PORT of TOWNSVILLE

North Queensland

Section 2
Description of the project

Townsville Marine Precinct Project

Environmental Impact Statement

GHD

2. Description of the project

2.1 Introduction

This section describes the project through its lifetime of construction, operation and decommissioning. Included is an overview of the project to describe:

- Reasons for the preferred operating scenario;
- A description of the key components of the project; and
- The expected cost, overall duration and timing of the project.

2.2 Overview of project – reference design

The Port of Townsville is situated between the mouths of the Ross River and Ross Creek in Cleveland Bay. Cleveland Bay is defined by Cape Pallarenda, Cape Cleveland and includes Magnetic Island. The proposed Townsville Marine Precinct Project will be situated at the mouth of Ross River (refer to Figure 2-1).

With increasing trade, commercial and residential growth in Townsville, strategic planning activities for the city have focussed on providing opportunities to relocate existing old commercial marine facilities spread around Ross Creek, Ross River and South Townsville into a new, purpose-built facility on Ross River, which will incorporate current best practice environmental management.

A Precinct concept in the mouth of the Ross River has been mooted since the mid 1970s. As discussed under Section 1.5.1 the first concept drawings were prepared in 1977. In 1991 the first environmental studies commenced to examine the potential impacts of developing a marine precinct in the eastern port area. More recent strategic planning activities in Townsville (Port Development Plan, Townsville City-Port Strategic Plan, Port of Townsville Limited Draft Land Use Plan) focus on the port interface area and provide a coordinated vision for the provision of key infrastructure.

The proposed project will require the reclamation of lands on Lot 773 on EP2211 (Benwell Road Beach). Lot 773 is approximately 34 hectares (ha), however, some of this land once reclaimed will be occupied by the TPAR and Services Corridor (approximately 2 ha). The proposal also incorporates the possible construction of a breakwater on the eastern side of the mouth of Ross River to protect the Precinct from sediment infill and the action of waves (refer to Figure 2-2).

POTL may justify capital investment in the proposed development on the basis that the following benefits could be derived:

- Provision of a marine precinct sheltered from prevailing waves where commercial marine activities in Townsville can be consolidated;
- Provision of an area in Ross River for relocation of the existing trawler fleet which is required to occur prior to completion of the bridge linking the TPAR to Townsville Port;
- Restriction of westward longshore sediment transport into the navigation channel and subsequent reduction in the requirement to dredge in the longer term;

- Consideration of provision of mooring areas for vessels currently on buoy and pile moorings in Ross River; and
- Consideration of provision of recreational boat ramp facilities and parking.

The concept master plan for the proposed Townsville Marine Precinct Project incorporates onshore and offshore elements, which are listed below. A concept layout is depicted in Figure 2-2.

Access to the precinct: Two dedicated access points will be provided from Benwell Road; one associated with the Boundary Street/Benwell Road intersection and one to the north of Archer Street. The final design of the access is still under negotiation with the Queensland Department of Main Roads in relation to the Port Access Road/Services Corridor interface.

Marine industry allotments: A commercial slipway, barge ramp, ship-lift, docking facility and associated marine facilities are proposed for the Precinct. A rack and stack vessel storage system is being considered.

Trawler berths: Approximately 50 trawler berths and two trawler maintenance berths are proposed for the Precinct.

