisational changes, or as a minimum, every three years.

(C2.2)1.6 Project Description

This section describes the construction phases of the PEP and the key components of work (Table 3).

Table 3 Summary of Key PEP Construction Components

Component	Description
Construction of breakwater and land perimeter revetments	
Breakwater and revetment infrastructure (around reclamation perimeter).	▪ A new north-eastern rubble mound breakwater with rock armouring will be constructed approximately one kilometre seaward of the existing eastern breakwater. ▪ Revetments with rock armouring will be constructed to protect the north-eastern and eastern edges of the reclamation area. ▪ The breakwater and revetment layouts will be configured to provide a protected outer harbour basin and the structural design will address extreme wave and water level events for the port infrastructure and land reclamation.
Western Breakwater (if required).	▪ Contingent upon detailed analysis, construction of a new western breakwater for additional outer harbour protection without affecting the port design and operations.
Dredging works for augmentation of channels and development of outer harbour	
Handling and placement of dredged sediments (onshore).	▪ Approximately 4,300,000 m^3 of dredged marine sediments from the outer harbour basin will be placed in bunds in tidal waters as part of land reclamation activities (note that management of dredge tailwater is addressed in the DMP, Chapter C2.1) ▪ Dewatering and ground improvement of emplaced sediments on tidal lands will be undertaken.
Development of Port Land	
Bunds and treatment areas	▪ A reclaimed area of approximately 100ha will be developed on tidal lands eastwards of the existing harbour (and defined by the north-eastern and eastern revetments and the wharf alignments).

Component	Description
	▪ Selected fill material from land sources will be used to build bunds over tidal lands, constructed as conventional earth/rock fill structures, to contain the reclamation material. ▪ Internal bunds will be constructed on the alignments of future key infrastructure (including rail and roads) as suitable foundations for heavy loading. ▪ Bund structures will be constructed and configured to retain fill in stages and provide settlement areas for the temporary management and treatment of reclamation tailwater and thereafter permanent reclamation areas for created land. ▪ Select ponds will be used for the treatment of stormwater. ▪ A surface capping layer (approximately one metre thickness) and pavement layer will be applied over land-sourced fill material (approximately 700,000 m3 imported fill).
Port Infrastructure	
Berths and wharves	▪ Up to six berths will be constructed in the outer harbour (termed Berth 14 through Berth 19) to support import and export trades and cargo handling requirements ▪ At berths, wharves will be constructed similar to the existing wharf structures for vessel berthing, mooring, loading and unloading of general cargo, dry bulk and bulk liquid goods. ▪ Berths will be sized for vessels with a nominal length overall of 250 metres. ▪ Construction will be staged to meet the demand for cargo throughput. This may be sequential on a berth-by-berth basis, or in stages involving multiple berth development. ▪ Berth pockets will be dredged to an all-tides depth of approximately -15.5 m CD.
Development on port land and ancillary services	

Cargo storage and handing areas	▪ Land area of approximately 100 ha to accommodate:
	    ▪ cargo operations, from approximately 52 metres behind the quayline
	    ▪ cargo storage area approximately 175m wide
	    ▪ road and rail transport corridors
	    ▪ cargo storage area in rail loop
	▪ Final finished reclamation level nominally +7.5m CD (+5.6m AHD) adjacent to the wharf structures and falling to the eastern revetment to accommodate drainage of stormwater.

Road Infrastructure	▪ Internal circulation road in a corridor 25 metres wide on the reclamation area to access facilities and key infrastructure. Vehicles ranging from cars to articulated combination vehicles will have access. ▪ Connection via existing Benwell Road to the Eastern Access Corridor (currently under construction). ▪ A turning area for articulated combination vehicles at northern end of the main access road. ▪ The road corridor will include a single traffic lane in each direction. Smaller access corridors along the back of wharves and from the main access road to storage areas will be built.
Rail Infrastructure	▪ A rail reserve 25 metres wide on the reclamation area to service bulk goods haulage. ▪ A 200 metre radius, three track rail loop behind cargo storage and handling areas with provision for future train lengths of 1,500 metres. ▪ Connection to the Eastern Access Corridor and existing rail network.
Buildings	▪ A port operations building to include administration facilities for POTL may be constructed.

Component	Description
	▪ A harbour control tower may be constructed. ▪ Provision for infrastructure for cargo storage and transfer in relation to rail and road access.
Utilities and other services	▪ Installation of services infrastructure relating to stormwater, water supply (including for fire fighting), power supply, waste water reticulation and telecommunications. ▪ Below ground services in the road corridor. ▪ Installation of a Zone substation in the port expansion area consisting of two (66kV to 11kV) transformers. ▪ Port security infrastructure. ▪ Area and road lighting.
Maritime operations	
Vessel movements during construction	▪ Management of vessels in regards to fauna strike. ▪ Implementation of safe vessel practises. ▪ Establishment of temporary navigational aids. ▪ Setting of vessel speed limits and movement areas. Refer to Vessel Traffic Management Plan (Construction) for full details.

C.1.6.1 Construction Activities

The construction phase of the PEP includes the development of the following infrastructure and construction activities:

- construction of a new breakwater approximately 1km seaward of the existing eastern breakwater to form a new deep water outer harbour
- possible construction of a new western breakwater to protect the outer harbour
- construction of up to six additional berths in the new outer harbour (Berth 14 through Berth 19) sized for vessels with a nominal length overall of 250m
- creation of approximately 100ha of reclaimed land backing the new berths to accommodate a cargo operations zone of 52m behind the wharf; a cargo storage area (175m deep to allow for two material storage facilities and associated equipment) a rail loop; and internal bunds to facilitate effective land reclamation
- installation of new aids to navigation
- construction of new road and rail infrastructure (road reserve 25m wide; and rail reserve 25m wide for three tracks) in the Project footprint and connection to the Eastern Access Corridor (EAC) currently under construction
- installation of new services infrastructure – stormwater, water supply, power, waste water, telecommunications, Port security infrastructure and areas and road lighting
- located in the reclamation area, construction of pond(s) for the treatment of tailwater from dredged material, for the separate containment of any contaminated material arising from the dredging, and for treatment of stormwater during the construction phase.

The spatial dimensions of the development and its layout are shown on Figure C.2.2.1.

C.1.6.2 Materials

The land area required for the PEP will be reclaimed using dredged material from the outer harbour basin.

Selected fill material will be required from land sources to build bund structures to retain the dredged fill, to protect the reclamation from erosion and wave attack, and provide settlement areas for the management and treatment of the reclamation tailwater. Good quality fill material will also be required for construction of capping and pavement layers on the surface of the reclamation.

The bund walls will be constructed as conventional earth/rock fill structures. POTL intends to use the quarry (POTL) to supply the rock required for the breakwaters, revetments and bund walls for the PEP. The quarry is located in the Pinnacles area, 30km south-west of Townsville.

Concrete for wharf construction will be transported to the site by road from various suppliers in the region via the new EAC.

Steel piles will be used for wharf construction. It is expected that the piles will be delivered by ship directly to the port and transported from the wharf to the construction site by the port's internal road system.

Other construction materials (steel reinforcement, pipes, culverts, etc) will be transported to the site by road from various suppliers in the region via the new EAC.

C.1.6.3 Design Requirements

Those perimeter bund walls exposed to the sea will be designed to withstand extreme metocean conditions with limited overtopping.

The construction of the walls will be made impervious to retain the tailwater and avoid turbidity plumes generated by the draining of water containing fine material from the dredged material escaping untreated to the sea.

The perimeter bund structure would typically incorporate a height adjustable weir box in the last settling pond to control the overflow tailwater discharge over a period of time.

Internal bund walls will control the movement of sediment and water so that areas can be dewatered and suspended sediments can settle to control the quality of tailwater. As for the perimeter walls, internal bund walls need to be fully impermeable but are only required to withstand wind-wave action that may be generated from the bunded areas.

Height adjustable weir boxes are required between bunded areas to control the flow of water and suspended sediments. These are generally located to create a long path for the movement of water to maximise retention time.

C.1.6.4 Construction Period

Construction of the PEP berths and associated land-side infrastructure is scheduled to occur over many years as shown below:

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Stage A	Berths 14 & 15																	
Stage B					Berth 16													
Stage C													Berth 17					
Stage D																	Berths 18 & 19	

Prior to Stage A, a pre-construction period leading up to 2014 will be required for preparatory and site establishment activities required prior to construction proper.

Construction of berths is scheduled over four stages (Stage A to D).

There are six key construction activities over the sequence of stages:

- *Construction of the Main Breakwater and Perimeter Revetments.* Construction will be undertaken in Stage A and completed in Stage D.
- *Construction of the Western Breakwater* (if required). Construction would be undertaken in Stage A.
- *Dredging.* Dredging is covered in the DMP. Dredging of the outer harbour basin would occur during Stages A, B and C.
- *Construction of the reclamation area* – commences in Stage A and continues throughout construction phases.
- *Installation of road, rail, civil works and services* – commences in Stage A and continues throughout construction phases.

- *Wharf construction* – commences in Stage A and continues throughout each of the construction phases for the respective berths.

C.1.6.5 Construction Equipment

During the construction phase, for the land-based construction activities, a range of plant and equipment will be used to develop the Port, including:

- trucks (on road and off-road)
- excavators
- bulldozers
- cranes
- utility vehicles
- transport barges and tug/s for barges
- workboats
- survey boat/s
- front end loaders
- stone column or wick drain rig
- bobcats
- grader
- paving machine
- track machine
- barge mounted pile driver.

(C2.2)1.7 General Requirements

This Section outlines the general environmental requirements that Construction Contractors would be expected to fulfil, in addition to meeting specified requirements for the environmental values set out in Section (C2.2)1.8.

Contractors would be expected to address these general requirements as part of project planning, and throughout the construction period. This is to confirm that activities are being carried out consistently with any existing procedures or protocols and comply with relevant environmental duties and obligations as set out in Queensland legislation and with environmental permit requirements.

C.1.7.1 General Method Statement

For each construction work package, a general method statement will be prepared outlining the intended scope of works and methodology to be employed. At a minimum, the method statement will include the following:

- introduction
- description of the general scope of works (noting this may need to be by Stage only)
- references to relevant legislation, company standards (such as quality, OHS and environment management systems), how they apply to the current project and any other project specific document.
- responsibilities of the contractor and key staff.
- a clear map of the areas where the construction activities are to take place consistent with regulatory approvals.
- a general description of the construction process and the specifics of the plant to be used including the construction methods and controls.
- specific work Method Statements.

C.1.7.2 Site/Activity-Based Environmental Management Plan

A site/activity-based EMP will need to be prepared by the construction contractor prior to commencement of construction. The contractor's EMP must address the following:

- environmental commitments – including a commitment by senior management of the contractor to achieve specified and relevant environmental goals
- identification of environmental risks and potential impacts
- control measures for routine operations to reduce the likelihood of environmental harm
- a suitable Emergency Spill/Incident Response Plan and Cyclone Plan
- contingency plans and Emergency Response Procedures for non-routine situations organisational structure and responsibility
- effective communication
- monitoring of contaminant releases
- conducting environmental assessments
- staff training
- record keeping
- periodic review of environmental performance and continual improvement
- develop and implement hazardous material handling procedures.

C.1.7.3 Hazardous Substances, Health and Safety

The construction contractor will meet OHS requirements as they will be contractually obliged from POTL.

Precautions will be taken to protect the health and safety of people working at the site. Particularly in light of climate change impacts and potential for increased high-temperature days, cyclones and storm events. The construction contractor will consider precautions including:

- developing stop-work procedures for extreme heat days
- providing appropriate PPE and educate/induct staff on managing heat stress
- monitoring heat stress incidents and adjusting practices if the number of incidents increases
- site evacuation training.

C.1.7.4 Maintenance of Measures, Plant and Equipment

The construction contractor must check that measures, plant and equipment necessary to undertake the activity are operated and maintained in a proper and efficient condition.

This includes appropriate servicing and maintenance of engines and emission control devices such that emissions comply with relevant guidelines and standards.

C.1.7.5 Reasonable and Practicable Measures

The construction contractor must take reasonable and practicable measures to prevent and/or reduce the likelihood of environmental harm being caused.

C.1.7.6 Notification of Environmental Harm

The construction contractor is responsible for ceasing activities and notifying POTL if it becomes aware of material or serious environmental harm (as defined in the Queensland *Environmental Protection Act 1994*) as a result of carrying out of the construction works. In such circumstances, the contractor must also contact POTL and the Queensland Department of Environment and Heritage Protection (DEHP) Pollution Hotline or local DEHP office as soon as practicable after becoming aware of any release or emissions not in accordance with conditions of approval or licences. Additionally to otherwise express the general environmental duty which is to '.....do all that is reasonable and practicable to minimise the risk of environmental harm'.

Other notifications may be required in accordance with legislation and port notices as relevant to the specific environmental harm event.

(C2.2)1.8 CEMP Elements

This section of the CEMP identifies specific environmental management procedures related to the on-land construction phase of the PEP. The requirements in this section are intended to apply in addition to the general requirements outlined in Section (C2.2)1.7 of this CEMP. In most cases it will need to be integrated in broader site-based management plans and documentation and any conditions of approval imposed on the PEP under relevant legislation.

These requirements are to be addressed by either POTL or its construction contractor (whomever is applicable) as part of project planning so that the activities being carried out are consistent with any existing procedures or protocols in port limits or under relevant corporate environmental policies or strategies.

C.1.8.1 Structure of the EMP

The following environmental values have been identified in the EIS as key risks for the set of factors that require consideration in the CEMP:

- land
- water resources (surface water aspects) *
- marine water quality (reclamation aspects) *
- marine sediment quality (reclamation aspects) *
- marine ecology and conservation (reclamation aspects) *
- terrestrial ecology;
- air quality
- noise and vibration
- greenhouse gases
- waste
- transport and infrastructure
- indigenous cultural heritage
- visual amenity and lighting
- pest management
- hazards and hazardous materials.

*Note: Marine aspects in relation to these factors are described in the DEMP.

For each value identified, an environmental management strategy and actions have been developed to address potential risks that may arise. Each value has a stated environmental objective, performance criteria, management actions, monitoring, reporting, and corrective actions. The structure used for the strategy and actions is outlined in Table 4.

Table 4 CEMP Structure

Order of implementation	Plan Component	Description of Content
1	Environmental risks (Aspect-Impact)	The environmental aspect of construction requiring management response - strategies and actions.
2	Environmental Performance Objective	The guiding performance objective that applies to the values of the factor.
5	Management Actions	The mechanisms and management actions through which the performance objective will be achieved.

Order of implementation	Plan Component	Description of Content
3	Performance Criteria	The criteria by which the success of the implementation of the policy will be determined.
4	Monitoring and Reporting	The process of measuring actual performance, or how well the policy has been achieved, including format, timing and responsibility for reporting and auditing of the monitoring results.
5	Corrective Action	The action to be implemented and by whom in the case where a performance criterion is not met.

A separate table is provided to address each value (refer to Sections C.1.8.2 to 8.15). Mitigation of some potential impacts, such as the removal of marine habitat through reclamation, will be considered through potential offsetting opportunities rather than construction management measures, and are not included in this CEMP.

C.1.8.2 Land

Aspect Impacts	▪ Disturbed dredged or excavated PASS material, or imported contaminated soil/fill could be placed in the reclamation area. ▪ Spills or leakage of fuels/oil and other contaminants, hazardous materials or dangerous goods, may cause soil contamination.
Environmental Performance Objectives	To reduce the risk of environmental harm as a result of changes to landforms in relation to : ▪ Contamination; and ▪ Acid Sulfate Soils
Performance Criteria	▪ No soil contamination from leaks, spills on site or other hazardous material brought to site. ▪ No contaminated fill from external sources brought into site. ▪ ASS management procedures and plans developed and implemented as part of subsequent approvals.
Monitoring and Reporting	▪ Regular site inspections to check for leaks, spillage and damage to bunded/storage/refuelling areas and equipment. ▪ Monitor the pH of retained water in the dewatering ponds.. ▪ Monitor and record sources, condition and movement of fill.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Maintain significant depths of filling over soft Holocene sediments in the reclamation area to prevent heaving and displacement of PASS above sea level.	Construction contractor	During construction of the reclamation area.	Review reclamation management practices if adverse impacts are observed.
As a general precaution (once the reclaimed height is above sea level), provide a 10m wide 'guard layer' of agricultural lime on the seaward edge batters under the fill platform Such a barrier layer would consist of a surface application of agricultural lime ($CaCO^3$) applied at a minimum rate of 1-2 kg/m^2.	Construction contractor	During construction of the reclamation area.	Review reclamation management practices if adverse impacts are observed.
To reduce the risk of fuel/oil spills undertake regular inspections and maintenance of machinery: ▪ daily inspection of machinery ▪ undertake maintenance of site machinery and vehicles as soon as practicable after the requirement is identified ▪ inspection for leaks prior to allowing any external	Construction contractor	Throughout the construction period.	Any material impacted by spills shall be managed through: ▪ investigation ▪ excavation of impacted material. Disposal of impacted material at a suitable disposal facility, with appropriate EHP approvals and by a licensed waste disposal subcontractor.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
vehicles or machinery on site).			
Store hazardous materials, chemicals, oils and fuels in clearly designated areas, as far as practicable from residences, watercourses and other sensitive receptors. Storage areas are to consist of a compacted base and bunding to contain spillages, as per AS/NZS 3833:2007, AS 1940:2004, AS 3780:2008, AS/NZS 4452:1997 and AS/NZS 4681:2000 and any other standards applicable to the time of construction. Storage areas to be roofed to prevent contamination and infiltration of stormwater.	Construction contractor	Install designated storage areas prior to storing hazardous material on site.	Undertake repairs to bunded area to mend cracks and damage in as soon as practicable following detection. Clean up any spilled material promptly.
Maintain storage to quantities to limits specified. Maintain an up-to-date hazardous and potentially hazardous materials register on site.	Construction contractor	Throughout construction period.	Where on site storage exceeds minor storage limits, a permit shall be obtained from the appropriate authority for bulk storage of chemicals, oils and/or petroleum products.

C.1.8.3 Water Resources (stormwater and drainage)

Aspect impacts	▪ Increased turbidity of marine waters during construction of PEP lands due to sediment in stormwater runoff (note that dredge tailwater management is discussed in the DMP, Chapter C2.1) ▪ Stormwater contamination may arise due to oil/fuel leaks and spills into Cleveland Bay. ▪ Effects on marine life, as well as indirect potential impacts to human health, through the exposure and potential release of contaminants in stormwater to marine waters.
Environmental Performance Objectives	▪ No adverse impacts to water and sediment quality of Cleveland Bay. ▪ Reduce the load of contaminants into the environment from construction activities. ▪ Reduce the dispersion of turbidity from stormwater discharges beyond the development footprint.
Performance Criteria	▪ No exceedance of limits set in reactive monitoring programme for suspended sediment concentrations for open waters. ▪ Fuel / chemical storage is secure or any spill is adequately contained and cleaned up. ▪ No failure of erosion and sediment controls.
Monitoring and Reporting	▪ Regular inspections of stormwater runoff areas to check for cleanliness and potential for contaminants to impact on water quality; ▪ Regular site inspections to check for leaks, spillage and damage to bunded storage areas; ▪ Immediately notify POTL in the event of an uncontained spill; ▪ Site specific management actions including erosion and sediment controls, will be developed and implemented by the contractor prior to construction.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Surface drainage from the reclaimed area is to be controlled through appropriate site management (i.e. drainage reports to sediment ponds and drains are collected and prevented from entering the sea by use of low bunds, sand bags or other temporary control measures). The on-site containment will be integrated in the turbidity management/treatment that is required for any discharge water.	Construction contractor and POTL during periods between construction stages.	During construction of the reclamation area.	Temporarily cease releases to prevent outflows and to increase retention times in accordance with the reactive monitoring plan for dredge tailwater (refer to Chapter C2.1)
To reduce the risk of fuel/oil spills, undertake regular inspections and maintenance of machinery: ▪ daily inspection of machinery ▪ undertake maintenance of site machinery and vehicles as soon as practicable, after the requirement is identified ▪ inspection for leaks prior to allowing any external vehicles or	Construction contractor	Throughout construction period.	Any material impacted by spills shall be managed through: ▪ investigation ▪ excavation of impacted material ▪ disposal of impacted material at a suitable disposal facility, with appropriate EHP approvals and by a licensed waste disposal

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
machinery on site.			subcontractor.
Store hazardous materials, chemicals, oils and fuels in clearly designated areas, as far as practicable from residences, watercourses and other sensitive receptors. Storage areas are to consist of a compacted base and bunding to contain spillages, as per AS/NZS 3833:2007, AS 1940:2004, AS 3780:2008, AS/NZS 4452:1997 and AS/NZS 4681:2000 and other standard applicable at the time of construction. Storage areas to be roofed to prevent contamination and infiltration of stormwater.	Construction contractor	Install designated storage areas prior to storing hazardous material on site.	Undertake repairs to bunded area to mend cracks and damage as soon as practicable following detection. Clean up any spilled material promptly and test discharged waters prior to release to marine areas.
Reduce the likelihood and impact of contaminant spills by: ▪ Developing and implement hazardous material handling procedures ▪ Implement emergency response procedures ▪ Undertake spill response training for staff ▪ Install oil and grit separators for equipment maintenance areas on site ▪ Provide spill control materials including booms and absorbent materials, to control the event of chemical spill in the waterway ▪ Have appropriate equipment onsite and accessible.	Construction contractor	Develop procedures applicable for each construction area and update for change of work as appropriate.	Review and modify spill clean-up procedures if any adverse impacts are observed.
Reduce contamination of surfaces exposed to runoff generation through source controls.	Construction contractor	Install in each staged construction area prior to staged construction commencement.	Review and modify equipment and controls if any adverse impacts are observed.
Install vehicle wash racks at site entry/exit.	Construction contractor	Prior to construction of reclamation area.	Review and modify equipment and controls if any adverse impacts are observed.
Direct surface stormwater to sediment basins to eliminate off-site migration of sediment. The design and placement of sediment basins to be staged according to construction schedules.	Construction contractor	Install prior to construction of reclamation area.	Review and modify equipment and controls if any adverse impacts are observed.