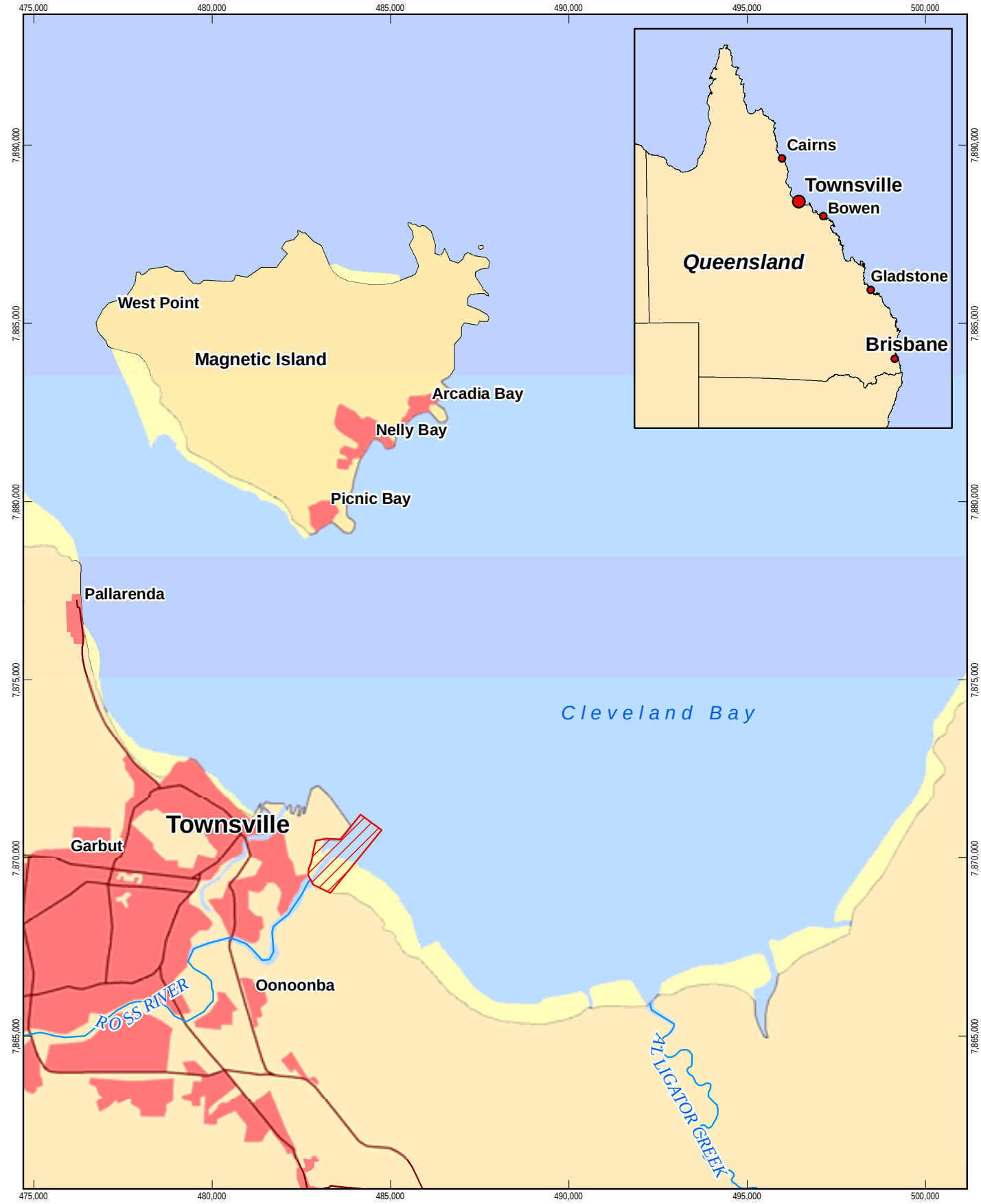
Private pile moorings: The inside of the proposed breakwater could accommodate 40 pile moorings. There may be the opportunity for provision of additional pile moorings at a later date should demand arise.

Boat ramps and car/trailer parking bays: Consideration is being given to the regional demand and location of boat ramps and car/trailer parking bays as part of a separate process involving Townsville City Council, Queensland Transport, POTL and DIP. Comment in regard to the inclusion of boat ramps in the Precinct was provided under Section 1.5.1. Opportunity for the co-location of the volunteer coastguard in any new proposed recreational boat ramp facility to service recreational vessel users will be considered under the boat ramp site selection process.

Services: The full range of site services including power, water, sewerage, stormwater drainage and telecommunications will be provided to the proposed development. Due to evolving legislative changes to wastewater requirements in the Great Barrier Reef World Heritage Area, a sullage pump out facility may be required.

Breakwater: A breakwater may be required to:

- Provide shelter for the commercial marine area and pile moorings from prevailing waves;
- Provide a sheltered swinging area for commercial vessels;
- Provide a sheltered departure point to Cleveland Bay for smaller recreational boats;
- Restrict westward longshore sediment transport into the navigation channel and reduce the requirement to dredge the Ross River channel in the longer term;
- Provide an effective barrier between the common use areas and the sensitive environmental areas to the east; and
- Allow sand to accrete on the eastern side of the wall to provide an alternative migratory bird roosting and nesting area.