C.1.8.4 Marine Ecology and Conservation (Reclamation Aspects)

Aspect impacts	▪ Increased turbidity and potential for hydrocarbon or other contaminant spill from on-site facilities, potentially affecting water quality, species or the quality of their habitats. ▪ Light spill from construction plant and port facilities may lead to disorientation of marine animals. ▪ Emission of waste may increase the risk of entanglement and/or ingestion of marine debris by marine vertebrates. ▪ Increase in noise leading to marine fauna temporarily avoiding affected area.
Environmental Performance Objectives	▪ To reduce indirect effects on marine megafauna and the marine ecology of benthos. ▪ To prevent contamination from construction into the adjacent marine environment.
Performance Criteria	▪ No injury or fatality to marine megafauna as a result of PEP construction activities. ▪ No reduction in fauna diversity or occurrence evident from light spill. ▪ No reduction in abundance in marine megafauna from noise. ▪ No permanent loss of benthic habitat beyond the development footprint. ▪ Creation of hard substrate inter-tidal and near sub-tidal marine habitat.
Monitoring and Reporting	▪ Regular site inspections carried out to monitor the construction area for compliance with light and waste management procedures, and hazardous material handling procedures. ▪ Marine performance monitoring of relevant aquatic indicators.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Implement light management procedures to reduce light spill to the marine environment.	Construction contractors	During design phase; implement and check during construction phase.	Review light management procedures.
Implement waste management procedures. Refer Waste Section 1.8.9.	Construction contractors	During construction phase	Review waste management procedures and modify if required so that rubbish does not affect marine animals.
Implement control measures to reduce the likelihood and impact of contaminant spills (refer to Land, Section C.1.8.2, and Water Resources, Section C.1.8.3).	Construction contractors	During construction phase	Review and modify equipment and controls if any adverse impacts are observed.
Implement control measures to reduce the likelihood and impact of turbidity (refer to Water Resources, Section C.1.8.3)	Reclamation area contractors	During construction phase	Review and modify site practices if any adverse impacts are observed (refer to tailwater management elements of the DMP, Chapter C2.1)

C.1.8.5 Terrestrial Ecology

Aspect impacts	▪ Spread of weeds by site movements and to and from site. ▪ Injury/mortality to fauna resulting from construction activities such as vehicle movements. ▪ Noise emissions (and vibration) e.g. piling leading to behavioural disturbance in fauna. ▪ Light spill from construction plant leading to disturbance to avian habitats.
Environmental Performance Objectives	▪ To reduce the spread of weeds to and from the site. ▪ To avoid injury and death of avifauna from construction activities. ▪ To reduce the level of noise and light spill on adjacent land used by shorebirds.
Performance Criteria	▪ Light spill from project site to bird nesting areas on the spit is avoided or minimised to the extent practicable.
Monitoring and Reporting	▪ Any incidents that affect terrestrial or fauna to be reported to relevant authorities. ▪ Regular site inspections for injured wildlife and use of fauna spotter during where relevant e.g. during piling.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
▪ Reduce the spread and introduction of weeds by thoroughly washing down, according to accepted industry standards before moving to the construction site or leaving for the first or last time. ▪ Use a wheel wash whenever vehicles move from unsealed roads to sealed roadways e.g. road between excavation area and off-site.	Construction contractors	Prior to and during construction.	Review and modify operational practices if there is a breach.
Implement procedures on the handling and reporting of injured fauna.	Construction contractors	Throughout construction period.	Review and modify controls if any adverse impacts are observed.
Implement control measures to manage noise risks to fauna outside of the port (refer to Noise and Vibration, Section C.1.8.7)	Construction contractors	Throughout construction period.	Review and modify equipment and controls if any adverse impacts are observed.
Lighting design and arrangements to reduce light spill from the site to shorebird habitat on the spit at the mouth of Ross River.	Construction contractors	Throughout construction period.	Review and modify equipment and controls if any adverse impacts are observed.

C.1.8.6 Air Quality

Aspect impacts	Fugitive dust from exposed surfaces during construction may result in: ▪ increased risks to human health ▪ nuisance ▪ discolouration of buildings or structures. Fuel combustion emissions from vehicles and equipment
Environmental Performance Objectives	▪ To reduce the particulate load from dust from construction activities ▪ To reduce vehicle emissions ▪ Minimise and address air quality complaints
Performance Criteria	▪ Air quality from the construction area to meet EPP (Air) standards and appropriate ambient air quality guidelines at sensitive receptor locations. ▪ Adaptive management in response to complaints from people affected by dust emissions or in accordance with reactive dust monitoring results. (specific performance thresholds for each PEP Stage to be determined in relation to the proposed work activities prior to any works being undertaken for respective stages)
Monitoring and Reporting	▪ Visual monitoring and observation of weather conditions that result in dust liberation and elevated particle concentrations. ▪ Continuous monitoring and/or air quality monitoring campaigns. ▪ Record and respond to complaints.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
To reduce fugitive dust: ▪ Erect localised windbreak barriers on activities (to 2.4 m height), particularly to the west of works, if required ▪ Water exposed surfaces at >2 L/m^2/min (ensure no pooling) ▪ Sweep and water using a water cart for materials handling, transport and haul routes ▪ Use a wheel wash whenever vehicles move from unsealed roads to sealed roadways e.g. road between excavation area and off-site ▪ Adjust work practices (as required) based on wind observations (e.g. ceasing dust-generating works under extreme windy conditions or when dust is observed to leave the site) ▪ Adjust work practices (as required) based on real time dust monitoring.	Construction contractor and POTL between stages.	During the construction phase.	Implement corrective measures outlined in Air Quality Reactive Monitoring Program which includes triggers against a staged approach: *Investigate, Action and Stop Work:* ▪ **Investigate:** designed to identify the issue, the likely reasons and formulate a response should the Action stage be reached. ▪ **Action:** designed to implement those measures formulated in the Investigate stage and review their effectiveness. ▪ **Stop Work:** there is a high likelihood that the pollutant criterion may be reached. Works are to stop at this stage until the measured pollutant levels are below the Action level. Amend construction program for modifying or

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
▪ Operate a complaints management system ▪ Vehicles to cover loads.			scheduling works that mobilise particulates depending on ambient conditions that may cause wind re-suspension (eg 20km/hr from the east or north-east).
To reduce fuel combustion emissions: ▪ Turn engines off while parked on site ▪ Regularly tune, modify or maintain equipment, plant and machinery to reduce visible smoke and emissions ▪ Implement site speed limits ▪ Reduce haul road lengths ▪ Manage vehicle movement to prevent queuing/idling.	Construction contractor	During the construction phase.	Review and modify engines if any adverse impacts are observed..
Vacant fill areas to be planted / hydro mulched as soon as possible after reaching final landform	Construction contractor	During the construction phase.	View final landform signoff procedure to include a review of need for stabilising vegetation.
Maintain vacant fill areas between PEP development stages	POTL	Between stages	Increase frequency of inspection of vacant areas and undertake identified maintenance actions.

C.1.8.7 Noise and Vibration

Aspect impacts	▪ Onsite construction equipment, particularly during piling works and rockfill reclamation, causeing offsite disturbance of sensitive receivers. ▪ Heavy vehicles impacting receivers on Boundary Street and near the boundary of the site. ▪ Vibration effects during the construction phase from use of plant and equipment and haulage
Environmental Performance Objectives	▪ To reduce noise generated by construction activities and haulage vehicles.
Performance Criteria	▪ Limited numbers of complaints related to noise and vibration events during the construction phase. ▪ Noise and vibration levels to meet relevant Queensland standards or appropriate noise guidelines at sensitive receptors.
Monitoring and Reporting	▪ Noise and/or vibration monitoring will be carried out as required by construction contractor. ▪ Information will be recorded in POTL database to identify areas and/or events where noise is creating adverse effects.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Advise residents and commercial operators of planned construction activities including timing and duration of piling and rockfill placement.	POTL and construction contractor.	Preceding noise activities.	Revise notification procedures and times to allow adequate consideration of potential noise impacts by the community.
Piling operations restricted to activities to prescribed daytime work hours, excluding Sundays and Public Holidays. Consideration of alternative piling types, e.g. screw-type piling in place of impact piling if alternative are available and feasible.	Construction contractor	During piling operations.	Review and modify construction practices if effects are anticipated to be prolonged. Monitoring, and adjusting where necessary, elements of piling such as reducing the height and weight of the impact hammer.
Equipment management includes the following: ▪ Select low-noise plant and equipment ▪ Equipment has have high-quality mufflers installed ▪ Equipment has been well maintained and fitted with adequately maintained silencers which meet the design specifications ▪ Plants known to emit noise strongly in one direction (ie. manifolds on compressors) are to be orientated so that the noise is directed away from noise sensitive areas ▪ Machines that are used intermittently are shut down in the intervening periods between works or throttled down to a minimum	Construction contractor	At all times during construction.	Review and modify construction practices as required.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
▪ Silencers and enclosures are kept intact, rotating plant is balanced, loose bolts tightened, frictional noise reduced through lubrication and cutting noise reduced by keeping blades sharp ▪ Equipment not in use is shut down ▪ Only necessary power is used to complete the task ▪ Only necessary equipment is on site ▪ Equipment to be in good working condition.			
Locate site compounds and noisy plant as far away from noise sensitive receptors as practicable. Orient noisy plant so that noise is directed away from sensitive receptors.	Construction contractor.	During construction.	Review and modify construction practices if adverse effects occur.
If plant is fixed in a stationary location, where sensitive receptor may be affected for one week or longer, installation of an acoustic enclosure constructed in accordance with *AS 2436-2010 Guide to noise and vibration control on demolition and maintenance sites* will be required.	Construction contractor.	If plant remains stationary, where sensitive receptor may be impacted for at least a week.	Review and modify equipment and construction practices if adverse effects occur.
Operate a complaints management system	Construction contractor.	During construction.	Review and modify construction practices if adverse effects occur.

C.1.8.8 Greenhouse Gases

Aspect impacts	• Greenhouse gas emissions will be produced during construction.
Environmental Performance Objectives	• To identify and reduce unmitigated greenhouse gas emission loads.
Performance Criteria	• Reduction in calculable greenhouse gas emissions through implementation of planning, design and management actions. • Meet applicable Commonwealth and State legislation and standards for greenhouse gas emissions release.
Monitoring and Reporting	• Monitor energy use and changes to efficiency on site, primarily through the use of monitoring fuel consumption. • Monitor key performance indicators to track construction greenhouse gas emissions, detect trends early and implement measures to address any unforeseen increases in emissions.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Increase awareness: ▪ Include greenhouse gas awareness training as part of site inductions ▪ Undertake periodic energy audits to monitor energy use and changes to efficiency on site ▪ Keep informed of best practice industry standards, research into new technology and energy efficiency and trial new approaches where appropriate.	Construction contractor	Prior to commencement of, and during construction.	Review practices and monitor on-going performance.
Develop targets and goals: ▪ Develop a set of key performance indicators for carbon management for the construction of the port expansion to track performance over time ▪ Monitor key performance indicators on a monthly basis to enable construction contractor to monitor construction greenhouse gas emissions, detect trends early and implement corrective actions.	Construction contractor	Prior to commencement of, and during construction.	
Implement energy efficiency measures: ▪ Maintain equipment ▪ Install energy saving timers, light sensitive switches and energy efficient lighting in and around the buildings ▪ Select appliances based on energy efficiency	Construction contractor	During construction	
Investigate use of renewable energy on site: ▪ Investigate renewable energy options for construction administration facilities ▪ Investigate the feasibility of generating electricity from a renewable source on-site	Construction contractor	Detailed design phase.	

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
▪ Consider the use of solar panels for rockwall, security and road lighting during construction and powering isolated items such as pumps.			
Reduce fuel use during construction by a number of measures such as: ▪ Reduce transport distances and mobilisation of plant ▪ Plan construction works to avoid double handling of materials ▪ Use fuel efficient vehicles and investigate replacing diesel with a less emission intensive fuel, such as biodiesel or use of hybrid vehicles; Turn off engines when any significant delays occur ▪ Coordinate staff travel arrangements.	Construction contractor.	During the construction phase.	
Material use and selection: ▪ Use materials with high recycled content or lower embodied construction materials ▪ Consider the feasibility of sourcing polyester geotextile manufactured from recycled PET for the reclamation area ▪ Reduce the quantity of construction material required ▪ Re-use dredge spoil wherever feasible as part of footprint design.	Construction contractor	During the construction phase.	
▪ Purchase carbon offsets through a certified offset provider in Australia	Construction contractor	During the construction phase	

C.1.8.9 Waste

Aspect impacts	▪ Incorrect handling and storage of waste materials may result in the introduction of wastes into the marine environment or surrounding lands. ▪ Presence of waste materials may encourage pests and provide breeding habitats for mosquitoes.
Environmental Performance Objectives	• Coordinate the handling, storage, recycling and disposal of waste materials during the construction phase. • No litter or waste lost from PEP development footprint into adjacent marine environment.
Performance Criteria	▪ Waste materials are handled, stored and disposed in a safe and secure manner. ▪ Environmental disturbance to the surrounding marine area from construction waste is avoided. ▪ Do not attract pests as a result of wastes generated during construction through implementation of appropriate management measures.
Monitoring and Reporting	▪ Monitor the management (storage, handling) and disposal of waste from the construction area. ▪ Regular site inspections for mosquito breeding areas prior to and during wet season. ▪ Any incidents will be recorded in the contractor database in order to identify areas where waste management is creating adverse impacts.

Implementation Strategies; Management Actions*	Responsibility	Timing	Corrective Actions
Only the minimum required amount of any substance required by construction activities to be brought to site.	Construction contractor	During the construction period.	Review waste management practices and modify if required if any adverse impacts are experienced.
Re-use construction waste onsite (for examples bricks/concrete and timber) where appropriate.	Construction contractor	During the construction period.	
Products that can be recycled to be taken to a licensed recycling facility.	Construction contractor	During the construction period.	
Products that cannot be re-used on or off site or recycled will be disposed appropriately offsite at a licensed facility.	Construction contractor	During the construction period.	
Provide separate stockpiles or bins for different waste streams avoid contamination with other waste streams. Provide waste bins/receptacles to isolate liquid wastes.	Construction contractor	During the construction period.	
Store hazardous and asphaltic wastes in an appropriate bunded and covered area.	Construction contractor	During the construction period.	
Licensed waste contractor to be engaged to regularly remove and dispose of waste at licensed facilities and maintain waste disposal areas.	Construction contractor	During the construction period.	

Implementation Strategies; Management Actions*	Responsibility	Timing	Corrective Actions
Sewage to be removed via a temporary connection to reticulated waste water system if possible.	Construction contractor	Until alternative or permanent connection established.	
Empty drums and storage containers (to be stored in bunded area).	Construction contractor	During the construction period	
Monitor the management (storage, handling) and disposal of waste from the construction area. Regular site inspections for mosquito breeding areas prior to and during wet season.	Construction contractor	Routinely during the construction period.	Review waste management practices and modify where performance objectives are not met.
Regulated waste to be stored, handled and transported in accordance with DERM requirements, and where applicable the Hazardous and Waste requirements listed in C1.1.14.	POTL / Construction contractor	During the construction period	Review waste management practices and modify where performance objectives are not met.

*Management actions listed in order of preference in accordance with the waste hierarchy.

C.1.8.10 Transport and Infrastructure

Aspect impacts	▪ Traffic congestion at some key road intersections due to construction traffic. ▪ Degradation of pavement due to additional traffic loading on pavements from construction activities.
Environmental Performance Objectives	• Reduce disruption to existing road transport infrastructure.
Performance Criteria	• Traffic delays from construction at the port do not contribute significantly to peak traffic loads.
Monitoring and Reporting	• All heavy vehicle movements to be recorded by contractor and reported to POTL.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Intersection improvements to mitigate against additional traffic impacts from construction related activities.	Construction contractor	Following commencement of construction and to be maintained throughout the construction phase.	Review intersection performance and apply alternative improvements if adverse impacts are experienced.
Pavement rehabilitation and maintenance to cater for the additional loadings from construction related heavy vehicles if required by pavement impact assessment.	Construction contractor	As required based on pavement impact assessment.	Road repairs to be undertaken as soon as practicable.
POTL to consider contractual requirements for contractor to use certain routes (e.g. EAR).	POTL and construction contractor	Pre-construction and construction.	Contractor to be penalised for not meeting obligations.
Construction heavy vehicles to use designated heavy vehicle routes.	Construction Contractor	Throughout construction period.	Review heavy vehicle route or driver training/induction.
Operate a complaints management system	Construction contractor	During construction	

C.1.8.11 Indigenous Cultural Heritage

Aspect impacts	• Disturbance or destruction of significant Aboriginal cultural heritage values or artefacts in the marine environment or land.
Environmental Performance Objectives	• To reduce the potential for disturbance of significant Indigenous values or artefacts.
Performance Criteria	• No loss or disturbance of significant Indigenous values or artefacts as a result of the PEP construction. • No complaints from people likely to be affected by damage to Aboriginal areas or archaeological sites.
Monitoring and Reporting	In accordance with the Cultural Heritage Monitoring Program

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Ongoing consultation with representatives of the Aboriginal parties in accordance with the CHMP.	POTL	Prior to and during construction as stipulated in the CHMP.	Review the CHMP and consultation protocol if there are risks of unexpected adverse effects or complaints are made,
If any Aboriginal cultural heritage sites, materials or values are discovered during development operations work and other activities are to cease pending an inspection by a representative from the Aboriginal Parties.	Construction contractor	During construction.	Follow advice provided on inspection by the representative from the Aboriginal Parties
If human skeletal material is discovered during development works operations will cease immediately within100m of the remains. The Queensland Police, Cultural Heritage Coordination Unit (DEHP) and an Aboriginal representative will be contacted immediately.	Construction contractor	During construction.	If works do not cease, penalties apply. Follow advice provided by DEHP and the Aboriginal representative regarding established policy and procedures for dealing with human remains.
Personnel and contractors involved in the development project will undertake a cultural heritage induction prior to commencement of development operations.	POTL and construction contractor.	Prior to, and during, construction.	Review the induction package and procedures if adverse impacts are observed.

C.1.8.12 Visual Amenity and Lighting

Aspect impacts	▪ Scenic amenity could be adversely affected by artificial light associated with the port infrastructure used during night time construction. ▪ Local scenic amenity may be affected by constructional plant, waste and suspended sediment in the marine environment. ▪ Dust emissions on residents and recreational users.
Environmental Performance Objectives	• To consider adverse visual effects associated with constructional activities of the PEP.
Performance Criteria	• Minimal visual impact on water clarity from construction activities. • Minimal visual impact from dust on surrounding areas. • Minimise light spill outside of POTL controlled areas.
Monitoring and Reporting	• Daily site inspections to monitor for water pollution, rubbish and dust associated with the construction. Regular inspection of areas surrounding the port development area, particularly following changed lighting conditions e.g. at the start up of a stage.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Manage lighting and design to reduce light spill from the site in so far as consistent with existing Operational Health and Safety and Land Use codes.	Construction contractor	During construction	Review and modify lighting management practices if any adverse impacts are observed.
▪ Implement control measures to reduce: ▪ fugitive dust (refer to Air Quality, Section C.1.8.6) ▪ stormwater releases (refer to Water Resources, Section C.1.8.3) ▪ suspended sediment from dredging (refer to DMP, Chapter C2.1).	Construction contractor	During construction	Review and modify management practices if any adverse effects are reported
Maintain a high standard of site cleanliness and presentation. Regularly remove and dispose of rubbish. Manage waste in accordance with C1.8.9.	Construction contractor	During construction	Review and modify site house-keeping practices and waste management if any adverse impacts are observed.
Progressive stabilisation of reclaimed land and reducing disturbed and exposed areas (e.g. access road verges).	Construction contractor	During construction	Disturbed land to be established and vegetated as appropriate as soon as practical after reaching final levels.

C.1.8.13 Pest Management

Aspect impacts	• Introduction or spread of pest animals into the construction.
Environmental Performance Objectives	• To reduce attraction of the PEP area to pest animals.
Performance Criteria	• No increase to the number of pest species on the construction site above background levels in surrounding port
Monitoring and Reporting	• Monitor the presence and abundance of pest animal species in the PEP reclamation area. • Regular site inspection for mosquito breeding areas during wet season.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Inspect construction site for likely mosquito breeding locations.	Construction contractors	Beginning of every wet season.	Regularly review the construction site and implement controls if required during the construction phase.
Keep construction work area free of food waste or other attractants to mice and rats.	Construction contractors	Throughout construction period.	Mice and rats will be trapped or poisoned before numbers cause human health concerns.
Keep construction work area free of food waste or other attractants to dogs, cats and foxes.	Construction contractors	Throughout construction period.	Feral dogs, foxes and cats will be trapped and euthanised humanely.
Keep construction work area free of food waste or other attractants to cane toads and birds	Construction contractors	Ongoing, regular inspections	Licensed pest control contractor engaged to control numbers if required.

C.1.8.14 Hazards and Hazardous Materials

Aspect impacts	• Potential impacts to human and environmental health from exposure to hazards and hazardous materials.
Environmental Performance Objectives	• To handle and store hazardous materials in the appropriate manner.
Performance Criteria	• Hazardous materials to be stored and handled in accordance with relevant standard or manufacturer's instruction.
Monitoring and Reporting	• Contractor to regularly inspect the MSDS register for currency and completeness. • Conduct inspections to monitor construction area for compliance with hazardous material handling and storage procedures.

Implementation Strategies; Management Actions	Responsibility	Timing	Corrective Actions
Use of hazardous materials to be minimised where possible and alternatives implemented if feasible.	Construction contractors	Throughout construction period.	Review of need for hazardous materials to be reviewed.
Hazardous materials to be stored and handled in accordance with relevant standards of manufacturer's instructions.	Construction contractors	Throughout construction period.	Review of handling and storage products to be undertaken.
Material Safety Data Sheets (MSDS) for hazardous materials held on site, to be displayed in a prominent location near the storage and usage sites of hazardous materials.	Construction contractors	Throughout construction period.	Inspection of hazardous material storage and use areas for correct MSDS.
Time delivery of hazardous materials to site in line with programmed use to avoid the need to store significant quantified of hazardous materials on site.	Construction contractors	Throughout construction period.	Review procurement procedures of hazardous materials in accordance with programed use.

(C2.2)1.9 Action Program

C.1.9.1 Continuous improvement

CEMPs are 'living documents' that require review (at least annually) during the construction phase and amended, as necessary, to allow new or changing environmental risks relating to the PEP to be addressed. Feedback systems will be in place for the duration of the Project to enable the CEMP to be updated and responsive to learning from any incidents, complaints and ongoing monitoring results.

This CEMP would be reviewed and updated to reflect knowledge gained during the course of construction and to reflect new knowledge and changed community standards (values). Changes to the CEMP may be developed and implemented in consultation with relevant authorities and stakeholders over time.

Other triggers for CEMP review may include:

- findings and recommendations of contractors EMPs and/ or work procedures
- changes to organisational structure, roles and responsibilities
- changes in environmental legislation and/or policies
- new technologies/innovation relevant to applied methods and controls that provide innovative means of executing work in order to meet performance criteria.

C.1.9.2 Environmental auditing

POTL will monitor performance against the contract held with the construction contractor in accordance with its Environmental Management System (EMS) during the contractor's construction campaign.

In addition, an audit of reclamation activities monitoring is to be carried out periodically by a suitably qualified and experienced person(s), during each phase of construction.

C.1.9.3 Monitoring

Monitoring for each value is detailed at Section (C2.2)1.8. This monitoring will enable:

- early detection of environmental management issues in the Port of Townsville during construction
- where applicable, development of baseline environmental information for the Port from which trends and changes in the environmental quality of the Port over the period of construction can be detected.

C.1.9.4 Records

During construction, records of the ongoing site monitoring shall be maintained for possible audit by regulating authorities. Permanent records for each phase of earthworks activities must be kept on site and updated regularly, to enable audit/review by means of a simple 'check list' or similar.

Records of any testing instrument calibrations (i.e. pH meter) shall also be kept. Calibration will be in accordance with the manufacturer's instructions.

Records would allow auditing and encourage the use of preventative action, as well as corrective action following non-compliance.

Environmental records will be:

- kept as objective evidence of compliance with environmental requirements
- maintained according to POTL's Recordkeeping Procedure.

Environmental records and the EMP will be controlled in accordance with the contractor management system.

C.1.9.5 Staff training

Construction personnel shall attend an induction prior to commencing work at the site. The induction will include the environmental commitments and measures contained in this CEMP. Construction workers attending the induction will be mentored to support the implementation of commitments by construction staff.

(C2.2)1.10 Community Engagement

This section outlines plans for on-going consultation with the community.

C.1.10.1 General Enquiries, Information and Visitors

POTL has an established Community Enquiry line. General enquires received shall be directed to this line in the first instance.

Contact can also be made via POTL's website. POTL invites public comment via their 'Tell us what you think' page (http://www.townsville-port.com.au/feedback). General contact details for POTL are also provided on their website:

- **Telephone**: 07 4781 1500
  Facsimile: 07 4781 1525
  Email: info@townsville-port.com.au.

C.1.10.2 Complaints Handling

The contractor would manage community complaints and feedback in accordance with the complaints handling procedure. A 'Complaint Lodgement Form' is available on the on POTL website http://www.townsville-port.com.au/complaint_form.The complaints handling procedure operates as follows:

- Complaints received directly at the site will be directed to the 24 hour enquiry line or website form in the first instance.
- Complaints received by the construction contractor must be recorded including investigations undertaken, conclusions formed and actions taken. Notification about the complaint and any associated response must be provided to POTL in a timely fashion.
- The complaint response procedure will include:
  (a) the time, date name and contact details of the complainant;
  (b) reasons for the complaint;
  (c) any investigations undertaken;
  (d) conclusions formed; and
  (e) any actions taken.

All outcomes of complaint(s), including the full detail of the complaint and corrective actions undertaken by the construction contractor, shall be communicated to POTL for further review of corrective actions.

Corrective actions shall be communicated to the complainant to close out the issues raised.

Port Expansion Project EIS

Part C

Section C2.3 – Vessel Traffic Management Plan (Construction)

AECOM BMT WBM

(C2.3)1 Background and Scope

(C2.3)1.1 Introduction

The interactions and potential impacts for vessel management have been considered between the construction works, continuing port operations and other existing vessel activities. This Vessel Traffic Management Plan – Construction (VTMPC) documents the vessel traffic management requirements for construction works and forms part of the set of PEP Environmental Management Plans.

This plan seeks to address potential vessel traffic and safety issues identified in relation to vessel operations associated with the construction phases of the Port Expansion Project (PEP). This is because a vessel collision, grounding or sinking can result in unplanned emissions or other potential consequences on marine environmental qualities and/or damage to property and human health and risk to safety and revenue.

The other management plan closely associated with the VTMPC and applicable to the construction stages is the Dredge Management Plan (Section C2.1). The Dredge Management Plan identifies the preferred means of addressing environmental matters associated with capital dredging (and associated dredge vessels), whereas the VTMPC addresses navigational safety issues for all vessels during construction phases.

The VTMPC will be also be used as a reference document for Port of Townsville Limited (POTL) tender documentation for selecting preferred dredging and marine construction contractors following completion of the EIS process.

(C2.3)1.2 Purpose of the VTMPC

The construction phases of the PEP will generate vessel traffic that has the potential to impact on vessel and marine safety and obstruct navigation including of trade shipping into the port. The VTMPC is necessary to meet the requirements of applicable environmental legislation, achieve best practice management of vessel traffic in relation to the PEP construction and to aid in achieving the requirements of both POTL and the relevant authorities.

It describes the measures to be implemented for monitoring and controlling vessel operations to achieve the following broad objectives:

- Provide evidence of practical and achievable plans for the management of construction vessel operations such that vessel safety is preserved and prevents obstructing the navigation of other traffic (such as shipping, commercial vessels, tugs, pilot boats, military vessels or recreation traffic).
- Provide a framework for the development of contractor specific VTMPCs to be prepared by the contractors.
- Provide POTL and regulatory authorities with a framework to confirm compliance with requirements.
- Provide the community with evidence of that the management of construction vessels will be conducted in a manner that supports safe navigation for recreation vessels.

The key Commonwealth and State legislation and regulations relevant to operations of vessels and dredging are described in Chapter B18 of the EIS.

(C2.3)1.3 Structure of the VTMPC

The VTMPC has been structured to address the vessel operation requirements for the construction of the PEP as follows:

- A description of the expected vessels and marine plant that will be used for the PEP construction works.
- Vessel management measures to be addressed during the construction stages of the PEP.
- An overview of legislative requirements associated with construction vessel operations.
- A description of the roles and responsibilities for implementation of the VTMPC.

- Provides an overarching VTMPC and a framework for the development of contractor specific VTMPC.

A detailed description of the PEP marine infrastructure is provided in Part A, while port operations are discussed in Section B18 of the EIS.

(C2.3)1.4 Project Overview

POTL proposes development of a new outer harbour, wharves, channel deepening, backing land, and associated infrastructure to support new berths (for cargo handling), collectively known as the Port Expansion Project (PEP). Development of the PEP is based on a clear strategy aimed at providing for future trade, in line with the *Port of Townsville Master Plan* (Maunsell AECOM, 2007) forecasts. The PEP will allow POTL to:

- satisfy its responsibility under the *Transport Infrastructure Act 1994* (TI Act) including establishment, management, and effective and efficient development and operation of port facilities
- respond to forecast trade growth and provide essential trade pathways for current and future trades in accordance with the National Ports Strategy (IA, 2010), thereby enhancing the economic prosperity of the region
- provide infrastructure for import and export of bulk and general cargo through the Port of Townsville for operations under competitive market conditions
- establish and maintain strong links between the local, regional, state, national and global economies
- accommodate future trends in global shipping practices
- facilitate redevelopment of the port.

The PEP will result in

- sufficient future capacity being delivered ahead of expected demand, avoiding bottlenecks or capacity constraints at the port on trade growth opportunities
- sufficient flexibility to accommodate demand, especially if trade growth driven by the mining sector growth is more rapid than predicted.

In summary, the PEP comprises:

- a new harbour (the outer harbour) enclosed within a new breakwater (north-eastern breakwater) and new reclamation area to the north-east of the existing port area
- deepening of the existing channels, together with minor widening near the harbour entrance and extension at the seaward end of the existing Sea Channel by approximately 2.7 km.

(C2.3)1.5 Site Location

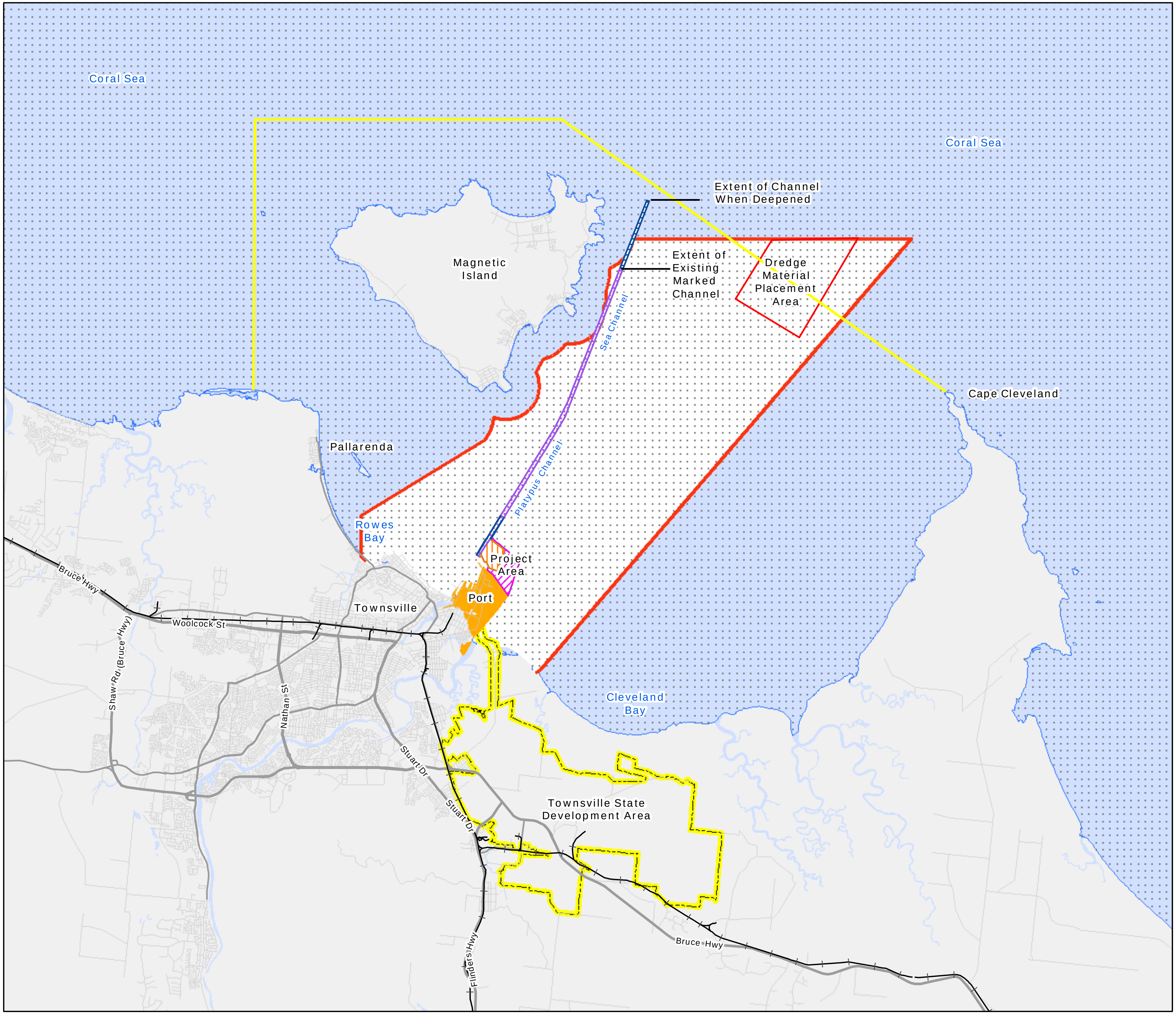
The Port of Townsville is located in Cleveland Bay adjacent to the city of Townsville. The new outer harbour is seaward of the eastern breakwater and inner harbour as shown in Figure C.2.3.1. The existing Platypus and Sea channels will be deepened in two stages which will result in the lengthening of the Sea Channel east of Magnetic Island.

The construction works and infrastructure developed for the PEP will be in the existing port limits, the designated water areas that navigation falls under the control of the Regional Harbour Master (RHM).

PORT EXPANSION PROJECT EIS

Locality Plan of PEP

Figure C.2.3.1



Legend

- Railway Line
- Highways
- Main Roads
- Minor Roads
- Local Roads
- Port Limits
- Channel to be Dredged
- Existing Port Land
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- Townsville State Development Area
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary
- GBRWHA/National Heritage Place

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_118

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012

(C2.3)1.6 Marine Construction Vessel Use

This section outlines the marine construction vessels and plant expected to be used for the development of the PEP, which will be used for:

- dredging and reclamation works
- construction of marine infrastructure.

A summary of the likely range and number of marine construction vessels and equipment expected to be deployed during each PEP stage of development is given in Table 1 through to Table 7. The dredging and marine infrastructure vessels are presented separately for each stage, noting that there is no dredging activity during Stage D of construction. The equipment is based on the adopted dredging and reclamation strategies discussed in Chapter A3.

Figure C.2.3.2 Typical trailer suction hopper dredge (sediment is drawn in by the draghead and placed into the hopper in the vessel hull. The vessel is self-propelled and discharges the dredged material at the DMPA through bottom discharge gates)

Figure C.2.3.3 Typical cutter suction dredger (rotating cutter head loosens material which is drawn up a pipe located as slurry. The slurry is pumped through floating/submerged pipeline to the placement area. The dredger is manoeuvred using the spud piles at the bow and an anchor and wire system from the stern).

Figure C.2.3.4 Typical backhoe dredge (mechanically excavates material using a bucket at the end of the excavator arm and places it in a self-propelled hopper barges which are moored alongside for transport of the dredged material to the DMPA. The dredger is anchored using spud piles and manoeuvred by a tug).

Table 1 Typical vessels and equipment for dredging – Stage A

Primary	Secondary	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Small TSHD	None	Dredge soft marine sediments	Outer harbour basin and relocate to DMPA.	4
1 x Large mechanical dredge (BHD or grab dredge)	3 x Self-propelled hopper barges.	Dredge soft marine sediments	Outer harbour basin and reclamation footprint, relocate to DMPA.	6
		Widening of Platypus Channel near outer harbour	Platypus Channel (Ch1,850-2,750), relocate to DMPA.	4
1 x Small/medium CSD	Pipelines and booster station.	Dredge basin areas	Outer harbour basin	10
1 x Medium-large TSHD	CSD or mechanical dredge and hopper barges if very stiff/hard material present.	Stage 1 deepening of Platypus and Sea channels.	Platypus and Sea channels and relocate to DMPA.	4
Ancillary Vessels				
1 x Survey craft	None	Hydrographic survey	Dredging areas and offshore DMPA	36
1 x Small tug	None	Support for mechanical dredge, hopper barges and CSD.	Dredging areas	36
1 (or 2) x Work boat	None	Support for all craft	Dredging areas	36

includes period of time while mobilising and de-mobilising

Table 2 Typical vessels and floating plant for marine infrastructure construction – Stage A

Vessels and Floating Plant	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Pile driving barge	Driving steel tubular piles for wharf structures.	Berth 14 and Berth 15 wharf areas. New markers at the end of Sea Channel.	9
1 x Dumb barge	Delivery of piles from land and general wharf construction support.	Berth 14 and Berth 15 wharf areas.	15
2 x Transport barges (if western breakwater is required)	Delivery of material for western breakwater	Transport material from Eastern Reclamation Area to western breakwater location.	12
Ancillary Vessels			
1 x Small tug	Support for pile driving barge and floating crane.	Berth 14 and Berth 15 wharf areas.	15
2 x Work boats	Support for pile driving barge and floating crane and diving operations.	Berth 14 and Berth 15 wharf areas.	15
2 x Tugs (if western breakwater is required)	To manoeuvre transport barges.	Transport material from Eastern Reclamation Area to western breakwater location.	12
1 x Work boat (if western breakwater is required)	Support for western breakwater construction.	Western breakwater	12
1 x Survey craft (if western breakwater is required)	Hydrographic survey	Western breakwater	12

includes period of time while mobilising and de-mobilising

Table 3 Typical vessels and equipment for dredging – Stage B

Primary	Secondary	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Small TSHD	None	Dredge soft marine sediments	Outer harbour basin and relocate to DMPA	1
1 x Large mechanical dredge (BHD or grab dredge)	2 x Self-propelled hopper barges	Dredge soft marine sediments	Outer harbour basin and relocate to DMPA	1
1 x Small/medium CSD	Pipelines and booster station	Dredge basin areas	Outer harbour basin	6
Ancillary Vessels				
1 x Survey craft	None	Hydrographic survey	Outer harbour basin and offshore DMPA	8
1 x Small tug	None	Support for mechanical dredge, hopper barges, CSD	Outer harbour basin	8
1 (or 2) x Work boat	None	Support for all craft	Outer harbour basin	8

includes period of time while mobilising and de-mobilising

Table 4 Typical vessels and floating plant for marine infrastructure construction – Stage B

Vessels and Floating Plant	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Pile driving barge	Driving steel tubular piles for wharf structure.	Berth 16 Wharf area	5
1 x Dumb barge	Delivery of piles from land and general wharf construction support.	Berth 16 Wharf area	9
Ancillary Vessels			
1 x Small tug	Support for pile driving barge and floating crane.	Berth 16 Wharf area	9
2 x Work boats	Support for pile driving barge and floating crane and diving operations.	Berth 16 Wharf area	9

includes period of time while mobilising and de-mobilising

Table 5 Typical vessels and equipment for dredging – Stage C

Primary	Secondary	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Small TSHD	None	Dredge soft marine sediments	Outer harbour basin and relocate to DMPA.	1
1 x Large mechanical dredge (BHD or grab dredge)	3 x Self-propelled hopper barges	Dredge soft marine sediments	Outer harbour basin and reclamation footprint and relocate to DMPA.	1
1 x Small/medium CSD	Pipelines and booster station	Dredge basin areas	Outer harbour basin	12
1 x Medium-large TSHD	CSD or mechanical dredge and hopper barges if very stiff/hard material present	Stage 2 deepening of Platypus and Sea channels	Platypus and Sea channels and relocate to DMPA	4
Ancillary Vessels				
1 x Survey craft	None	Hydrographic survey	Dredging areas and offshore DMPA	12
1 x Small tug	None	Support for mechanical dredge, hopper barges, CSD	Dredging areas	12
1 (or 2) x Work boat	None	Support for all craft	Dredging areas	12

includes period of time while mobilising and de-mobilising

Table 6 Typical vessels and floating plant for marine infrastructure construction – Stage C

Vessels and Floating Plant	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Pile driving barge	Driving steel tubular piles for wharf structures.	Berth 17 wharf area. New markers at end of Sea Channel.	5
1 x Dumb barge	Delivery of piles from land and general wharf construction support.	Berth 17 wharf area	9
Ancillary Vessels			

Vessels and Floating Plant	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Small tug	Support for pile driving barge and floating crane.	Berth 17 wharf area.	9
2 x Work boats	Support for pile driving barge and floating crane and diving operations.	Berth 17 wharf area.	9

includes period of time while mobilising and de-mobilising

Table 7 Typical vessels and floating plant for marine infrastructure construction – Stage D

Vessels and Floating Plant	Construction Activity	Location	Indicative Duration on Site# (months)
1 x Pile driving barge	Driving steel tubular piles for wharf structures.	Berth 18 and Berth 19 wharf areas. New markers at end of Sea Channel.	9
1 x Dumb barge	Delivery of piles from land and general wharf construction support.	Berth 18 and Berth 19 wharf areas.	15
Ancillary Vessels			
1 x Small tug	Support for pile driving barge and floating crane.	Berth 18 and Berth 19 wharf areas.	15
2 x Work boats	Support for pile driving barge and floating crane and diving operations.	Berth 18 and Berth 19 wharf areas.	15

includes period of time while mobilising and de-mobilising

(C2.3)1.7 Navigation Measures for Construction

Vessel traffic and marine based activities will be generated during dredging and marine construction works (refer Chapter A3) requiring measures to manage risk, maintain safe navigation, support efficient port operations and reduce disruption to other vessel traffic. The PEP EIS proposes that navigation measures are managed and implemented in accordance with the VTMPC appropriate to the works undertaken and methodology. This section identifies the potential vessel interactions that will result from the marine construction and dredging works and management measures to mitigate potential impacts.

(C2.3)1.7.1 Potential Vessel Interactions

The construction phases of the PEP will generate vessel traffic and marine based activities. These have the potential to impact on vessel safety and obstruct the navigation of other traffic such as shipping, commercial vessels, tugs, pilot boats, military vessels or recreation traffic. Significant construction traffic will be generated, particularly by dredging works in the channel and dredging in the outer harbour basin that involves offshore disposal.

Potential vessel interactions related to the construction activities will occur in existing navigation areas in the port, new areas developed by the Project, or areas under development at the time of the works. The main potential vessel interactions that will derive from the PEP construction phases have been identified as follows:

- Dredging in the Platypus and Sea channels which cannot take place concurrently with shipping movements in the channel system.
- Dredging works for the development of new basin areas and deepening of existing areas in the outer harbour.
- Transporting dredged material by trailer suction hopper dredger (TSHD) or hopper barges from dredging locations in the outer harbour and Platypus and Sea channels to the Dredge Materials Placement Area and returning to the dredging locations.
- Dredge pipelines and anchor wires used for cutter suction dredgers will constrain navigation paths.

- Floating piling rigs for construction of wharves and channel markers.
- Barging of rock material from land to the western breakwater if it is required.
- Work boats transporting personnel, vessel supplies and materials.
- Bunkering and re-fuelling of dredging and construction vessels.
- Tugs used for manoeuvring dredging plant and barges.
- Hydrographic survey of navigation areas using survey craft.
- Mooring of vessels at existing port facilities, temporary structures or anchorage areas.

When the new outer harbour basin areas are developed they can be demarcated for restricted use by authorised construction vessels only, thereby reducing the potential interacts with other vessels in these areas.

(C2.3)1.7.2 Vessel Management Measures

The key management measures identified in Table 8 are in response to the expected impacts of construction on vessel operations and navigation. These measures would be implemented through the VTMPC by POTL and contractors in consultation with MSQ and the RHM. These are in addition to the measures included in the Maritime Operations Management Plan that forms Section C2.4.

Table 8 Vessel management measures for marine construction

Management Measure	Description
Safe vessel navigation	▪ Protection of shipping and port operations from construction vessels. ▪ Construction vessels, dredge vessels, floating plant, floating equipment and support craft to be suitable for undertaking marine construction in a safe manner. ▪ Manage risk for recreational boating and commercial craft using Cleveland Bay. ▪ Dredging to achieve design depths confirmed by bathymetric survey to MSQ standards. ▪ Vessels to be crewed by suitably qualified mariners.
Vessel traffic management	▪ Prevent disruption to shipping movements. ▪ Scheduling of channel dredging works with ship movements.
Mooring	▪ Provide secure mooring of construction vessels, dredge vessels, floating plant and floating equipment. ▪ Temporary mooring structures to be approved by relevant authorities. ▪ Mooring procedures for inclement weather and cyclones.
Aids to navigation	▪ Lighting on new breakwaters and edge structures to make extents visible at night. ▪ Temporary aids to navigation to support safe navigation during construction areas and if necessary to demarcate vessel exclusion areas.
Pilotage resources during construction	▪ Plan resourcing to address construction stage requirements. ▪ Programme for obtaining pilot exemption certificates.
Port security	▪ Adopt the Maritime Security Plan for Port of Townsville during construction stages. ▪ Develop appropriate communications procedures and protocols.
Bunkering and refuelling	▪ Ensure that refuelling is undertaken safely and measures are in place to manage risk of spills.
Emergency management	▪ Review port wide emergency management procedures for cyclones and extreme weather events to cater for construction vessels, dredge vessels, floating plant, floating equipment and support craft. ▪ Review emergency response equipment and personnel resources during marine construction stages. ▪ Development of contractor emergency management procedures for cyclones and extreme weather events.
Recreational boating and	▪ Lighting on breakwaters and seawalls to show extents for visibility by

Management Measure	Description

commercial craft	recreational craft at night.
	▪ Vessel Traffic Management Plans at each stage of development and are required to address recreational boating safety, particular consideration to be given to:
	  ▪ temporary aids to navigation for construction areas
	  ▪ notices to mariners
	  ▪ consultation with the recreational boating community.

(C2.3)1.8 Townsville Port Procedures

MSQ publishes port procedures (Port Procedures and Information for Shipping – Port of Townsville) which are designed to complement the requirements of the above legislation, regulations and codes and also the procedures of:

- Port of Townsville Limited
- Townsville City Council
- Maritime Safety Queensland
- Australian Maritime Safety Authority
- Australian Customs Service
- Department of Agriculture, Fisheries and Forestry
- Royal Australian Navy
- Biosecurity Queensland

The mandatory port procedures ensure marine safety as they relate to ship movements in the jurisdiction of the RHM Townsville; they are regularly reviewed.

The *Transport Operations (Marine Safety) Act 1994* enables the RHM to give a general direction to ship owners, ship masters, ships, other persons or matters for purposes of ensuring safety and the effectiveness and efficiency of the Queensland maritime industry.

(C2.3)1.9 MSQ Guidelines for Major Development Proposals

To assist proponents of major development proposals in identifying maritime related impacts and to define mitigation strategies, MSQ has developed guidelines for major development proposals (DTMR, 2010). The guidelines specify the minimum information required by MSQ to evaluate significant development proposals. The preferred format for presentation of this information is through the development of management plans for:

- vessel traffic management
- aids to navigation
- ship-sourced pollution prevention.

(C2.3)1.10 Strategies and Management Measures

(C2.3)1.10.1 Responsibilities

There are a number of agencies and bodies with authority and responsibility for these matters.

(C2.3)1.10.1.1 Regulatory Bodies

The VTMPC complements the material presented in the main body of the EIS for the PEP as it brings together activity specific management and mitigation measures under consideration, in particular to support safe, efficient and effective vessel operations in the port during the construction stages of the PEP.

The VTMPC will be finalised at the conclusion of the EIS process, taking into consideration comments on the EIS and detailed during the PEP design. This VTMPC will provide the framework for progressing the management of construction vessel operations in the port.

Once the VTMPC is finalised, it will be the primary responsibility of POTL to implement the plan through the appointed contractors.

Each contract involving construction vessels and equipment to construct marine works (dredging and marine infrastructure) will require application of the VTMPC. This will be prepared by the managing contractor to suit the construction methodology, vessels and equipment in operational traffic at the time.

(C2.3)1.10.1.2 POTL

As the proponent of the PEP EIS, POTL is responsible for ensuring the PEP is designed and developed. Consequently, actions would be managed to support vessel operations in ways that are safe and meet the requirements of applicable legislation, that aim for best practice management of vessel traffic (related to the PEP construction) and aids in achieving the requirements of both POTL approval and the jurisdiction of relevant authorities.

POTL will oversee the tendering process and construction of the marine works and will generally be responsible for:

- managing contractors for works involving vessels, dredging equipment and marine plant prepare VTMPCs for submission to MSQ and to obtain approved plans prior to commencing construction activities
- relevant supervisory and management staff of POTL and contractors are aware of and understand their responsibilities under the VTMPC
- periodic reviews of performance against plan are conducted
- best practice vessel traffic management procedures are developed and implemented
- vessel traffic management performance and any major incidents that may have a significant impact on vessel safety and navigation are reported to relevant authorities
- appropriate and adequate resources are allocated to implement and monitor the VTMPC
- each appointed contractor has emergency procedures and equipment in place to respond to an emergency vessel traffic incident
- compliance with regulatory approval conditions.

(C2.3)1.10.2 VTMPC Implementation

(C2.3)1.10.2.1 Preparation and Approvals

Contractors involved with dredging or construction of infrastructure (using vessels, dredging or marine plant), as a part of their contracted work package, may need to prepare specific procedures for each stage to meet the VTMPC and be in accordance with the requirements of the Principal's VTMPC, as well as any State and Commonwealth Government approval permits and conditions.

In addition to the legislative and statutory requirements, contractors shall also have regard for the operational requirements of POTL and the RHM in terms of vessel movements and maritime safety.

(C2.3)1.10.2.2 Operations and Monitoring

Each contractor involved with dredging or construction of infrastructure, using vessels or marine plant will be responsible for:

- liaising with vessel crews to implement and monitor the contract specific VTMPC
- complying with provisions of the contract specific VTMPC as applicable
- regularly inspecting and monitoring activities for adherence to proper marine safety measures.

This will include routine inspection of the works, reports and correspondence relating to vessel safety management issues.

(C2.3)1.10.2.3 Reporting

Each managing contractor involved with dredging or construction of infrastructure will be responsible for establishing a VTMPC file that contains documentation pertaining to vessel traffic management and in particular the latest approved version of the VTMPC. The file shall also include monitoring data and information in relation to management of the VTMPC.

(C2.3)1.10.2.4 Review, Update and Improvement of Contract Specific VTMPC

A copy of the latest approved VTMPC (contract specific) will be kept on-site for the duration of the works and be easily accessible.

During the works, POTL Project Manager would also hold a copy of the latest approved version of the Principal and contractor-specific VTMPC. The VTMPC (contractor) will be regularly reviewed in relation to conditions encountered and updated as appropriate.

(C2.3)1.10.3 VMPC Components and Structure

Table 9 provides a summary of the components of the VTMPC.

Table 9 VTMPC components

Reference	Management Issue	Scope
Section (C2.3)1.10.4	VTMPC (Principal) - This document	Outlines the VTMPC, its requirements for each development stage of the PEP to be managed and issued by POTL.
Section (C2.3)1.10.5	VTMPC (Contractor)	Specifies the VTMPC requirements and any procedures under the contract Including the managing contract involving dredgers, construction vessels or marine plant to be implemented by the contractor.

(C2.3)1.10.4 Vessel Traffic Management Plan – Construction (Principal)

An overall VTMPC for each PEP development stage (A to D) will serve as a framework for contractors to prepare VTMPC details specific to its construction vessels and operations. As the principal, POTL will finalise the overall VTMPC in consultation with MSQ and the RHM to suit the marine construction works, contracting strategy and operating conditions at the time.

POTL will be required to monitor and update the VTMPC to reflect any changes to planned operations or construction methodology or the *Port Procedures and Information for Shipping*. For changes sought by POTL, the RHM shall be consulted in the preparation of each update.

Topic	Vessel Traffic Management Plan – Construction (Principal) (for all stages of construction)
Management Objective	Prepare, maintain, implement and monitor a VTMPC for the PEP.
Applicability	It provides a framework for the development and management of contractor VTMPCs for each PEP development stage.
Performance Criteria	▪ Safe vessel operations. ▪ Reduce risk and disruption to shipping, commercial vessels and recreational boating ▪ Reduce risk to infrastructure and aids to navigation
Implementation Strategy	▪ Determine the allowable extent, type and location of temporary structures. ▪ Specify requirements for temporary aids to navigation and demarcation of construction areas. ▪ Outline consultation requirements with regulatory authorities, MSQ and RHM. ▪ Outline consultation requirements with regard to recreational boating and commercial vessels. ▪ Specify hydrographic survey requirements (frequency, type and class) for monitoring depth in navigation areas during construction. ▪ Specify methods for dealing with spilt material or obstructions in navigation waters. ▪ Identify resourcing levels for pilotage and pilot exemption certificates for the construction. ▪ Identify management measures for interfaces between contractors if work is to be

Topic	Vessel Traffic Management Plan – Construction (Principal) (for all stages of construction)
	undertaken simultaneously under separate contracts. ▪ Specify limitations to vessel operations and refuelling. ▪ Determine the frequency and details of vessel movement schedules to be submitted by contractors. ▪ Detail emergency planning requirements. ▪ Detail port security requirements. ▪ Specify requirements for management of safety and navigation.
Monitoring	▪ POTL in conjunction with RHM will oversee the development of contractor VTMPCs. ▪ POTL monitors the contractor's performance against VTMPC (Contractor).
Auditing	▪ POTL will oversee construction activities to monitor contractor's performance against VTMPC. ▪ MSQ Vessel Traffic Services to record non-conformances and incidents from construction vessel operations.
Reporting	Contractor is to develop VTMPC (Contractor) in line with VTMPC (Principal) and report back on performance.
Corrective Action	Revise the VTMPC to reflect any deficiencies identified during construction activities due to: ▪ changes to planned operations or construction methodology ▪ changes to the *Port Procedures and Information for Shipping* Should any changes be required to the overall VTMPC, these are to be reflected in the contractor VTMPC.
Responsibility	POTL with ongoing consultation with contractors, MSQ and RHM.

(C2.3)1.10.5 Vessel Traffic Management Plan – Construction (Contractor)

For construction work involving the use of dredging or marine construction vessels and floating plant, the managing contractor shall prepare and implement its plan in accordance with the requirements of the VTMPC discussed in Section (C2.3)1.10.4. The requirements of the contractor VTMPC will be outlined in the VTMPC (Principal). The VTMPC does not replace any requirement for any regulatory documentation required by MSQ or the RHM.

During the construction, the contractor shall update parts of the VTMPC to reflect any changes to planned operations, construction methodology or the *Port Procedures and Information for Shipping* and detail the manner in which it will perform any construction works or dredging operations for the PEP.

If changes are sought by the contractor, POTL and the RHM will be consulted in the preparation of each update and once complete the contractor will submit each update to RHM for consent.

The contractor, where indicated, is to consult with and incorporate the requirements of the RHM and POTL into the VTMPC.

The contractor will be responsible for identifying and obtaining approvals required under Commonwealth and State legislation to undertake construction works and dredging operations.

Topic	Vessel Traffic Management Plan – Construction (Contractor)
Management Objective	Prepare, maintain, implement and monitor VTMPC for construction works and dredging operations.
Applicability	Contractors undertaking marine operations involving dredgers, construction vessels and floating plant.
Performance Criteria	▪ Safe vessel operations. ▪ Reduce risk and disruption to shipping, commercial vessels and recreational boating. ▪ Reduce risk to infrastructure and aids to navigation. ▪ Reduce risk of potential impacts from marine construction operations.
Implementation Strategy	In preparing a VTMPC the contractor shall: ▪ Comply with the requirements of the VTMPC (Principal).

Topic	Vessel Traffic Management Plan – Construction (Contractor)
	▪ Consult with POTL, RHM, MSQ and other relevant regulatory authorities. ▪ Consider the requirements of *Port Procedures and Information for Shipping – Port of Townsville*. The VTMPC shall address the following: 1) Protection of shipping and port operations 2) Protection of existing port and other structures and assets including existing navigation aids/markers 3) The management of recreational craft 4) Pilotage requirements and programme for obtain pilotage exemption certificates as appropriate 5) Workplace health and safety requirements 6) Induction and training procedures 7) Site security and compliance with the Maritime Security Plan for Port of Townsville 8) Communication protocols and procedures with POTL, RHM, Vessel Traffic Services and other parties 9) Temporary marine structures and aids to navigation 10) Bunkering and refuelling procedures and maintenance of construction vessels 11) Emergency procedures (including cyclone contingency plans). Details are to be provided in the VTMPC of construction vessels including: 1) The vessel name, draft, tonnage, pump power, dimensions, lifting capacity etc. 2) Valid Certificate of Survey or a valid permit issued by MSQ pursuant to the *Transport Operations (Maritime Safety) Act 1994*. 3) Description of how each vessel will be crewed and how it is to be used for the Project. Details are to be provided in the VTMPC of temporary works (including aids to navigation), moorings and existing marine facilities that will be used.
Monitoring	The contractor shall consult with the RHM and submit specific Weekly Works Schedules for consent. The Weekly Work Schedules to be approved by the RHM, they shall specifically describe the following: 1) The general location, activities and program for the works (i.e. the program indicates expected routes) 2) The number and type of construction vessels greater than 35m LOA to be deployed 3) An estimate of the number and type of construction vessels less than 35m LOA to be deployed for dredging and construction operations 4) Consideration of shipping schedules, and port operating hours to ensure that impacts on peak operational periods are reduced 5) Applicable weather and/or night time constraints 6) Additional communication protocols and procedures 7) Development of protocols for communication between parties relevant to the dredging and construction operations.
Auditing	▪ Contractor is to monitor and audit the progress of the VTMPC as part of the quality assurance plan including for those items required by VTMPC (Principal) ▪ POTL shall monitor Contractor's performance against the VTMPC in consultation with MSQ and RHM.
Reporting	▪ Contractor to report back on VTMPC at construction works schedule meetings including for those items required by VTMPC (Principal). ▪ MSQ Vessel Traffic Services to record non-conformances and incidents from construction vessel operations.
Corrective Action	Contractor to revise the VTMPC to reflect any deficiencies identified during construction activities due to: ▪ changes to planned operations or construction methodology ▪ changes to the *Port Procedures and Information for Shipping*

Topic	Vessel Traffic Management Plan – Construction (Contractor)
	If any changes are required to the Contractor's VTMPC, these shall be submitted to POTL and to the RHM for consent.
Responsibility	▪ Contractor to prepare in consultation with POTL, MSQ and RHM. ▪ Contractor to conduct vessel operations in accordance with the approved VTMPC. ▪ POTL to monitor Contractor's performance against VTMPC in consultation with MSQ and RHM.

Port Expansion Project EIS

Part C

Section 2.4 – Maritime Operations Management Plan

AECOM BMT WBM

(C2.4)1.0 Introduction

(C2.4)1.1 Overview

The Port of Townsville is located on Cleveland Bay, approximately three kilometres east of the city centre in Townsville, North Queensland (refer to Figure C.2.4.1.1). The port is situated in the Great Barrier Reef World Heritage Area and the majority of the port infrastructure is positioned in an excised portion of the Great Barrier Reef Marine Park.

The Port of Townsville is Queensland's third largest commercial port and is capable of handling a diverse range of cargo. Port operations must be undertaken in a manner that is sympathetic to the surrounding area, reducing potential impacts on the receiving environment to ensure sustainable operations and growth. The port is located in close proximity to the adjacent city and residential areas and is located in a sensitive natural environment. It is in close proximity to other important sensitive environments such as seagrass beds, RAMSAR wetlands, mangrove communities, and coral reef communities.

This Marine Operations Management Plan (MOMP) has been prepared in accordance with the Maritime Safety Queensland (MSQ) *Guidelines for Major Development Proposals* (DTMR, 2010) .

(C2.4)1.2 Purpose

The purpose of this MOMP is to identify the preferred means of addressing issues and reduce the potential for negative environmental impacts associated with maritime operational activities (operational shipping) as a result of the PEP. The MOMP:

- describes POTL's commitments regarding maritime activity management, environmental performance and the reduction of potential adverse impacts
- specifies the actions that would be taken to implement commitments (such as monitoring)
- identifies corrective actions to rectify any deviation from performance criteria's
- provides an action program to ensure the environmental commitments are implemented and achieved
- provides mechanisms for complaints management, community engagement and on-going improvement.

(C2.4)1.3 Scope

This MOMP only applies to the PEP operational shipping that is under POTL's control or utilising POTL's facilities as part of the PEP. This MOMP falls under the overall PEP EMP System which includes:

- Construction phase:
  - PEP Construction Environmental Management Plan;
  - Construction Dredge management Plan;
  - Vessel Traffic Management Plan.
- Operational phase:
  - PEP Operational Management Plan;
  - Maritime Operations Management Plan (this document).

(C2.4)1.4 Terms of Reference

The MOMP has been prepared in response to the Queensland Government's *Townsville Port Expansion Project - Terms of Reference for an Environmental Impact Statement*, February 2012 (Appendix A), issued by the Coordinator General. Section 5.3.1 plus the *Commonwealth Guidelines for an Environmental Impact Statement for Port of Townsville Port Expansion Project, Queensland,* Section 5.10.11. The Terms of Reference states the management plans required to address marine transport impact management strategies.

This MOMP addresses:

- *Shipping Sourced Pollution Prevention Management Plan – Environmental Management* (Section (C2.4)4.0)
- *Vessel Traffic Management Plan - Port Operations* (Section (C2.4)5.0*)*
- *Aids to Navigation Management Plan (*Section (C2.4)6.0).

These three management aspects have been combined into a single management plan that includes operational marine side management strategies. This reduces duplication and improves the ease of implementation, thereby ultimately increasing the effectiveness of the management actions over the long term. The aim of the MOMP is to reduce the potential for negative impacts on the environment. The MOMP provides life-of-project control strategies in accordance with agreed performance criteria for specified acceptable levels of environmental harm.

(C2.4)1.5 Legislation and Policy

The MOMP has been developed cognisant of legislative requirements and International Conventions at the time of writing.

(C2.4)1.5.1 Commonwealth

The key Commonwealth legislation and regulations considered in, and relevant to, the development of this MOMP (including Acts implementing relevant international conventions) includes:

- *Maritime Transport and Offshore Facilities Security Act 2003 and Regulations 2003;*
- *Navigation Act 1912;*
- *Ship Registration Act 1981;*
- *Australian Maritime Safety Authority Act 1990;*
- *Environmental Protection and Biodiversity Conservation Act 1999;*
- *Environmental Protection (Sea Dumping) Act 1981 and Regulations 1983;*
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983;*
- *Great Barrier Reef Marine Park Act 1975 and Regulations 1983; and*
- *Quarantine Act 1908.*

In addition, a number of international conventions have been entered into by the Commonwealth which apply to the management of shipping. These include:

- *International Convention for the Prevention of Pollution from Ships (MARPOL)* (IMO, 2011).
- *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (The London Convention)* (IMO, 1972).
- *International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)* (IMO, 1990).
- *Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol)* (IMO, 2007).
- *International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS)* (IMO, 2001).
- *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (IMO, 2004a).

Commonwealth plans and guidelines also applicable to this MOMP include:

- Australian Ballast Water Management Requirements Version 5 (DAFF, 2011)
- National Biofouling Management Guidelines for Commercial Vessels (Commonwealth of Australia, 2009)
- Australian Marine Pest Monitoring Guidelines Version 2.0 (DAFF, 2010a)Australian Marine Pest Monitoring Manual Version 2.0 (DAFF, 2010b)

- The National Plan to Combat Pollution of the Sea by Oil and other Hazardous and Noxious Substances (AMSA, 2010a).

(C2.4)1.5.2 State Legislation

The following State legislation is relevant to the construction and has been considered in the development of this MOMP:

- *Transport Operations (Marine Safety) Act 1994 and Regulations 2004;*
- *Transport Operations (Marine Pollution) Act 1995 and Regulations 2008;*
- *Transport Infrastructure Act 1994;*
- *State Development and Public Works Organisation Act 1971;*
- *Work Health and Safety Act 2011;*
- *Coastal Protection and Management Act 1995;*
- *Environmental Protection Act 1994;*
- *Fisheries Act 1994 and Regulations;*
- *Marine Parks Act 2004 and Marine Parks (Great Barrier Reef) Zoning Plan;*
- *Nature Conservation Act 1992.*

(C2.4)1.5.3 State Policies and Plans

The following State policies and plans are relevant to the construction and have been considered in the development of this MOMP:

- Environmental Protection Policies.
- Queensland Coastal Plan[1].

(C2.4)1.5.4 Townsville Port Procedures

MSQ has published the *Port Procedures and Information for Shipping – Port of Townsville* (DTMR, 2012) which is designed to complement the requirements of the above legislation, regulations and codes and also the procedures of:

- Port of Townsville Limited
- Townsville City Council
- Maritime Safety Queensland
- Australian Maritime Safety Authority
- Australian Customs Service
- Department of Agriculture, Fisheries and Forestry (Australian Quarantine and Inspection Service)
- Royal Australian Navy.

---

[1] State Planning Policy 3/11 Coastal Protection was replaced by the Queensland Government on 8 October 2012 by the *Draft Coastal Protection State Planning Regulatory Provision: Protecting the Coastal Environment*. The Draft SPRP will operate for 12 months unless earlier repealed. Due to the release of the Draft SPRP at such a late juncture in the preparation of the PEP EIS, the various chapters and assessments contained within the EIS address SPP 3/11 as required by the approved Terms of Reference for the Project under the *State Development and Public Works Organisation Act 1971*. If required and still in place at the time of preparation, the EIS Supplement will address the Draft SPRP to the extent required by the Coordinator General.

The *Transport Operations (Marine Safety) Act 1994* enables the RHM to give a general direction to ship owners, ship masters, ships, other persons or matters for the purposes of ensuring safety, effectiveness and efficiency of the Queensland maritime industry.

(C2.4)1.5.5 MSQ Guidelines for Major Development Proposals

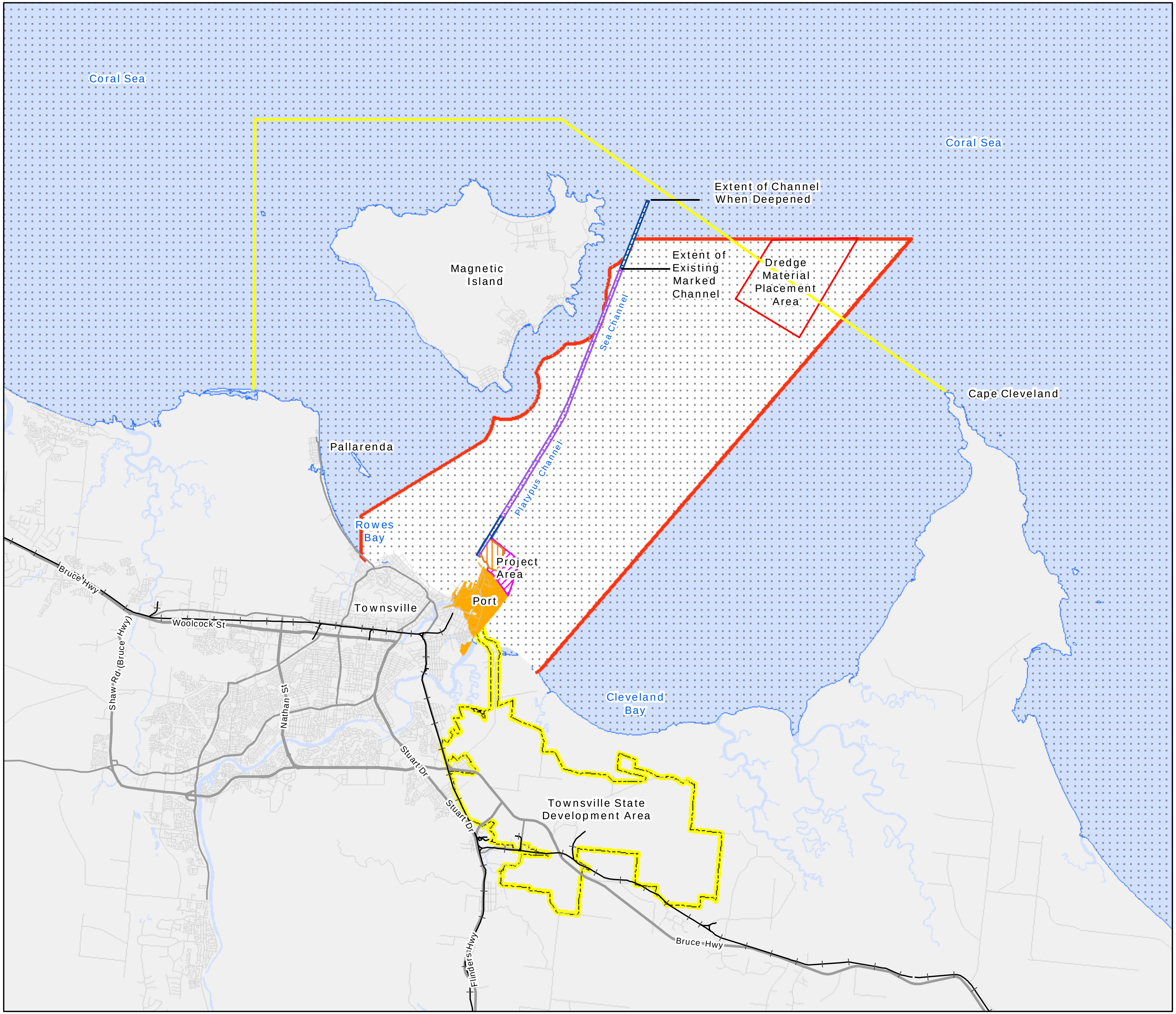
To assist proponents of major development proposals in identifying maritime related impacts and mitigation strategies, MSQ has developed guidelines for major development proposals. The guidelines specify the information required by MSQ for its evaluation. The preferred format for presentation of this information is through the development of management plans for:

- vessel traffic management
- aids to navigation
- ship-sourced pollution prevention.

These guidelines have been adopted in the development of this MOMP, in the breakdown specified in Table 1, to provide management actions that would be applied to operational shipping movements.

(C2.4)1.6 Site Location

The port is located in Cleveland Bay adjacent to the City of Townsville. The new Outer Harbour is seaward of the existing breakwater and inner harbour as shown in . The existing Platypus and Sea channels will be deepened in stages, resulting in the lengthening of the Sea Channel east of Magnetic Island. This MOMP applies to these areas and shipping within them. The Australian Maritime Safety Authority (AMSA) mapping of the extent of traffic movement into and out of the harbour is shown in Figure C.2.4.1.2.



PORT EXPANSION PROJECT EIS

Locality Plan and PEP

Figure C.2.4.1.1

Legend

- Highways
- Main Roads
- Minor Roads
- Local Roads
- Railway Line
- Port Limits
- Channel to be Dredged
- Existing Port Land
- Existing Channel to be Deepened
- Harbour Basin
- Reclamation Area
- Townsville State Development Area
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary
- GBRWHA/National Heritage Place

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_030

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012

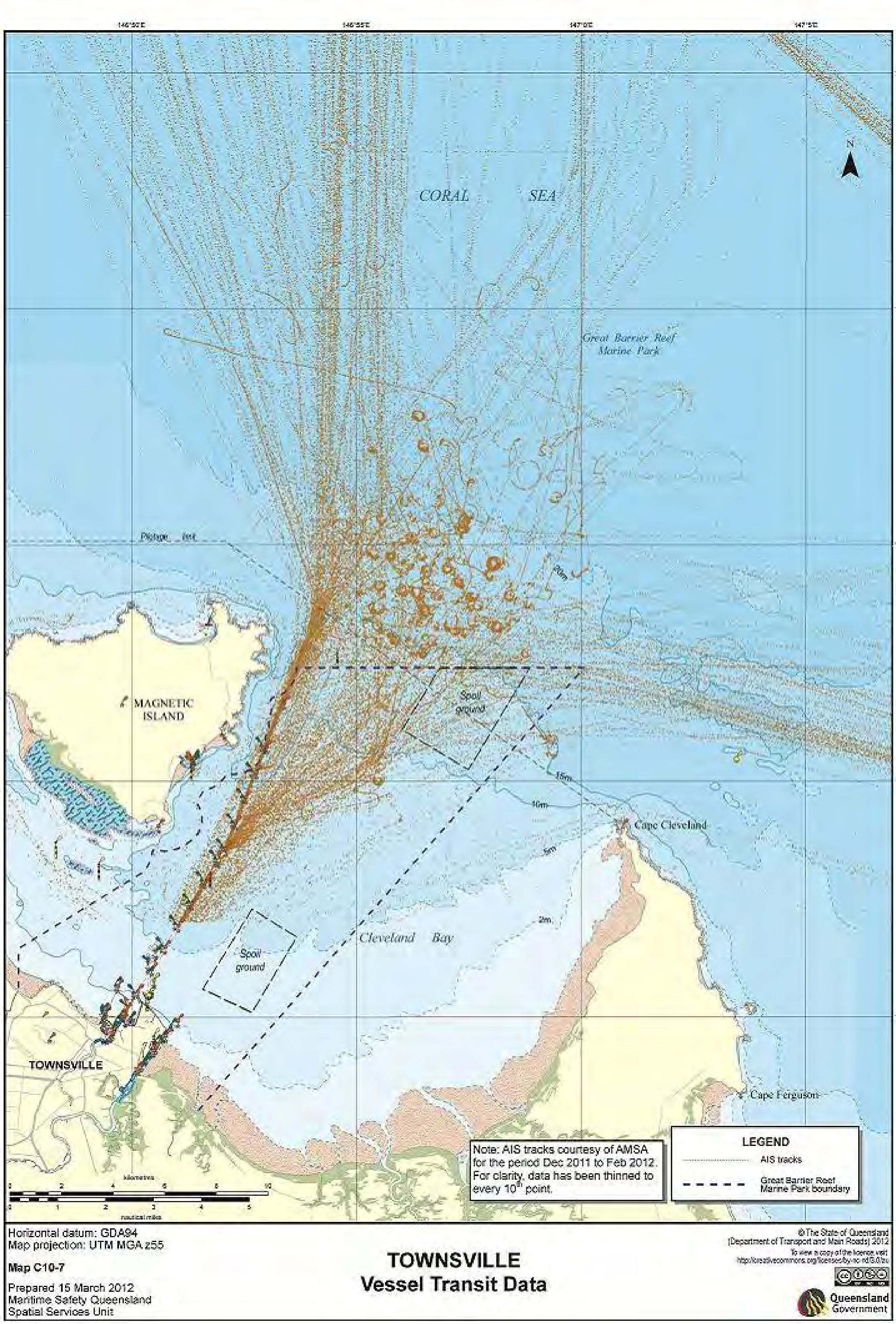


Figure C.2.4.1.2 Townsville Vessel Transit Data

(C2.4)2.0 Environmental Management Framework

(C2.4)2.1 Environmental Management System

POTL maintains a high level of commitment to sustainable development and operation through its Environmental Management System (EMS). POTL's EMS is compliant with AS/NZS ISO 14001 2004 and aims to facilitate the continual improvement of environmental performance by:

- integrating environmental considerations into decision making and work practices related to the Corporation's core functions
- maintaining a high level of environmental awareness throughout the Corporation and the wider port Community
- utilising systems which act to reduce the risk of environmental harm through the identification reporting, assessment, monitoring and control of environmental risks.

The EMS provides a framework for environmental management at the port. The EMS reflects POTL's Environmental Policy (Appendix C) and commitments to manage its activities with concern for people and the environment.

Actions that are identified within this MOMP as being POTL's responsibility will be incorporated into POTL's EMS. It refers to relevant sections of POTL's EMS and incorporates additional elements necessary to satisfy POTL's environmental requirements.

POTL will control actions in the common user areas in accordance with their EMS, other integrated management documents, conditions of statutory approval and regulatory requirements (refer Section (C2.4)1.3). These actions include: management responsibilities, incident management, emergency responses, non-conformances, environmental training, monitoring, reporting, auditing and complaint handling.

Continuous improvement of the EMS is a mandatory requirement. As part of the continuous improvement the MOMP may be updated or amended as required. This may include being merged to streamline EMP documentation. Any future amendments will take into account the intent of this document, the conditions of the existing approvals and be undertaken in consultation with relevant stakeholders.

(C2.4)2.2 Environmental Policy

POTL Environmental Policy (Appendix C) applies to POTL lands, including the common user areas of the Port of Townsville. It is:

- displayed at prominent locations in the workplace of POTL employees and on POTL website
- communicated to POTL employees during induction and training
- reviewed regularly.

POTL personnel, contractors and visitors must comply with the spirit and intent of the policy. POTL's Environmental Policy states:

> *Port of Townsville Limited (the Corporation) and its senior management are committed to the protection of the environment and considers it as critical corporate value in the delivery and maintenance of port infrastructure and services and in planning for the future development of the Port of Townsville and Port of Lucinda.*
>
> *The Corporation is committed to sustainable development and operation through responsible environmental management and continual improvement of environmental performance and the effectiveness of its Environmental Management System.*
>
> *To achieve corporate performance consistent with this policy, the Corporation will employ the following principles:*
>
> - *Integrate environmental considerations into decision making and work practices related to the Corporation's core functions.*
> - *Maintain a high level of environmental awareness throughout the Corporation and the wider port community.*

- *Implement systems which act to minimise the risk of environmental harm through the identification, reporting, assessment, monitoring and control of environmental risks.*
- *Establish a framework for setting and reviewing environmental objectives and targets and measuring the Corporation's performance.*
- *Establish and maintain systems for assessing the environmental impacts associated with the Corporation's activities, identifying and acting on opportunities for improvement.*
- *Compliance with all relevant legislation, codes of practice and standards.*
- *Core functions to be conducted in a manner that will minimise waste, prevent pollution, promote efficient use of resources, reduce environmental impacts, and continually improve environmental and management system performance.*
- *Providing adequate resources including finances, to facilitate the fulfilment of the Corporation's environmental responsibilities.*

Senior Management is responsible for providing the leadership to support the development and implementation of this Policy and for ensuring it is effectively applied.

This policy will be regularly reviewed following legislative or organisational changes, or as a minimum, every three years.

(C2.4)3.0 Maritime Operations Management Plan Structure

(C2.4)3.1 Management Issues

The following issues have been identified in the EIS Terms of Reference and the MSQ *Guidelines for Major Development Proposals* (DTMR, 2010). Table 1 provides a summary of the components of the MOMP.

Table 1 MOMP components

Reference	Management Issue	Scope
Shipping Management – Environmental outcomes		
(C2.4)4.1	Release of ballast water	Controls to manage, record and monitor the release of ballast water potentially with contaminants or exotic organisms.
(C2.4)4.2	Introduction of exotic organisms	Manage the potential for exotic organisms to be released into the local marine environment from shipping through ballast release or biofouling.
(C2.4)4.3	Release of shipping waste	Manage the movement of waste from ship to shore and prevent illegal dumping and accidental release.
(C2.4)4.4	Spills	Implement measures to prevent spills, and actions to be undertaken in the event of spills.
(C2.4)4.5	Vessel strike	Reducing the potential for contact between ships and marine fauna.
(C2.4)4.6	Ship sourced pollution	Preventing the release of any substances from shipping.
Vessel Traffic Management – Port operational outcomes		
(C2.4)5.1	Channel and outer harbour development	Design, construction and maintenance of navigation water areas.
(C2.4)5.2	Ship anchorage	Review of present and future anchorage locations/procedures.
(C2.4)5.3	Marine operations management systems	On-going review of systems for the management of marine systems.
(C2.4)5.4	Marine operations resources	Planning of resources to manage and conduct marine operations.
(C2.4)5.5	Emergency management	On-going review of plans and procedures for the management of risk and emergency responses for shipping.
Aids to Navigation – Port operational outcomes		
(C2.4)6.0	Aids to navigation	Design, installation and maintenance of aids to navigation for the channel and outer harbour basin.

(C2.4)3.2 Environmental Management Strategies

For each element identified, an environmental management strategy and actions have been developed to address potential risks that may arise. Each element has stated environmental objectives, performance criteria, management actions and monitoring and corrective actions. The structure used for the strategy and actions is outlined in Table 2.

Table 2 Environmental management strategy components

Environmental Management Strategy Component	Description of Content
Element/Issue	Aspect of operational shipping to be managed (as it affects environmental values).
Potential Impacts	The potential impacts the element/issue may create without management.
Performance Objective	The aims and objectives which drive the need for management of the element/issue.
Performance Criteria	Measurable performance criteria (outcomes) for each element/issue of the operation.

Environmental Management Strategy Component	Description of Content
Monitoring and reporting	The monitoring requirements to measure actual performance (for example specified limits to pre-selected indicators of change).
Management Actions	The strategies, tasks or action program (to nominated operational design standards) that would be implemented to achieve the performance criteria.
Responsibility	Identify who will be responsible for implementing the management actions, undertaking monitoring of actions any subsequent reporting requirements or other responsibilities which may arise out of the individual management actions.
Timing	Identify the frequency at which management actions need to be implemented.
Corrective Action	The action (options) to be implemented in case a performance requirement is not reached and the person(s) responsible for corrective action (including staff authority and responsibility management structure).

(C2.4)4.0 Shipping Management - Plan Elements

This section of the MOMP identifies specific environmental management measures (including strategies and/or actions) related to the shipping and marine side activities for the PEP which have potential impacts on the marine environment. In most cases, management actions will need to be integrated in the broader site-based management plans, documentation and any conditions of approval imposed on the PEP.

POTL's role with respect to matters in this Section would be to address and meet these requirements either by POTL or the relevant party (whoever is applicable) for activities to be carried out consistently with any existing procedures or protocols.

(C2.4)4.1 Release of Ballast Water

Potential Impacts	▪ Potential harm to marine ecosystems. ▪ Potential harm to economic activities (port operations, commercial fishing and tourism). ▪ Harm to reputation of ship operators
Performance Objectives	▪ To reduce the potential for prohibited releases of ballast water to occur. ▪ To reduce the potential for environmental harm to marine environments, as a result of release from shipping, through implementation of appropriate contingency measures. ▪ To emolliate the impacts of any unauthorised ballast water release.
Performance Criteria	▪ No incidents of environmental harm involving ballast water releases. ▪ Ballast summary sheets to be provided to AQIS for relevant shipping.
Monitoring and Reporting	▪ Maintain 24/7 CCTV monitoring of harbour areas for potential releases and discharges. ▪ Ballast water movements must be recorded in ship manuals for verification.

Management Actions	Responsibility	Timing	Corrective Actions
Tank-to-tank shipboard ballast water exchanges to be outside Australian territorial waters.	Ship Owner / operator.	Prior to entering territorial waters. Tank to tank transfers are permissible in territorial waters, however it is ideal they are conducted at the maximum distance possible from land.	Transfer is to stop if unauthorised discharge occurs in Australia waters. Authorities are to be notified who will advise of the next appropriate action commensurate with the level of risk. Severe penalties apply under s78 of the *Quarantine Act 1908* for the unauthorised discharge.
Full ballast water exchange to occur outside Australian territorial waters and the Great Barrier Reef Marine Park	Ship Owner / operator to ensure only the following approved methods are used: ▪ sequential exchange (empty/refill) method ▪ flow through exchange method ▪ dilution exchange method.	Prior to entering Australian territorial waters. No exchanges in the Great Barrier Reef Marine Park. International ships cannot exchange ballast water until in international waters (12 nautical miles from the edge of the Great Barrier Reef Marine Park) Ballast water cannot be exchanged in the port limits.	AQIS can carry out audits of ballast tanks to confirm that the ships have complied with these conditions. IMO rules are to be implemented: *http://www.imo.org/Pages/home.aspx*

Management Actions	Responsibility	Timing	Corrective Actions
Sediment discharges in ballast water to occur outside Australian territorial waters.	Ship Owner / operator to ensure that no sediment is discharged in Australian waters.	Ongoing.	Sedimentary material from ballast tanks may be landed as quarantine waste in some Australian ports, or it can be dumped back into the sea in deep water, which is at least 200m deep and outside the 12nm limit, but preferably beyond 200nm from land.
Ballast tank stripping only via permanent vessel pumps.	Ship Owner / operator to ensure ballast tank stripping is only undertaken via permanent vessel pumps.	Ongoing.	If ship does not have pumps capable of stripping ballast, they will be unable to dump ballast. No portable pumps can be used due to potential contamination.
Ballast Water Management Plans to be carried by vessels.	Ship Owner / operator to ensure vessels carry Ballast Water Management Plans.	Ongoing.	Enforceable under the *Quarantine Act 1908*. Ships without a Ballast Water Management Plan may be refused entry.

Note the following:

1. AQIS deems salt water from ports and coastal waters outside Australia's territorial sea to be a 'high-risk' and capable of introducing exotic marine pests into Australia. The discharge of high-risk ballast water from ships is prohibited anywhere inside Australia's territorial sea.
2. Vessels must retain ballast water records in the AQIS Ballast Water Management Summary Sheet and any relevant vessel logbooks, and make these available to quarantine officers on request.
3. Vessels are not permitted to discharge ballast water in Australian waters until AQIS officers have conducted ballast log verification and confirm that appropriate ballast exchanges have been conducted. Ballast verification can occur prior to arrival by submitting AQIS Ballast Water Ballast Summary Sheet to the Maritime National Co-ordination centre for assessment 12 – 96 hours prior to arrival or alternatively an on board verification can be conducted following vessel arrival. Vessels cannot discharge ballast water without written permission from AQIS.

(C2.4)4.2 Introduction of Exotic Marine Organisms

Potential Impacts	▪ Potential harm to marine ecosystems. ▪ Potential harm to economic activities (port operations, commercial fishing and tourism). ▪ Harm to reputation of ship operators
Performance Objectives	▪ To prevent or reduce the risk of release of introduced marine organisms into the marine environment from shipping traffic generated by the PEP.
Performance Criteria	▪ Management measures are implemented to avoid or limit releases of exotic organisms into the marine environment to the greatest extent practicable.
Monitoring and Reporting	▪ AQIS Officers will conduct ballast water verification inspections on-board vessels as required to ensure compliance with Australia's ballast water management requirements. ▪ Identification of exotic of foreign species in Port waters will be recorded in POTL database and advised to DAFF/Biosecurity Qld accordingly.

Management Actions	Responsibility	Timing	Corrective Actions
International vessels are to comply with AQIS pre-arrival reporting requirements[1] and ballast water exchange/discharge requirements.	Ship Owner / operator, DAFF and Biosecurity Qld	Prior to entry into Port	AQIS to recommend necessary corrective or disciplinary actions as required.

1. *Refer to C2.4.4.1 for requirements for "Release of Ballast Waters"*

Other notes:

a. potential for exotic marine organisms (also known as introduced marine pests) from ships may arise from biofouled hulls or vessel infrastructure and/or from release of infected ballast waters.

b. potential for release of terrestrial exotic organisms from ships can be reduced through the introduction of controls designed to prevent the spread of exotic organisms. Further landside controls in regards to management of terrestrial exotic species may be found in the PEP Operational Environmental Management Plan (OEMP) which provides environmental controls for land side operational activities.

c. terrestrial exotic organism release would also be managed as part of the waste management actions in Section (C2.4)4.3 and ship sourced pollution actions in Section (C2.4)4.6.

(C2.4)4.3 Release of Shipping Waste

Potential Impacts	▪ Harm to marine life through entanglement and or ingestion. ▪ Harm to recreation and tourism through degradation of visual amenity. ▪ Harm to human health through release of sewage. ▪ Damage to environmental management reputation of the Port of Townsville
Performance Objectives	▪ To prevent or reduce the release of shipping waste from POTL generated shipping traffic, into the marine environment.
Performance Criteria	▪ Waste releases into the marine environment are in accordance with relevant laws and standards. ▪ No complaints from public or government agencies regarding noticeable waste, as a result of shipping activities.
Monitoring and Reporting	▪ Regular visual inspections of wharf areas. ▪ Any complaints or waste release incidents will be recorded in POTL database in order to identify areas for action or improvement.

Management Actions	Responsibility	Timing	Corrective Actions
Vessels are to carry Garbage Record Books.	Ship Owner / operator. Regulation 9, Annex V of MARPOL requires ships of ≥400 gross tonnage and every ship certified to carry ≥15 persons to carry a garbage record book to record disposal and incineration operations. The date, time, position of ship, description of the garbage and the estimated amount incinerated or discharged must be logged and signed.	Ongoing. The Garbage Record Book must be kept for a period of two years after the date of the last entry.	POTL to notify ship owner / operator of obligations.
Commercial vessels required to carry a Garbage Management Plan.	Ship Owner / operator. All ships of ≥400 gross tonnage and every ship certified to carry ≥15 persons. The Garbage Management Plan designates the person responsible for carrying out the plan and is in the working language of the crew. Garbage Management Plan, to include written procedures for collecting, storing, processing and disposing of garbage, including the use of equipment on board.	Ongoing	POTL to notify ship owner / operator of obligations. Garbage Management Plans are subject to inspection by MSQ or Commonwealth officials.

Management Actions	Responsibility	Timing	Corrective Actions
No discharge of sewage at sea unless at appropriate distance from land. The treatment, quality and distance requirements for different vessel types are stipulated by GBRMPA and MSQ requirements.	Ship Owner / operator and MSQ. The regulations in Annex IV of MARPOL and the requirements of MSQ prohibit the discharge of sewage into the sea within a specified distance of the nearest land, unless they have in operation an approved sewage treatment plant.	Whenever discharging sewage to sea.	Ships seeking to discharge sewage must move to the appropriate offshore distance prior to discharge, in accordance with Annex IV of MARPOL and MSQ requirments.
Non-cargo Liquid Transfer Notifications to be prepared for the transfer of any non-liquid cargo.	Ship Owner / operator. Notification to be submitted to the RHMs office.	Must be submitted to the RHM's office prior to conducting non-cargo liquid transfer operations in the port. It is the responsibility of the vessel's Master to notify Port Control and VTS prior to commencing transfer and at completion of transfers.	If no notification occurs then no liquid waste transfer can occur. If the transfer is still required, the Harbour Master must be notified.
POTL to undertake inspections of Non-Cargo Liquid Transfer operations.	POTL	Prior to undertaking non-cargo liquid transfers. Inspections, if required, will be arranged one (1) hour prior to the start of transfer operations by contacting the ships Master.	Undertake inspections for non-cargo liquid transfers.
No wastes to be discharged to port waters.	POTL and ship operators.	Ongoing.	Informal surveillance and reporting of nonconformities. Garbage record book checks by DAFF.
Provision of port side bins.	POTL	Ongoing	Review port side waste bin types and quantities and rectify.
Provision of quarantine waste bins.	Ship Owner / operator	Ongoing	Review requirements for quarantine waste generation and amend provided facilities as necessary. (ASMA)complaint investigations.

(C2.4)4.4 Spills

Potential Impacts	Potential impacts from a spill of any substance in a marine environment may include: ▪ mortality or long term impacts on sea birds, marine mammals and other sea life ▪ physical damage or permanent loss of foreshore and marine habitats ▪ impacts on the health, viability and diversity of coastal ecosystems ▪ damage to commercial fishing ▪ smothering of, and damage to, intertidal biota and vegetation ▪ contamination of coastal infrastructure and amenities leading to impacts on tourism and other recreational activities ▪ economic loss at both the regional and national level ▪ impacts to public health ▪ adverse media and attention on the oil and shipping industries and their operations.
Performance Objectives	▪ To reduce spill of any substance into the marine environment from shipping traffic generated by the port.
Performance Criteria	▪ Accidental releases of any substance into the marine environment are avoided or promptly managed to avoid material impacts. ▪ No complaints from public or government agencies regarding noticeable spills as a result of shipping activities.
Monitoring and Reporting	▪ Opportunistic visual inspections of POTL controlled areas. ▪ Any complaints or spill release incidents will be recorded in POTL database in order to identify potential adverse impacts. ▪ Spills to be reported to environmental and public health authorities, in accordance with legislation and port notices, incident reporting requirements.

Management Actions	Responsibility	Timing	Corrective Actions
Review stochastic modelling during spill event to aid understanding of potential spill area. Refer *Oil Spill Risk and Exposure Modelling Study for the Townsville PEP* (Appendix X1).	POTL, MSQ or DEHP.	Immediately on identification of spill event.	Update spill response actions. AMSA to calibrate model based on observed spill behavious and whether to refine for future events.
All dangerous goods in the Port to be handled in accordance with the International Maritime Dangerous Goods (IMDG) Code.	POTL, Ship Owner / operator, tenents and transport companies.	Ongoing	If handling of dangerous goods is not in accordance with IMDG then handling procedures to be ceased and reviewed. Handling can commence when procedures are in accordance with the code.

Management Actions	Responsibility	Timing	Corrective Actions
A Notification of Transporting and Handling Dangerous Goods* (Marine) required for dangerous goods transfers.	Ship Owner / operator.	Form is to be lodged at the RHM's office no later than 48 hours prior to the vessel's estimated time of arrival.	If the form has not been obtained, signed and lodged appropriately, further handling and transport of the goods cannot take place until legitimate form has been obtained.
A Non-cargo Liquid Transfer Notification is required for the transfer of non-cargo liquids.	Ship Owner / operator.	Must be submitted to the RHM's office prior to conducting non-cargo liquid transfer operations in the port. It is the responsibility of the vessel's Master to notify Port Control and VTS prior to commencing transfer and at completion of transfers.	Operators undertaking transfers without appropriate approvals may be subject to penalties.
Australian system for pilotage to be adhered to for ships requiring pilotage.	Ship Owner / operator.	Ongoing	Report breaches to appropriate regulatory authorities. POTL to consider issuing penalties as per Port Notices.
Mandatory recording of shipping movements.	POTL	Ongoing	Systems to be reviewed to ensure shipping movements are recorded in an internal systems. Internal and external audits may be required to identify deficiencies.
Refuelling to be undertaken by licensed refuelling operators with appropriate emergency response equipment.	POTL and port operators/tenants to ensure licensed refuelling operators are used.	Prior to and during refuelling event.	Report breaches to appropriate regulatory authorities. POTL to consider issuing penalties as per Port Notices.
Follow incident response procedures.	POTL implements appropriate incident response measures. Port Users in accordance with mooring agreements for common use areas, tenant leases and port notices.	During and following incident.	Review incident response measures to ensure effectiveness.
Undertake investigations in the event of an incident or failure to comply.	MSQ or DEHP / TCC	Following incident.	MSQ/DEHP/TCC Investigate and implement mitigating measures. Report breaches to appropriate

Management Actions	Responsibility	Timing	Corrective Actions
			regulatory authorities. POTL to consider issuing penalties as per Port Notices.
Shipping activities to be undertaken having regard to the prevailing weather conditions.	Ship operator and MSQ	Ongoing	Shipping activities to be reduced or stoped during weather warning periods.
Townsville Emergency Response Plan to be activated in the event of a major spill, as defined under that plan.	POTL, MSQ or DEHP.	Ongoing	Revise triggers for activation of Emergency Response Plan if current triggers are considered insufficient for changing port conditions.

*A Dangerous Goods List is to be completed and submitted to the RHMs office with the notification form. The Dangerous Goods List is required to specify the following information for all dangerous goods transported or handled:

- Correct technical name;
- U.N. Number;
- I.M.D. G Class;
- Packing group;
- Flash point (C);
- Intended fate of dangerous good (i.e. storage, load, unload or cargo in transit);
- Period of storage on berth;
- No. and description of containers or tanks;
- Identification marks on containers or tanks;
- Stowage / proposed stowage on ship;
- Net weight or volume;
- Consignor or consignee phone number; and
- NET explosive quantity (NEQ).

In obtaining a permit to transport or handle dangerous goods in the Port, the Applicant acknowledges and agrees:

1. to comply with IMDG Code.
2. to comply with AS3846 "*The handling and transport of dangerous cargoes in port areas*" and provide evidence of compliance to POTL whenever requested.
3. to comply with all applicable legislation including but not limited to *Transport Infrastructure Act 1994* and *Transport Operations (Marine Safety Act) 1994*.
4. to comply with the Port of Townsville Limited Port Notices.

(C2.4)4.5 Vessel Strike

Potential Impacts	▪ Marine wildlife mortality ▪ Marine wildlife injury.
Performance Objectives	▪ Vessel strike to marine fauna avoided or minimised to the greatest practical extent. ▪ To ensure marine fauna are not adversely impacted by maintenance dredging activities.
Performance Criteria	▪ Vessel strike with marine fauna as a result of POTL vessel movements is avoided or minimised.
Monitoring and Reporting	▪ Ensure any fauna injury or mortality during vessel movement or maintenance dredging is immediately reported to POTL. ▪ POTL will ensure that the relevant regulatory agencies are informed of any incident in accordance with existing EMS procedures.

Management Actions	Responsibility	Timing	Corrective Actions
Port users are to comply with maritime signage and regulations, including use of designated shipping channels and speed limits.	Port Users in accordance with mooring agreements, Port Notices and relevant legislation.	Reporting by exception and compliance at all times.	Assist relevant agencies to investigate incidents. Review control measures to ensure effectiveness.
Implement incident response procedures.	POTL and port users to report any vessel strike.	During and following incident.	Review the management actions of this MOMP.

(C2.4)4.6 Ship Sourced Pollution

Potential Impacts	▪ Effects on amenity and water quality as a result of the release of pollution other than ballast water as covered by Section (C2.4)4.1, shipping waste covered by Section (C2.4)4.3 or accidental spills as covered by Section (C2.4)4.4. ▪ Death or injury to marine life from contact, ingestion or entanglement.
Performance Objectives	▪ Prevent impacts to the marine environment as a result of pollution from shipping.
Performance Criteria	▪ Pollution as a result of POTL shipping activities are avoided or managed in accordance with relevant legislation and guidelines.
Monitoring and Reporting	▪ POTL will ensure that the relevant regulatory agencies are informed of any incident in accordance with its existing EMS procedures. ▪ Opportunistic visual inspection of POTL controlled areas

Management Actions	Responsibility	Timing	Corrective Actions
Shipping and equipment to be maintained in good working order.	Ship owner / operator.	Ongoing.	Vessels to undertake maintenance to ensure they can operate in a safe and efficient manner.
No discharge of bilge water to occur.	Ship owner / operator.	Ongoing.	POTL to ensure vessels are advised of bilge water management requirements.
No discharge of any other substance from any ship unless to licensedcontractor.	Ship owner / operator.	Ongoing.	MSQ to investiage and implement corrective action as necessary.
Spoiled cargos and cargo residues to remain on ships for onshore removal.	Ship owner / operator.	Ongoing.	Licensed waste removalist to remove soiled cargos.
Reduction of accidental cargo loss through implementation of appropriate cargo storage and handling.	Ship owner / operator.	Ongoing.	Mechanisms for securing cargo to be reviewed by tenants and upgraded as necessary.
Conformance with MARPOL annexures 1 – 6 (refer Appendix W2).	Ship owner / operator.	Ongoing.	Notification of relevant regulatory authority to take necessary action.

(C2.4)5.0 Vessel Traffic Management - Plan Elements

This section of the MOMP identifies specific management procedures related to the vessel movement and operations as a result of the PEP. In most cases, management actions will need to be integrated in broader site-based management plans and documentation and any conditions of approval imposed on the PEP under relevant legislation.

POTL's role with respect to this section would be to ensure these requirements are addressed and met by either POTL or POTL contractors to ensure activities are being carried out consistently with any existing procedures or protocols.

(C2.4)5.1 Vessel Management in Channels or Outer Harbour

Potential Impacts	▪ Potential grounding of vessel. ▪ Potential economic impacts due to suspension of port operations e.g. shutting channel due to grounded vessel.
Performance Objectives	▪ Design and development of navigation areas for PEP development stages and operations are to be undertaken in accordance with approved design standards.
Performance Criteria	▪ Design of channels and outer harbour basin to achieve safe vessel navigation. ▪ Dredging works to achieve minimum navigation design depth. ▪ Navigation design depths preserved by ongoing maintenance dredging.
Monitoring and Reporting	▪ Design to be undertaken in accordance with MSQ and RHM design review, input and quality control procedures.

Management Actions	Responsibility	Timing	Corrective Actions
Review minimum ship underkeel clearance (UKC) requirements for design vessels in each stage of channel deepening.	POTL. The RHM is to be consulted during the design, construction and operation phases for each stage.	Prior to construction of each stage of the PEP.	Increase frequency of hydrographic surveys and review minimum under keel requirements.
Detailed navigation design to be undertaken in consultation with RHM (if necessary undertake detailed navigation simulation).	POTL (In consultation with the RHM).	Detailed design is to be undertaken prior to the development of each stage of the Project.	Review navigational design procedures and verification.
Ongoing review of the suitability of the channel and harbour to support efficient vessel operations and safety, as well as regular maintenance.	POTL (In consultation with the RHM).	Ongoing.	Undertake independent audit/review of channel suitability, safety and maintenance requirements.
Undertake harbour basin dredging works.	POTL (In consultation with the RHM).	To suit shipping requirements for each stage of PEP development	Review basin depth requirements against shipping to be introduced ahead of each stage.

Management Actions	Responsibility	Timing	Corrective Actions
Completed dredging works to be surveyed in accordance with MSQ *Standards for Hydrographic Surveys in Queensland Waters.*	POTL.	Following dredging.	Undertake independent hydrographic survey of dredged works.
Undertake regular hydrographic survey of the seabed in navigation areas.	POTL.	Following extreme weather events and following dredging as required.	Increase the frequency or undertake additional surveys after extreme weather events.
Undertake maintenance dredging of navigation areas to preserve the navigation design depths.	POTL.	Ongoing.	Review the frequency and extent of maintenance dredging program.

(C2.4)5.2 Ship Anchorage

Potential Impacts	▪ Physical disturbance to the benthic environment. ▪ Potential interruption of navigation.
Performance Objectives	▪ To provide temporary anchorage arrangements for vessels calling at the port address safety, efficiency and environmental objectives.
Performance Criteria	▪ Safe vessel anchorage for operational trade vessels. ▪ Achieve best practice environmental outcomes in the context of provision of safe vessel anchorage.
Monitoring and Reporting	▪ Shipping and anchorage movements to be managed by the Vessel Traffic Service (VTS) and monitored and recorded in POTLs database. ▪ Any non-conformances to be reported to POTL, RHM and MSQ.

Management Actions	Responsibility	Timing	Corrective Actions
All vessels to anchor in accordance with directions issued by MSQ	POTL will work with MSQ, the Regional Harbour Master and other agencies such as Great Barrier Reef Marine Park Authority in developing any anchorage requirements (ie. designated areas) for Cleveland Bay. This process is being handled separately from the PEP project.	Ongoing	Work with MSQ and relevant agencies and identify further actions required.

(C2.4)5.3 Marine Operations Management Systems

Potential Impacts	▪ Uncoordinated shipping movements potentially leading to collisions, congestion or delays for shipping traffic.
Performance Objectives	▪ Align and review the adequacy of marine management systems for the PEP development to provide safe and efficient navigation in the Platypus and Sea channels and outer harbour.
Performance Criteria	▪ Prevention of vessel incidents (collisions or grounding) from operational PEP marine traffic. ▪ Prevention of vessel incident (near misses) from operational PEP marine traffic.
Monitoring and Reporting	▪ Delay times for ships due to systems issues to be regularly monitored, reported and periodically reviewed to determine efficiency of systems.

Management Actions	Responsibility	Timing	Corrective Actions
Review of marine management systems over the PEP timeframe to ensure that systems and resourcing are appropriate for the port expansion and the incremental growth in shipping.	POTL in conjunction with MSQ	For operational traffic prior to and following the development of each Stage.	Pre and post stage development review of marine management systems for adequacy.
Provide RHM with relevant information in relation to the PEP as an input to the ongoing review and update of the Port Procedures and Information for Shipping (Port of Townsville).	POTL	Ongoing	RHM signoff required prior to any amendments to POTL operations or procedures.
Review adequacy of Vessel Traffic Service (VTS) systems and resources for increased shipping and construction vessel operations	POTL and RHM	Prior to each stage.	Independent verification and review of VTS systems, resources and operations.
Review requirements for information systems for real time and predictive weather and tide information.	MSQ and POTL	Annually	MSQ to undertake audit of available technology and information resources available to improve real-time monitoring.
Review future channel operation procedures to include ship convoys during high tides when ship traffic reaches levels when delays are incurred to transit the channel	POTL	Prior to each stage, or, when shipping channels reach capacity.	RHM and MSQ to verify predicted shipping levels to ensure worst case ‘high traffic’ periods are modelled.

(C2.4)5.4 Marine Operations Resources (Physical and Human resources)

Potential Impacts	▪ Inefficient port operations due to ship queues. ▪ Potential exasperation of emergency situations if inadequate or inappropriate emergency equipment used during response.
Performance Objectives	▪ Plan resource levels for marine services to support safe, efficient and effective navigation operations in the port.
Performance Criteria	▪ Adequate resources for marine services available to support safe vessel navigation. ▪ Achieve acceptable marine operations service levels for vessel operations. ▪ Adequate emergency equipment to be available for likely emergency scenarios.
Monitoring and Reporting	▪ Any damage to resources to be reported immediately. ▪ Resources to be monitored for maintenance requirements and upgrades as necessary.

Management Actions	Responsibility	Timing	Corrective Actions
Undertake forward planning and monitoring of shipping requirements to identify future resource requirements for: ▪ tug fleet number and capacity ▪ number of pilots and pilot launches ▪ navigation aids, for example. Portable Pilot Units ▪ staffing requirements of POTL and MSQ to manage systems for safe and efficient marine operations ▪ MSQ Vessel Traffic Services Centre.	POTL in conjunction with MSQ.	Annually and prior to construction of each stage.	Have independent assessment of predicted shipping requirements for each stage prepared.
Undertake detailed assessment of PEP operational traffic at each stage of the development. Ensure that adequate marine operation resources are available during construction periods to manage ship operations .	POTL.	During planning for each stage of the PEP.	Acquire additional resources to overcome any operational issues associated with shipping operations.

(C2.4)5.5 Emergency Management

Potential Impacts	▪ Exacerbation of emergency situations due to inadequate or inappropriate response and management.
Performance Objectives	▪ To identify, assess, prevent and manage emergencies including the subsequent recovery after an emergency / disaster that may occur in the port. This also includes the managed, planned and safe evacuation of vessels and personnel.
Performance Criteria	▪ Prevention of emergency situations through proactive measures. ▪ Early detection of potential or actual emergency situations through effective processes, communication and monitoring. ▪ Quick and effective response to emergency situations and recovery from events. ▪ Availability of First-strike Response Equipment.
Monitoring and Reporting	▪ Emergencies are to be reported and monitored in accordance with existing POTL emergency management plan requirements which require escalating levels of agency and community reporting depending on circumstances.

Management Actions	Responsibility	Timing	Corrective Actions
Ongoing review of emergency management plans, resource levels and equipment with the development of PEP port infrastructure, additional vessel berths, increased ship traffic, operational vessels and equipment.	POTL is to ensure that as each stage becomes operational appropriate emergency management plans are in place.	Ongoing	Plans and procedures to be reviewed more frequently.
The emergency management plans are to ensure that there are appropriate preventative, detection, response and recovery measures to protect safety and the environment.	POTL	Prior to initiation of works for each stage of the PEP.	Risk workshops to review emergancy management plans
Undertake staged review/update of Emergency plans for: ▪ POTL Emergency Response Plan ▪ POTL Cyclone Emergency Response Procedure ▪ First-strike Oil Spill Response Plan – Port of Townsville.	POTL or MSQ	Prior to initiation of works for each stage of the PEP.	Review response plans following emergencies or increase periodic review of plans in addition to staged reviews.
Review minimum requirements for First-strike response equipment.	MSQ	Ongoing.	If equipment is inadequate in an emergency, undertake audit/review to identify equipment gaps to be filled as a priority.

Management Actions	Responsibility	Timing	Corrective Actions
Response to emergency situations in accordance with Port of Townsville Emergency Response Plan.	POTL/MSQ	Ongoing	Identify source of emergency and implement the actions from the Emergency Response Plan.

(C2.4)6.0 Aids to Navigation Management - Plan Elements

This section of the MOMP identifies specific navigational management measures and procedures related to vessel movement's resulting from the PEP.

The PEP will require ongoing changes to navigational aids (markers, buoys, signs and lights) through the development of successive stages, and as a result of an expanded range of shipping type entering the Port. In most cases management actions will need to be integrated in broader site-based management plans and documentation and any conditions of approval imposed on the PEP under relevant legislation.

POTL's role with respect to this section is to ensure these requirements are addressed and met by either POTL or the relevant party and to ensure activities are being carried out consistently with any existing procedures or protocols.

(C2.4)6.1 Aids to Navigation

Potential Impacts	▪ Potential ship to shore and ship to ship collisions with potential human safety, damage to property and environmental consequences.
Performance Objectives	▪ To design, install, maintain and manage aids to navigation, to support safe and efficient navigation in the Platypus and Sea channels and the outer harbour basin. ▪ Design, development and maintenance of aids to navigation for PEP development stages and operation.
Performance Criteria	▪ Safe navigation for shipping. ▪ Safe navigation for recreational boating.
Monitoring and Reporting	▪ Navigational equipment to be regularly monitored to ensure it is fully functional. ▪ Any navigational aid that is damaged, broken or otherwise not operating in proper manner to be reported to POTL and RHM.

Management Actions	Responsibility	Timing	Corrective Actions
Detailed design of aids to navigation for PEP development stages to be undertaken in consultation with RHM.	POTL and RHM.	Prior to the development of each PEP stage	Introduce additional layer of design review/verification.
Install additional channel markers (fixed piled channel markers similar to the existing Sea Channel beacons) to demarcate the dredged extents of lengthened Sea Channel.	POTL and RHM	Prior to the development of channel deepening	Review number, location and type of channel markers.
Relocate outer harbour basin buoys at each stage of PEP development to mark dredged extent.	POTL and RHM	Prior to the development of each PEP stage	Review number and location of buoys.
Remove the existing Berth 11 leads (turning) when the outer basin is enlarged for Berth 16.	POTL and RHM	Prior to the enlarging of Outter Basin for Berth 16.	Prevent Berth 11 vessel turning leads to be removed prior to enlargement of Outer Basin for Berth 16.
Provide lighting on reclamation edge structures and breakwaters as appropriate to assist with visibility for recreation boating.	POTL with advice from RHM	Provide prior to, and for the duration of, reclamation works. Any temporary lighting to remain until alternative/permanent reclaim edge demarcation installed.	Provide additional lighting. Potential use of short term temporary lighting structure to fill identified lighting gap until permanent solutionis built.

Management Actions	Responsibility	Timing	Corrective Actions
Provide detailed drawings with coordinates of new, relocated and removed markers to MSQ to support the revision of nautical charts and Notice to Mariners for each stage of PEP development.	POTL.	As soon as practically possible following any removal or relocation of markers.	Re survey marker location.
Seek agreement with MSQ for the provision, maintenance and management of existing and new aids to navigation for the Port of Townsville.	POTL and MSQ.	Prior to the provision, maintenance work or any other management actions in relation to any existing or proposed navigation markers.	Undertake audit of POTL navigation aids to identify any gaps.

(C2.4)7.0 Action Program

(C2.4)7.1 Continuous improvement

This MOMP is a 'living document' that will be reviewed regularly and amended as necessary to allow new or changing environmental risks relating to the PEP to be addressed.

As part of POTL's overall environmental management system, feedback systems will be in place for the duration of the Project to enable the MOMP to be updated and responsive to learning's from monitoring and site management.

Other triggers for MOMP review may include:

- changes to organisational structure and roles and responsibilities
- changes in environmental legislation and/or policies
- new technologies/innovation relevant to applied methods and controls.

(C2.4)7.2 Environmental auditing

Environmental review is periodically done by POTL for all systems. Monitoring of the requirements of this MOMP will be undertaken during the EMS audits.

To aid the auditing process the following records will be kept:

- a register of ballast water movements, including legal, illegal and accidental, with time date, quantities, ship details, ship origins details and corrective actions included (RHM).
- records of shipping and cargo movements
- records of actions shall be maintained, including any visual inspections, for possible audit by regulating authorities
- any other information listed by this plan as requiring collection including evidence of actions undertaken to satisfy the requirements of this plan and signoff from actionees that requirements have been fulfilled.

In the event of continual breaches, procedural reviews will be undertaken to identify the underlying cause.

(C2.4)7.3 Monitoring

Monitoring for each element is detailed in Sections (C2.4)4.0 and (C2.4)5.0. This monitoring program will enable:

- early detection of environmental management issues in the port during shipping operations
- development of baseline environmental information for the port, from which trends and changes in the environmental quality during shipping can be detected. For example monitoring and recording of all vessel strike will help identify problems areas (if any).

(C2.4)7.4 Records

As noted in Sections (C2.4)4.0 and (C2.4)5.0, records would be kept of actions taken in regards to the MOMP to enable possible auditing. Records would allow auditing and encourage the use of preventative action, as well as corrective action following non-compliance.

Environmental records will be:

- kept as objective evidence of compliance with environmental requirements
- maintained according to POTL's Recordkeeping Procedure or contractors record keeping procedure.

Environmental records and the MOMP will be controlled in accordance with POTL's integrated management system.

Reporting requirements in relation to shipping waste, spills, vessel strike and reef strike are specified in the relevant tables in Section (C2.4)4.0.

In addition to regular reporting as required by this plan information obtained during the implementation of this MOMP which is to be recorded will be available for inclusion into environmental reporting undertaken by POTL as part of its EMS.

(C2.4)7.5 Responsibilities

(C2.4)7.5.1 Regulatory Bodies

The MOMP complements the material presented in the main body of the EIS for the PEP as it brings together activity-specific environmental management and protection measures under consideration, in particular to support safe and efficient and effective vessel operations in the Port of Townsville.

The MOMP will be progressed at the conclusion of the EIS process, taking into consideration comments from regulatory bodies on the EIS, and detailed during the PEP detailed design, to:

1) provide the framework for progressing the management of vessel operations in the Port of Townsville
2) be submitted to address approval requirements under Queensland State and Commonwealth legislation

Once the MOMP is finalised, it will be the primary responsibility of POTL to implement the plan. It will require POTL to engage with other relevant authorities, such as MSQ, to seek alignment of their vessel management procedures with the PEP development.

Authorities and agencies in addition to POTL have been listed in this MOMP as their roles and responsibilities apply to the marine side operational functioning of the Port. These authorities have additional responsibilities that are not listed in this MOMP which must continue to be adhered to as relevant to individual vessels.

(C2.4)7.5.2 POTL

As the proponent of the PEP EIS, POTL is responsible for ensuring that project is designed, developed and subsequently managed to support vessel operations that are safe and meet the requirements of applicable environmental legislation, achieve best practice environmental management and achieve the requirements of the proponent and the relevant authorities.

POTL is a Queensland Government Owned Corporation responsible for the management of the Port of Townsville and Port of Lucinda. The ports operate on a commercial basis and in a competitive environment. POTL’s primary role is to maximise trade growth through the commercial management of an efficient and customer focused port. This is accomplished by providing necessary infrastructure through the planning and sustainable development of new facilities and through the maintenance and management of those existing.

(C2.4)7.5.3 Ship Owners and Operators

Ship owners and operators who propose to use the PEP have a number of responsibilities under this MOMP. While it will be POTL’s responsibility to communicate this MOMP to ship masters, it will be the responsibility of the individual and organisation for individual ships to ensure that relevant management actions are implemented.

(C2.4)7.6 Staff training

Relevant personnel shall attend an induction prior to commencing work at the site. The induction shall include the environmental commitments and measures contained in this MOMP as relevant to individual staff positions. Staff attending the induction shall be mentored to ensure commitments will be implemented by the appropriate staff.

(C2.4)8.0 Complaints Management

(C2.4)8.1 General Enquiries and Information

General enquiries and can be made via POTL's website or General Enquiries contact details:

- Contact can also be made via POTL's website. POTL invites public comment via their 'Tell us what you think' page (http://www.townsville-port.com.au/feedback); and
- General contact details for POTL (also provided on their website):
  - Telephone: 07 4781 1500
    Facsimile: 07 4781 1525
    Email: info@townsville-port.com.au.

(C2.4)8.2 Complaints Management Process

Complaints can be made via POTLs 'Complaint Lodgement Form' on their website http://www.townsville-port.com.au/complaint_form, or via the telephone line.

Complaints received must be recorded including investigations undertaken, conclusions formed and actions taken. Notification about the complaint and any associated response must be provided to POTL in a timely fashion.

The complaint response procedure will include:

(a) the time, date name and contact details of the complainant

(b) reasons for the complaint

(c) any investigations undertaken

(d) conclusions formed

(e) any actions taken.

Port Expansion Project EIS

Part C

Section C2.5 – Operational Environmental Management Plan

(C2.5)1.0 Introduction

This Operational Environmental Management Plan (OEMP) details environmental management procedures to be implemented during the operational phase of the Port of Townsville Limited (POTL) Port Expansion Project (PEP). The aim of the OEMP is to reduce potential negative impacts on the environment associated with the PEP operations. The OEMP has been developed from, and is consistent with, the PEP Environmental Impact Statement (EIS).

(C2.5)1.1 Project Overview

The Port of Townsville is located on Cleveland Bay, approximately three kilometres east of the city centre in Townsville, North Queensland (refer to Figure C2.5.1.1). The port is situated in the Great Barrier Reef World Heritage Area and the majority of the port infrastructure is positioned in an excised portion of the Great Barrier Reef Marine Park.

The Port of Townsville is a multi-purpose port that handles predominantly bulk and general cargo. The PEP aims to address current capacity constraints and accommodate the forecast growth in trade over a planning horizon to 2040.

The PEP includes development of port infrastructure and work to ‘top of wharf’ including: dredging, reclamation, breakwaters and revetments, wharves, access roads, rail loop, and trunk services and utilities. The PEP does not include development ‘above-wharf’, which may include: terminal pavements, shiploaders and unloaders, materials conveyors, storage buildings for transhipped products, rail loaders and unloaders, stacking and reclaiming equipment, storage tanks and pipelines. These elements would be approved and managed under separate approvals as required.

(C2.5)1.2 Purpose

The purpose of this OEMP is to identify the preferred means of addressing and reducing potential adverse environmental impacts associated with the operation of the PEP. The OEMP:

- describes POTL’s commitments regarding environmental performance and the reduction of adverse impacts;
- specifies the actions that would be taken to implement commitments (such as monitoring);
- identifies corrective actions to rectify any deviation from performance standards; and
- provides an action program to enable delivery of the environmental commitments so they are achieved and implemented.

(C2.5)1.3 Scope

This OEMP **only** applies to the on-land operations of the PEP; and only to those activities that are under POTL’s control in the common user areas. It does not address activities in tenant areas of the port, and does not address operational (maintenance) dredging issues. Maintenance dredging will be incorporated in POTL’s relevant dredging documentation and permits at the time of operation.

This OEMP falls under the overall PEP EMP System which includes:

- Construction phase:
  - PEP Construction Environmental Management Plan;
  - Construction Dredge management Plan;
  - Vessel Traffic Management Plan.

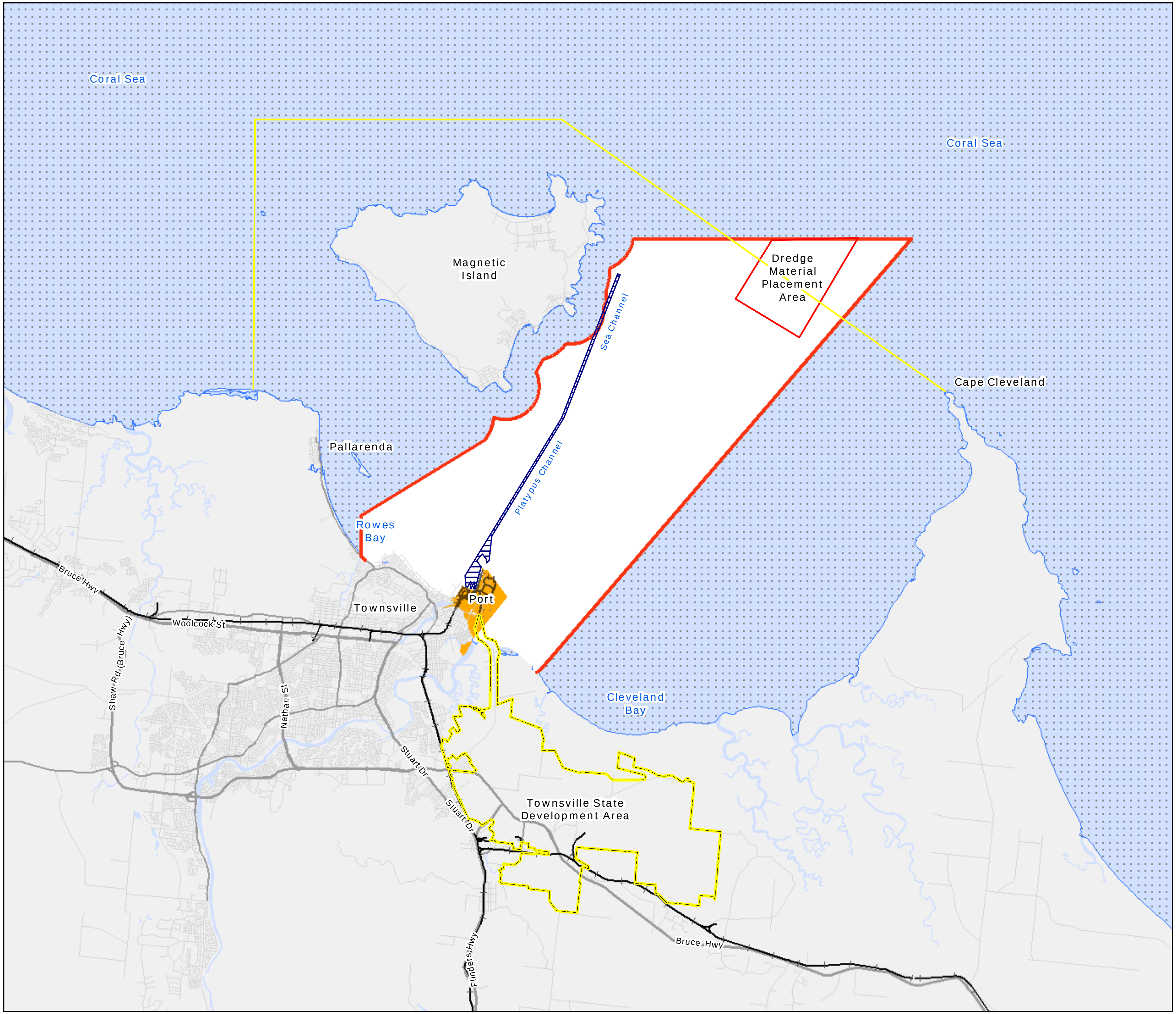
- Operational phase:
  - PEP Operational Environmental Management Plan (this document);
  - Maritime Operations Management Plan.

The key environmental values likely to be affected by on-land operational activities associated with the PEP were identified in the EIS. These values are specified in Section (C2.5)4.0. For each key value identified, the environmental management procedures to address the potential risks and impacts have been provided.

PORT EXPANSION PROJECT
EIS

Port of Townsville

Figure C.2.5.1.1



Legend

- Highways
- Main Roads
- Local Roads
- Railway Line
- Port Limits
- Channel
- Townsville State Development Area
- Existing Port Land
- Dredge Material Placement Area
- Great Barrier Reef Marine Park Boundary
- GBRWHA/National Heritage Place

N

Scale: 1:200,000 (when printed at A4)

0 0.5 1 2 3 4 5 6 7 8

Kilometres

PROJECT ID 60161996

LAST MODIFIED CFS 05-Oct-2012

FILE NAME 60161996_PLN_020

Data Source:
StreetPro © 2010 Pitney Bowes Software Pty Ltd
Roads, Parks - © 2010 PSMA Australia Pty Ltd
GBRMP Zones - Queensland Goverment 2012
World Heritage Area - Queensland Goverment 2012

(C2.5)1.4 Terms of Reference

The OEMP also responds to the Queensland Government's *Townsville Port Expansion Project - Terms of reference for an environmental impact statement*, February 2012, issued by the Coordinator General (Appendix A). Section 10 of the Terms of Reference (TOR) states the requirements of the EMPs. These requirements, and if appropriate where these requirements are addressed in this OEMP, are shown in Table 1.

Table 1 Terms of Reference Section 10 - EMP Requirements

Requirement	Where addressed in this OEMP
Detail the EMPs for both the construction and operation phases of the Project.	This OEMP details the management measures for the on-land operational phase of the PEP. Separate EMPs have been prepared for construction, dredging and shipping (refer Section (C2.5)1.3).
The EMP should be developed from, and be consistent with, the information in the EIS. The EMP must address discrete project elements and provide life-of-proposal control strategies. It must be capable of being read as a stand-alone document without reference to other parts of the EIS.	The Project elements from the EIS that require management measures are detailed in Section (C2.5)4.0 and form the basis of this OEMP.
The EMP must comprise the following components for performance criteria and implementation strategies: the proponent's commitments to acceptable levels of environmental performance, including environmental objectives, performance standards and associated measurable indicators, performance monitoring and reporting.	Refer Section (C2.5)4.0 for specific environmental commitments during port operations.
Impact prevention or mitigation actions to implement the commitments	Management actions are provided in Section (C2.5)4.0
Corrective actions to rectify any deviation from performance standards	Management actions are provided in Section (C2.5)4.0
An action program to ensure the environmental protection commitments are achieved and implemented. This will include strategies in relation to: ▪ continuous improvement ▪ environmental auditing ▪ monitoring ▪ reporting ▪ staff training ▪ a rehabilitation program for land proposed to be disturbed under each relevant aspect of the proposal.	An action program is provided in Section (C2.5)4.0 There has been no on-land vegetation disturbed as a result of the PEP.No rehabilitation or rehabilitation program will be required.
The recommended structure of each element of the EMP is: ▪ element/issue ▪ Operational policy ▪ Performance criteria ▪ Implementation strategy ▪ Monitoring ▪ Auditing ▪ Reporting ▪ Corrective action	Refer Section (C2.5)4.0.

The TOR also refers to additional information that is to be provided in the EMPs. The information required, and where these requirements are addressed in this OEMP, is summarised in Table 2.

Table 2 Terms of Reference - Additional EMP requirements

Section from Terms of Reference	Requirement	Where addressed in this OEMP
5. Environmental values and management impacts	*The mitigation measures, monitoring programs etc., identified in ... the EIS should be used to develop the EMP for the Project.*	The OEMP has been developed from, and is consistent with, the PEP EIS.
3.6.2 Objectives of the EIS	*The purpose of the EIS is to:... provide information to formulate the Project's EMP*	The OEMP has been developed from, and is consistent with, the PEP EIS.
5.3.5 Transport management strategies	*Conditions of approval for transport management impacts should also be detailed in the EMP.*	Transport impacts and transport management measures are provided in SectionB14.and (C2.5)5.9.
5.5.1 Sensitive environmental areas	*Outline how these measures* [to mitigate impacts on sensitive environmental areas] *will be implemented in the overall EMP for the Project.*	Measures to mitigate impacts on sensitive marine and land environments are provided in Section (C2.5)5.3 and (C2.5)5.4.
	The overall EMP for the Project should address the performance requirements of the relevant policies and regional vegetation management codes published by DERM (now DEHP).	There is no on-land vegetation impacts by the PEP. PPerformance requirements from DERM for native vegetation are not applicable. Mitigation measures for terrestrial ecology are provided in Section (C2.5)5.4.
5.5.2 Terrestrial flora	*Include details of any post construction monitoring programs.*	Post-construction monitoring is included for each value/element in Section(C2.5)4.0.
	Outline how these measures [addressing harm to the ecological values of the area] *will be implemented in the overall EMP for the Project.*	Mitigation measures for terrestrial ecology are provided in Section (C2.5)5.4.
	Discuss the [weed management] *strategies in accordance with provisions of the Land Protection (Pest and Stock Route Management) Act 2002 (Qld)...in the pest management plan in the EMP for the Project.*	Pest management measures are provided at Section (C2.5)5.11.
5.5.3 Terrestrial fauna	*Outline how these measures* [for protecting rare or threatened species] *will be implemented in the overall EMP for the Project.*	Mitigation measures for terrestrial ecology are provided in Section (C2.5)5.4.
	Discuss the [feral animal (including pest)] *strategies in accordance with the provisions of the Land Protection (Pest and Stock Route Management) Act 2002 (Qld) ... in the pest management plan in the EMP for the Project.*	Pest Management measures are provided in Section (C2.5)5.11.
5.5.4 Aquatic ecology	*Outline how ...* [aquatic ecosystem] *measures will be implemented in the overall EMP for the Project.*	Marine ecology measures are provided Section (C2.5)5.3 of this OEMP.
5.6.2 Water resources	*Incorporate strategies to enhance water resource values into the EMP (paraphrased).*	Mitigation measures for water resources are provided in Section (C2.5)5.2.
13 Appendices – Consultation report	*...plans for ongoing consultation to be outlined and included in the EMP.*	Consultation regarding the PEP will occur during the construction phase. Plans for consultation are considered in the CEMP for review and consideration for use in OEMP in the future.

(C2.5)2.0 Environmental Management System

This Section describes POTL's commitments regarding environmental performance and the reduction of any adverse impacts.

(C2.5)2.1 POTL's Environmental Management System

POTL maintains its commitment to sustainable development and operation through its Environmental Management System (EMS). The EMS provides a framework for environmental management at the Port, reflects POTL's Environmental Policy and commitments to manage its activities with concern for people and the environment.

POTL's EMS is compliant with AS/NZS ISO 14001 2004 and facilitates the continual improvement of environmental performance by:

- integrating environmental considerations into decision making and work practices related to the core functions of the corporation
- maintaining a high level of environmental awareness throughout the corporation and the wider port community
- utilising systems which act to reduce the risk of environmental harm through identification reporting, assessment, monitoring and control of environmental risks.

This OEMP includes the work elements necessary to satisfy environmental requirements during the operation of the PEP and will be incorporated into POTL's EMS. POTL will control actions in the common user areas in accordance with their EMS, other integrated management documents, conditions of statutory approval and regulatory requirements. These actions include: management responsibilities, incident management, emergency responses, non-conformances, environmental training, monitoring, reporting, auditing and complaint handling.

Continuous improvement is a mandatory requirement of the EMS. As part of the continuous improvement, the EMP may be updated or amended as required. This may include the merging of other documents to streamline EMP documentation. Any future amendments will take into account the intent of this document and the conditions of the existing approvals.

(C2.5)2.2 Environmental Policy

POTLs Environmental Policy applies to POTL land, including the common user areas of the Port. It is:

- displayed at prominent locations in the POTL employee workplace areas and available on the website
- communicated to POTL employees and contractors during induction and training
- reviewed regularly.

POTL personnel, contractors and visitors must comply with the spirit and intent of the policy.

POTL's Environmental Policy (Appendix C) states:

> *Port of Townsville Limited (the Corporation) and its senior management are committed to the protection of the environment and considers it as critical corporate value in the delivery and maintenance of port infrastructure and services and in planning for the future development of the Port of Townsville and Port of Lucinda.*
>
> *The Corporation is committed to sustainable development and operation through responsible environmental management and continual improvement of environmental performance and the effectiveness of its Environmental Management System.*
>
> *To achieve corporate performance consistent with this policy, the Corporation will employ the following principles:*
>
> - *Integrate environmental considerations into decision making and work practices related to the Corporation's core functions.*

- *Maintain a high level of environmental awareness throughout the Corporation and the wider port community.*
- *Implement systems which act to minimise the risk of environmental harm through the identification, reporting, assessment, monitoring and control of environmental risks.*
- *Establish a framework for setting and reviewing environmental objectives and targets and measuring the Corporation's performance.*
- *Establish and maintain systems for assessing the environmental impacts associated with the Corporation's activities, identifying and acting on opportunities for improvement.*
- *Compliance with all relevant legislation, codes of practice and standards.*
- *Core functions to be conducted in a manner that will minimise waste, prevent pollution, promote efficient use of resources, reduce environmental impacts, and continually improve environmental and management system performance.*
- *Providing adequate resources including finances, to facilitate the fulfilment of the Corporation's environmental responsibilities.*

Senior Management is responsible for providing the leadership to support the development and implementation of this Policy and for ensuring it is effectively applied.

This policy will be regularly reviewed following legislative or organisational changes, or as a minimum, every three years.

(C2.5)3.0 Project Description

The PEP will enable approximately 1,300 cargo ships per annum to call at the port by the end of 2040. It is anticipated that vessel operations will continue to occur on a 24 hour, 7 day per week basis.

POTL will own and manage the new 100 ha reclaimed port-side outer harbour, and have control over the common areas. POTL will lease the land and berth facilities to tenants to occupy and undertake port related activities. Tenants will develop their leased areas and construct and install their own operating infrastructure. These may include: terminal pavements, shiploaders and unloaders, materials conveyors, storage buildings for transhipped products, rail loaders and unloaders, stacking and reclaiming equipment, storage tanks and pipelines. Necessary environmental approvals for operations in the leased areas will be independently undertaken by the proponents (tenants) at the appropriate time in the future. The proponents will need to meet legislative requirements that apply at the time of their application.

Tenant activities will need to be undertaken in accordance with the existing operational protocols established at the port. In order to reinforce this, POTL will incorporate a set of conditions into each lease. This will help ensure that the use of the facilities will follow the existing port protocols and meet the overall environmental requirements established for the port. These leases could include provisions such as:

- stockpiles, conveyors and receival/distribution facilities are to be enclosed by dust proof buildings
- dust from the leased sites would be controlled to meet regulatory requirements
- stormwater runoff is to be handled in accordance with relevant guidelines, regulatory and POTL requirements
- wastewater and solid waste is to be treated and managed in accordance with relevant licensing requirements
- noise levels at specified receptors are not to exceed specified guidelines
- tanks, pipelines and associated facilities will be bunded and any spillage collected and treated in accordance with relevant standards and best practise management
- operational areas to be fenced and gated to prevent entry by unauthorised personnel in accordance with the port's security protocols
- operational activity is to be undertaken in accordance with port procedures
- exterior lighting is to comply with relevant guidelines

- buildings and equipment are to comply with maximum height and visual amenity provisions established by the port.

Many of these provisions are detailed in Section (C2.5)4.0. POTL also require tenants to develop site specific EMPs and Emergency Management Plans.

Commissioning activities for fixed port infrastructure will be minimal. Trunk services (stormwater, sewer, power, water supply, and telecommunications) will be commissioned by the relevant authority in accordance with standard procedures.

The new site will be fenced and access controlled in a similar manner to the existing port. POTL and the port community will be responsible for port security.

(C2.5)4.0 Operational Environmental Management Plan Structure

(C2.5)4.1 Management Issues

The environmental values listed in Table 3 have been identified in the EIS as key areas of concern that require consideration in the OEMP in order to avoid unacceptable environmental impacts.

Table 3 OEMP components

Reference	Management Issue	Scope
(C2.5)5.1	Land	Manage the potential impacts to land and manage the use of land through the operation of the Port.
(C2.5)5.2	Water Resources	Manage surface water and drainage issues to reduce impacts to water quality and the receiving catchment.
(C2.5)5.3	Marine ecology and conservation	Reduce any impacts to marine ecology as a result of landside operational activities.
(C2.5)5.4	Terrestrial ecology	Reduce any impacts to terrestrial ecology as a result of operational activities.
(C2.5)5.5	Air quality	Manage impacts to air quality as a result of operational processes and activities.
B10 & C2.5	Noise and vibration	Manage and reduce noise and vibration impact as a result of operational activities to acceptable levels.
(C2.5)5.7	Greenhouse gases	Reduce greenhouse gas production from operational activities.
B12 & C2.5	Waste	Reduce waste generation and maximise the use of the waste hierarchy in managing operational waste.
B14 & C2.5	Transport infrastructure	Implement and maintain appropriate levels of transport infrastructure during the development of the PEP to reduce congestion and impacts to other stakeholders.
(C2.5)5.10	Scenic amenity and lighting	Maintain appropriate levels of lighting and reduce potential effects on the environment (such as shore birds and turtles) and public amenity.
(C2.5)5.11	Pest management	Manage pest incursions during port operations.

For each value identified, an environmental management strategy and actions have been developed to address potential risks that may arise. Each value has a stated environmental objective, performance criteria, management actions, monitoring, reporting, and corrective actions. The structure used for the strategy and actions is outlined in Table 4.

(C2.5)4.2 Structure of the OEMP

Table 4 EMP Structure

Management Strategy Component	Description of Content
Element/Issue	The aspect of the operational environmental issue to be managed (as it affects environmental values).
Potential Impacts	The potential impacts the issue/element may create without management.
Performance Objective	The aims and objectives which drive the need for management of the issue/element.
Performance Criteria	Measurable performance criteria (outcomes) for each element of the operation.
Monitoring and reporting	The monitoring requirements to measure actual performance (for example .specified limits to pre-selected indicators of change).
Management Actions	The strategies, tasks or action program (to nominated operational design standards) that would be implemented to achieve the performance criteria.
Responsibility	Identify who will be responsible for: implementing the management actions, undertaking monitoring of actions, subsequent reporting requirements, and other responsibilities which may arise out of the individual management actions.
Timing	Identify the frequency at which management actions need to be implemented.
Corrective Actions	The action to be implemented and by whom in the case where a performance criterion is not met.

(C2.5)5.0 Management Plan Elements

This section of the OEMP identifies specific environmental management procedures related to the on-land operations of the PEP. The requirements in this section are intended to apply in addition to the general requirements for tenants under POTL's lease arrangements.

These requirements are to be addressed by POTL as part of project planning. This aims to ensure the activities being carried out are consistent with any existing procedures or protocols in port limits or under relevant corporate environmental policies or strategies.

(C2.5)5.1 Land

Potential Impacts	▪ Impacts to land from spillage or leakage of goods/cargo (for example, petroleum products, liquefied gases, flammable and polluting chemicals, other hazardous wastes and loose bulk products such as mineral concentrates)
Environmental Performance Objectives	▪ To reduce the potential for environmental harm as a result of changes to landform
Performance Criteria	▪ Spills are reported ▪ Spills are appropriately cleaned up ▪ Spilled material is appropriately disposed
Monitoring and Reporting	▪ Any spill or contamination of land to be reported to DEHP in accordance with POTL procedures

Management Actions	Responsibility	Timing	Corrective Actions
Operation of berths and cargo handling facilities by port tenants in compliance with relevant management plans.	Port tenants are to be aware of compliance responsibilities. On-going operational compliance is the responsibility of the port tenants.	POTL is to advise port tenants of the responsibilities prior to signing lease. The port tenants are to maintain compliance at all times during the lease.	1) Engagement with tenant to address non-compliance and investigate. 2) Follow breach provision under lease, where required.
Any spills of dangerous goods shall be managed in accordance with relevant incident / emergency plan	POTL, or the tenant if spills occur on a leased site.	On-going	Investigate breach. Take disciplinary actions if required.
Copies of the Emergency Spill Response Plan are to be on board POTL vehicles,	POTL	On-going	Replace copy as soon as practicable after being aware it is missing.
Emergency spill kits are to be provided at each loading/unloading bay and at each refuelling location in the port.	POTL, or tenant if on a leased site.	On-going	Replace spill kits as soon as practicable after use or if missing.
POTL vessel/plant refuelling SOP is to be followed when using POTL plant and equipment.	POTL	Procedure is to be implemented during refuelling.	Investigate breach and take disciplinary action if required. Review staff training and awareness.

(C2.5)5.2 Water Resources

Potential Impacts	▪ Disturbance of marine waters due to sediment in stormwater runoff, (note that dredge tailwater management is discussed in the DMP, Chapter C2.1). ▪ Stormwater contamination may arise due to oil/fuel leaks and spills into Cleveland Bay. ▪ Effects on marine life, as well as indirect potential impacts to human health, through the exposure to substances released in stormwater into marine waters.
Environmental Performance Objectives	▪ To reduce adverse impacts on water and sediment quality of Cleveland Bay. ▪ To reduce the introduction of contaminants into the environment from the operational activities.
Performance Criteria	▪ No discharge of contaminated surface water to the surrounding environment . ▪ Spills are adequately contained and cleaned up.
Monitoring and Reporting	▪ Regular visual site inspections of stormwater runoff areas, to check for cleanliness and potential for contaminants to impact on water quality. ▪ Regular site inspections to POTL controlled common areas, to check for leaks, spillage and damage to bunded storage areas. ▪ Immediately notify POTL in the event of an uncontained spill. ▪ Site specific Environmental Management Plans (EMP's) will be developed by tenants and implemented during port operations.

Management Actions	Responsibility	Timing	Corrective Actions
Appropriate sized and designed drainage infrastructure.	POTL	Prior to operation of that Stage of the PEP	Review and modify infrastructure if insufficient capacity.
Source and site design protocols will be implemented for each development area according to layout and operation of lease areas	Port tenants	Prior to tenant occupation of the lease area	Report breaches to appropriate regulatory authorities. POTL to consider issuing penalties as per Port Notices.
Implement specific operational controls to contain contaminants at the source, or reduce runoff areas with the potential to generate contaminants. Source control measures to be implemented, include, but are not limited to: ▪ Vehicle wash racks ▪ Machinery drip pans ▪ Covered trash compartments ▪ Dry cleaning ▪ Chemical cabinets	POTL	Design stage	Report breaches to appropriate regulatory authorities. POTL to consider issuing penalties as per Port Notices.

Management Actions	Responsibility	Timing	Corrective Actions
Drainage design as a means of source control will focus on reducing the occurrence of uncontaminated runoff entering contaminated surfaces, and to separate contaminated and uncontaminated areas.	POTL and applicable site tenent.	Detailed design	Report breaches to appropriate regulatory authorities.
Develop procedures to remove any spillage prior to it entering the stormwater system where possible.	POTL	Prior to tenant occupation of the lease area.	Implement treatment control measures if source control measures fail.
General storm water treatment will be addressed through primary treatment devices such as appropriately sized gross pollutant removal devices. The devices will be incorporated into drainage systems for the treatment of hydro-carbons and suspended sediments	It is recommended that operators implement treatment processes specific to the contaminants most likely to occur on site under individual EMPs.	Prior to tenant occupation of the lease area.	Review and amend controls if adverse impacts are observed.
Develop a site based stormwater management strategy to apply to system requirements and engineering design. Apply requirements of Queensland Urban Stormwater Management Manual (DERM, 2010a) and the principles of water sensitive design.	POTL	Detailed design	Review and amend controls if adverse impacts are observed.
Erosion and sediment controls will be regularly inspected for maintenance and efficiency. Changes may have to be made to Environment and Sediment Control Plans (ESCP) to meet environmental conditions.	POTL, or tenant if on a leased site.	Operation	Review and amend controls if adverse impacts are observed.
Prepare a Stormwater Management Plan that aligns to the Model Urban Stormwater Quality Management Plans and Guidelines (DERM, 2010a) and provides guidelines that will guide the preparation and required content of Stormwater Quality Management Plans in Queensland.	Tenant	Prior to tenant occupation of the lease area.	Review and amend controls if adverse impacts are observed.
Any spills of dangerous goods shall be managed in accordance with authorised Emergency Spill Response Plan (refer to (C2.5)5.1 Land).	POTL, or tenant if on a leased site.	Ongoing	Review and amend controls if adverse impacts are observed.
Chemicals/fuels/contaminates to be stored appropriately with proper signposting and bunding.	POTL, or tenant if on a leased site.	As required	Review and amend controls if adverse impacts are observed.

(C2.5)5.3 Marine ecology and conservation

Potential Impacts	▪ General disturbance and degradation of benthic communities in the harbour basin through day to day port operations (such as stormwater discharges, spills, vessel movements). ▪ Light spill from the port facilities potentially leading to disorientation of shore birds or turtles. ▪ Increase in rubbish production, increasing the risk of entanglement and/or ingestion of marine debris by turtles and marine mammals.
Environmental Performance Objectives	▪ To reduce indirect effects on marine ecology during the operational phase. ▪ To prevent contamination from operations entering the marine environment.
Performance Criteria	▪ No injury or fatality to marine vertebrates as a result of PEP operational activities. ▪ No permanent loss of benthic habitat beyond the development footprint.
Monitoring and Reporting	▪ Regular visual site inspections will be carried out to monitor the site for compliance with light and waste management procedures, and hazardous material handling procedures. ▪ Marine monitoring to will be carried out for relevant aquatic indicators.

Management Actions	Responsibility	Timing	Corrective Actions
Implementation of stormwater and waste management measures (refer to (C2.5)5.2 Water Resources and (C2.5)5.8 Waste).	POTL	Opportunistically checked during regular inspection.	Review measures and modify if any adverse impacts are observed.
Implement light management procedures to reduce light spill to the marine environment.	POTL, or tenant if on a leased site.	Opportunistically checked during regular inspection.	Review and modify equipment and controls if any adverse impacts are observed.
Any spills of dangerous goods shall be managed in accordance with POTL's Emergency Spill Response Plan (refer to (C2.5)5.1 Land).	POTL, or tenant if on a leased site.	During incident response	Review and modify equipment and controls if any adverse impacts are observed.
Expand current port water quality testing program to include new operational areas.	POTL	Ongoing	Review triggers in the plan requiring relevant action, to address specific water quality parameter changes outside background levels.

(C2.5)5.4 Terrestrial Ecology

Potential Impacts	▪ Spread of weeds (into landscaped port lands) by the movement of vehicles, machinery and equipment by road or rail to and from site, through weed infested areas. ▪ Potential injury or death of fauna as a result of operational activities.
Environmental Performance Objectives	▪ To avoid the spread of weeds to and from the site. ▪ To reduce the injury and death of fauna (birds) from operational activities.
Performance Criteria	▪ Control of weeds on the communal area controlled by POTL. ▪ No reported incidents of harm to terrestrial fauna.
Monitoring and Reporting	▪ Regular weed inspections will be carried out to identify weeds or injured fauna on the site.

Management Actions	Responsibility	Timing	Corrective Actions
Implement regular weed control activities (for example, spraying, mowing and removal)	POTL, or tenant if on a leased site.	Ongoing	Review and modify management practices if any adverse impacts are observed.
Implement control measures to reduce the likelihood and impact pests (refer to (C2.5)5.11 Pest Management)	POTL, or tenant if on a leased site.	Ongoing	Review and modify management practices if any adverse impacts are observed.
Management of lighting to reduce light spill from the site in so far as consistent with existing Operational Health and Safety and land use codes.	POTL, or tenant if on a leased site.	Regularly checked as per maintenance schedules.	Review and modify lighting management practices if any adverse impacts are observed.

(C2.5)5.5 Air Quality

Potential Impacts	▪ Fugitive dust from exposed surfaces may result in: ▪ increased risks to human health ▪ nuisance ▪ discolouration of buildings or structures ▪ depositions into the marine environment. ▪ Fuel combustion emissions from vehicles and equipment result in increased risk to human health.
Environmental Performance Objectives	▪ To reduce the effects from emissions generated during the PEP operation so ambient air quality in maintained.
Performance Criteria	▪ No complaints from affected persons due to air or dust emissions from POTL controlled areas. ▪ Performance in relation to relevant standards or appropriate guidelines at sensitive receptors including stipulated EPP (Air) criteria.
Monitoring and Reporting	▪ Visual monitoring and observation of weather conditions. ▪ Continuous PM10 monitoring. ▪ Record complaints.

Management Actions	Responsibility	Timing	Corrective Actions
To reduce fugitive dust: ▪ Clean up spills. ▪ Contain potentially dust generating cargos. ▪ Operate a complaints management system. ▪ Use a wheel wash whenever vehicles move from unsealed roads to sealed roadways.	POTL, or tenant if on a leased site.	Ongoing	Review and modify controls if any adverse impacts are observed.
To reduce fuel combustion emissions: ▪ Turn engines off while parked on site. ▪ Regularly tune, modify or maintain equipment, plant and machinery to reduce visible smoke and emissions. ▪ Implement and follow site speed limits.	POTL, or tenant if on a leased	Ongoing	Review and modify controls if any adverse impacts are observed.

(C2.5)5.6 Noise and Vibration

Potential Impacts	▪ Night time noise from the port operations may adversely affect adjacent residents. ▪ Reduction in daytime acoustic amenity for the closest residential locations; as a result of operations (including tenants loading and unloading activities) and heavy vehicle movement on public and internal roads.
Environmental Performance Objectives	▪ To reduce noise generated by operational activities.
Performance Criteria	▪ Adaptive management during operations, in response to any complaints related to noise and vibration. ▪ Noise levels to meet relevant standards or appropriate noise guidelines at sensitive receptors where monitoring is deemed necessary to satisfy complainants.
Monitoring and Reporting	▪ Noise and vibration corrective actions taken if complaints are received.

Management Actions	Responsibility	Timing	Corrective Actions
Truck movements are to be via the approved transport route.	POTL, or tenant	At all times.	Review transport routes and driver procedures.
Equipment management includes the following: ▪ Select lownoise plant and equipment. ▪ Equipment has high-quality mufflers installed. ▪ Equipment is well maintained and fitted with adequately maintained silencers which meet the design specifications. ▪ Plants known to emit noise strongly in one direction (such as manifolds on compressors) are orientated so that noise is directed away from noise sensitive areas. ▪ Machines that are used intermittently are shut down in the intervening periods between works or throttled down to a minimum. ▪ Silencers and enclosures are kept intact; rotating plants are balanced; loose bolts are tightened; frictional noise is reduced through lubrication; and cutting noise is reduced by keeping blades sharp. ▪ Equipment that is not in use is shut down. ▪ Only necessary power is used to complete the task. ▪ Only necessary equipment is on site. ▪ Equipment to be in good working condition.	POTL, or tenant	At all times.	Review and modify equipment and controls if any adverse impacts are observed.
Operate a complaints management system.	POTL	Ongoing	Review and modify controls if any adverse impacts are observed.

Management Actions	Responsibility	Timing	Corrective Actions
Operational Noise Management will be incorperated into site EMP. to ensure that port operators understand the issues of controlling environmental noise to sensitive receptors.	Tenant	At all times.	In the event of exceedances to the operational noise and vibration performance goals and criteria, or complaint , the activity in question will be reviewed and alternative methods/equipment/timing investigated and implemented where practical.
Where possible undertake noisey works during daytime working hours to reduce any offsite impacts.	POTL, or tenant if on a leased site.	Ongoing	Review and modify operational practices if any adverse impacts are observed.

(C2.5)5.7 Greenhouse Gases

Potential Impacts	▪ Increase in greenhouse gas emissions produced from operations.
Environmental Performance Objectives	▪ To consider greenhouse gas emissions from POTL controlled areas during port operations and reduce where possible.
Performance Criteria	▪ Reduction in calculable greenhouse gas emissions through implementation of management actions. ▪ Meet the applicable Commonwealth and State legislation and standards for the release of greenhouse gas emissions from POTL controlled areas.
Monitoring and Reporting	▪ Undertake periodic energy audits to monitor energy use and changes to efficiency on site. ▪ Monitor key performance indicators on a regular basis to track operational greenhouse gas emissions, detect trends early and implement measures to address any unforeseen increases in emissions.

Management Actions	Responsibility	Timing	Corrective Actions
Implement energy efficiency measures: ▪ Undertake preventative maintenance on equipment and engines. ▪ Switch off lighting and other electrical equipment that is not in use, where possible under OHS requirements ▪ Use variable speed drives with high efficiency linings. ▪ Consider the use of high efficiency electrical motors. ▪ Consider purchasing electricity from renewable sources through Green Power.	POTL	Ongoing	Review and modify practices if adverse impacts are experienced.
Investigate use of renewable energy on POTL controlled areas: ▪ Investigate the feasibility of generating electricity from a renewable source on-site. ▪ Consider the use of solar panels for road lighting and powering isolated items such as pumps.	POTL	Ongoing	Review and modify practices if adverse impacts are experienced.
Procurement: ▪ Consider energy efficiency in the procurement of equipment.	POTL	Ongoing	Review and modify practices if adverse impacts are experienced.
Purchase offsets as required by legislation through a certified offset provider in Australia.	POTL	Ongoing	Review and modify practices if adverse impacts are experienced.

(C2.5)5.8 Waste

Potential Impacts	▪ Incorrect handling and storage of waste materials may result in the introduction of wastes into the marine environment or surrounding lands. ▪ Incorrect handling and storage of waste materials may encourage pests and provide breeding habitats for mosquitos. ▪ General waste and debris generated from port operations
Environmental Performance Objectives	▪ Appropriately manage the handling and storage of waste materials in PEP areas.
Performance Criteria	▪ Waste materials are handled and stored in a safe and appropriate manner. ▪ No environmental impact on, or disturbance to, the surrounding marine area from loss of waste. ▪ Animal pests discouraged and mosquito breeding habitats are not created.
Monitoring and Reporting	▪ POTL will monitor the management and disposal of waste for POTL controlled areas. ▪ Regular site inspections for mosquito breeding areas prior to and during the wet season. ▪ Any incidents will be recorded in POTL database in order to identify areas where waste management is creating adverse impacts.

Management Actions	Responsibility	Timing	Corrective Actions
Staff site induction and awareness training programs to maximise the waste hierarchy implementation.	POTL, or tenant if on a leased site.	At all times	Review tenant management procedures if waste becomes an issue.
Implement *Resourcesmart*; Reducing and Recycling Workplace Waste (SV, 2008), Waste Reduction in Office Buildings, A Guide for Building Managers (SV, 2008), or similar.	POTL to implement for common areas and POTL buildings through provision of appropriate waste facilities.	At all times	Review waste measures.
Supply designated collection bins or other appropriate containers to facilitate segregation and encourage waste recycling or re-use. Waste storage to be in designed areas Use internationally recognised, and where possible ISO signage to aid international visitors/crews to meet AMSA and AQIS requirements for their waste and prevent mixing.	POTL to supply bins for common areas. Tenants to comply in tenant areas.	Opportunistically checked during regular inspection.	Modify bins where appropriate if any adverse impacts are observed.
The Port site to be maintained in a clean and tidy manner and waste will be progressively removed from site and not allowed to stockpile.	POTL in common areas. Tenants to comply in tenant area	Opportunistically checked during regular inspection.	Review tenant management procedures if waste becomes an issue.

Management Actions	Responsibility	Timing	Corrective Actions
Any trade or regulated waste will be removed by a licensed trade waste contractor to a licensed reception facility.	POTL, or tenant if on a leased site.	At all times.	Review tenant management procedures if waste becomes an issue.
The movement and quantities of regulated and quarantine wastes will be recorded.	POTL, or tenant if on a leased site.	At all times.	Review tenant management procedures if waste becomes an issue.
Sealing of waste receptacles and regular removal of waste to reduce attraction of pests or vermin.	POTL, or tenant if on a leased site.	Ongoing	Review waste storage arrangements and removal frequences if pest become an issue.

(C2.5)5.9 Transport and Infrastructure

Potential Impacts	▪ Traffic congestion at some key intersections. ▪ Pavement degradation from additional traffic loading. ▪ Increase in demand for rail infrastructure reduces performance of rail network.
Environmental Performance Objectives	▪ To deliver appropriate traffic performance during operations. ▪ To maintain or improve current standards of rail infrastructure and network performance.
Performance Criteria	▪ No loss of travel time. ▪ No decrease in the standard of rail infrastructure or network performance.
Monitoring and Reporting	▪ Monitoring for infrastructure wear and tear and pavement degradation.

Management Actions	Responsibility	Timing	Corrective Actions
Trafficmanagement to be incorperated into management plans or applications for tenants or facilities that will generate significant traffic.	Port tenants. POTL to review.	Prior to operations.	Review of TMP in consultation with POTL.
Maximise use of the Eastern Access Corridor where possible.	POTL	Commence the implementation prior to the operational phase.	Review and modify the rail planning if adverse impacts are experienced.

(C2.5)5.10 Scenic Amenity and Lighting

Potential Impacts	▪ Local scenic amenity could be adversely affected by waste, water pollution, and plumes in the marine environment. ▪ Scenic amenity could be adversely affected by artificial light associated with the new port infrastructure.
Environmental Performance Objectives	▪ To reduce adverse visual impacts associated with operational activities. ▪ To reduce and/or manage adverse lighting impacts of operation.
Performance Criteria	▪ Light levels from POTL controlled areas meet relevant standards or appropriate guidelines and standards. ▪ No complaints regarding lighting overspill ▪ Meet waste, water quality, air quality and marines ecology and conservation performance criteria.
Monitoring and Reporting	▪ Regular site inspections to monitor for water pollution, rubbish and dust associated with port operations. ▪ Any complaints or incidents will be recorded in POTL database.

Management Actions	Responsibility	Timing	Corrective Actions
Management of lighting to reduce direct light spill from the site and consistent with the existing Operational Health and Safety and land use codes.	POTL	Regularly checked as per maintenance schedules.	Review and modify lighting management practices if any adverse impacts are observed.
Implementation of waste management measures. Refer to (C2.5)5.8 Waste.	POTL	Oppotunistically checked during regular inspection.	Review measures and modify if any adverse impacts observed.
Implementation of marine ecology and conservation management measures. Refer to (C2.5)5.3 Marine Ecology and Conservation.	POTL	Oppotunistically checked during regular inspection.	Review measures and modify if any adverse impacts observed.

(C2.5)5.11 Pest Management

Potential Impacts	▪ Introduction or spread of pest animals into the port area or surrounding lands
Environmental Performance Objectives	▪ To minimise attraction pest animals to the PEP area
Performance Criteria	▪ Animal pests discouraged: none of the following species are to proliferate in the PEP area: Cane toad, Rock Dove, Nutmeg manikin, House sparrow, Common starling, Common myna, Dog, Cat, Pig, Rabbit, Fox, House mouse, Black rat ▪ Mosquito breeding habitats are not to be created.
Monitoring and Reporting	▪ Monitor the presence and abundance of pest animal species in the PEP area ▪ Regular site inspection for mosquito breeding area during wet season

Management Actions	Responsibility	Timing	Corrective Actions
Implement chemical control measures to control mosquito breeding if required.	Tenants and POTL for common areas.	Beginning of every wet season.	If mosquito larvae are present on PEP lands, manual or chemical control must be implemented to interrupt the mosquito breeding cycle.
No shallow standing water to collect in structures on the site.	Tenants and POTL for common areas.	Ongoing	Prevent water from collecting in structures or around buildings.
Keep PEP area free of food waste or other attractants to pest animals	Tenants and POTL for common areas.	Ongoing	Licernsed pest control contractor engaged to control pest animals as required.

(C2.5)6.0 Action Program

(C2.5)6.1 Continuous improvement

This OEMP is a 'living document' that will be reviewed (every 3 years, or as required by changes to Port operations or legislation) and amended as necessary. This allows for new or changing environmental risks relating to the port operations to be addressed.

As part of POTL's overall environmental management system, feedback systems will be in place. This will enable the OEMP to be updated and responsive to learning's from any incidents, complaints and ongoing monitoring. Changes to the OEMP may be developed and implemented in consultation with relevant authorities and stakeholders over time.

Other triggers for OEMP review may include:

- changes to organisational structure and roles and responsibilities
- changes in environmental legislation and/or policies
- new technologies and innovation relevant to applied methods and controls.

(C2.5)6.2 Environmental auditing

POTL will undertake a review of the performance of its own environmental, in accordance with the relevant EMP.

Records of on-going site monitoring shall be maintained for possible audit by regulating authorities. Permanent records must be kept on site and updated regularly, to enable audit/review by means of a simple 'check list' or similar.

(C2.5)6.3 Monitoring

Monitoring for each value is detailed at Section (C2.5)4.0. That monitoring will enable:

- early detection of environmental management matters
- development of baseline environmental information from which trends and changes in the environmental quality can be detected. For example monitoring waste quantities and monitoring generation rates over time measures effectiveness of reduction measures.

(C2.5)6.4 Records

As noted in section (C2.5)6.2, records would be kept of environmental monitoring and actions taken in regards to the OEMP to enable possible auditing. Records would allow auditing and encourage the use of preventative action, as well as corrective action following non-compliance.

Environmental records will be:

- kept as objective evidence of compliance with environmental requirements
- maintained according to POTL's Recordkeeping Procedure, or in the case of tenants, individual tenant record keeping procedures.

Environmental records and the EMP will be controlled in accordance with POTL's integrated management system.

(C2.5)6.5 Staff training

In accordance with POTL or tenant requirements, personnel will attend an induction prior to commencing work in the PEP area.

(C2.5)7.0 Community Protocols

This section outlines plans for on-going community enquiries and complaints.

(C2.5)7.1 General Enquiries

POTL’s general contact details phone number and email is:

- **Telephone**: 07 4781 1500
  Facsimile: 07 4781 1525
  Email: info@townsville-port.com.au.

Contact can also be made via POTL’s website. POTL invites public comment via their ‘Tell us what you think’ page (http://www.townsville-port.com.au/feedback).

(C2.5)7.2 Complaints Management

Complaints can be made via POTL’s ‘Complaint Lodgement Form’ on their website http://www.townsville-port.com.au/complaint_form.

Complaints received directly by tenants must be recorded including investigations undertaken, conclusions formed and actions taken. Notification about the complaint and any associated response must be provided to POTL in a timely fashion.

The complaint response procedure will include:

(a) the time, date name and contact details of the complainant

(b) reasons for the complaint

(c) any investigations undertaken

(d) conclusions formed

(e) any actions taken.