LEGEND

Project Area of Interest | Watercourse | Major Road | Builtup Area | Foreshore Flat

1:140,000 (at A4)

0 1 2 3 4 5

Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Project Location

Figure 2-1

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia T +61 7 3316 4496 F +61 7 3316 333 E bnemail@ghd.com.au W www.ghd.com.au

Data source: Project AOI - GHD; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management); 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007. Created by: TH

LEGEND

- Breakwater Option C
- Road and Rail Corridor
- Channel Base
- Marine Interface

Proposed Marine Precinct
- Stage 1
- Stage 2
- Stage 3

- Shed
- Maintenance (Open Hardstand)
- Industrial Shed
- Barge Berth

- Fuel Berth
- Marine Infrastructure
- Ramp
- Shed - Stage 3

- Potential Temp. Hardstand Site
- Unloading Berth
- Trawler/Commercial Berth
- Work Berths

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	A
Date	01 July 2009

Concept Layout

Figure 2-2

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

From the concept master plan and concept layout a Reference Design has been established against which studies reported here have been undertaken. This includes a Precinct facility with an inner harbour, vessel moorings and land area developed from reclamation on which sheds and other infrastructure are to be located, a dedicated trawler fleet base, pile moorings for recreational vessels and an offshore breakwater to protect the swing basin, pile moorings and quay line of the Precinct from waves. The preferred option for the breakwater is discussed further in Section 1.5.3.

To enable considered studies to be undertaken for this EIS the Reference Design includes requirements for a number of industries and facilities that may be included in the Precinct. These are identified as:

- Marine industry allotments including:
  - maritime infrastructure fabrication;
  - commercial and recreational vessel construction and maintenance (land based);
  - commercial slipway, barge ramp, ship-lift, docking facility and associated marine facilities;
- Berth facilities including:
  - 50 trawler berths;
  - Two trawler maintenance berths;
  - Loading, unloading and provisioning wharf area for a minimum of 10 vessels;
  - Provisioning, sullage and refuelling docks accessible to both commercial and recreational users;
  - Barge berthing facility plus a vehicle ramp, including vessels up to 35m long;
  - Tourism/scientific vessel berthing facilities; and
  - General purpose berthing wharf or jetty length of minimum 80m;
- Commercial and recreational chandlery;
- Defence force marine activities, including vessel maintenance
- Seafood industry cold storage and distribution facility;
- Small scale eateries to service industry within Precinct;
- Marine industry training facilities;
- Potential relocation of the Volunteer Coastguard office and mooring;
- Public and recreational use facilities including:
  - Provision for 40 pile moorings;
  - Boat ramps and associated vehicle/trailer parking;
  - Recreational boat dry stack storage and associated lift out facilities;
  - Recreational marina to accommodate vessels up to maximum 25 metres in length; and
  - Boat sales.

Dredging: POTL undertakes an approved program of maintenance dredging to maintain the navigability of channels, within the port area, including Ross River. The Ross River channel dredging program is sufficient to provide access for the commercial, defence and recreational

vessels that currently use Ross River. It is not anticipated that development of the project will increase the requirement for maintenance dredging.

Capital dredging will be required for the initial development of the project to obtain the necessary depth for vessel movements. Capital dredging would also be required to provide a swing basin and mooring area for any pile moorings adjacent to the proposed breakwater. Dredging will vary across the required areas (i.e. there may be a channel, swing basin and pile mooring area dredged initially). The requirement for further capital dredging could be driven by demand for additional pile moorings. The depth and volume of dredge material is described in detail in Section 2.4.

A large volume of the material identified for dredging (>70%) is considered to be unsuitable for reclaim fill and it is expected that this material will be disposed of at sea. This is discussed further in Section 2.4. For the small quantity that may be suitable for use as reclaim fill the preferred method of dredging to reclaim would be to use a cutter suction dredge discharging through pipes directly into the reclamation area. Any material that is determined unsuitable as engineering fill may be extracted with an excavator rather than cutter suction dredge.

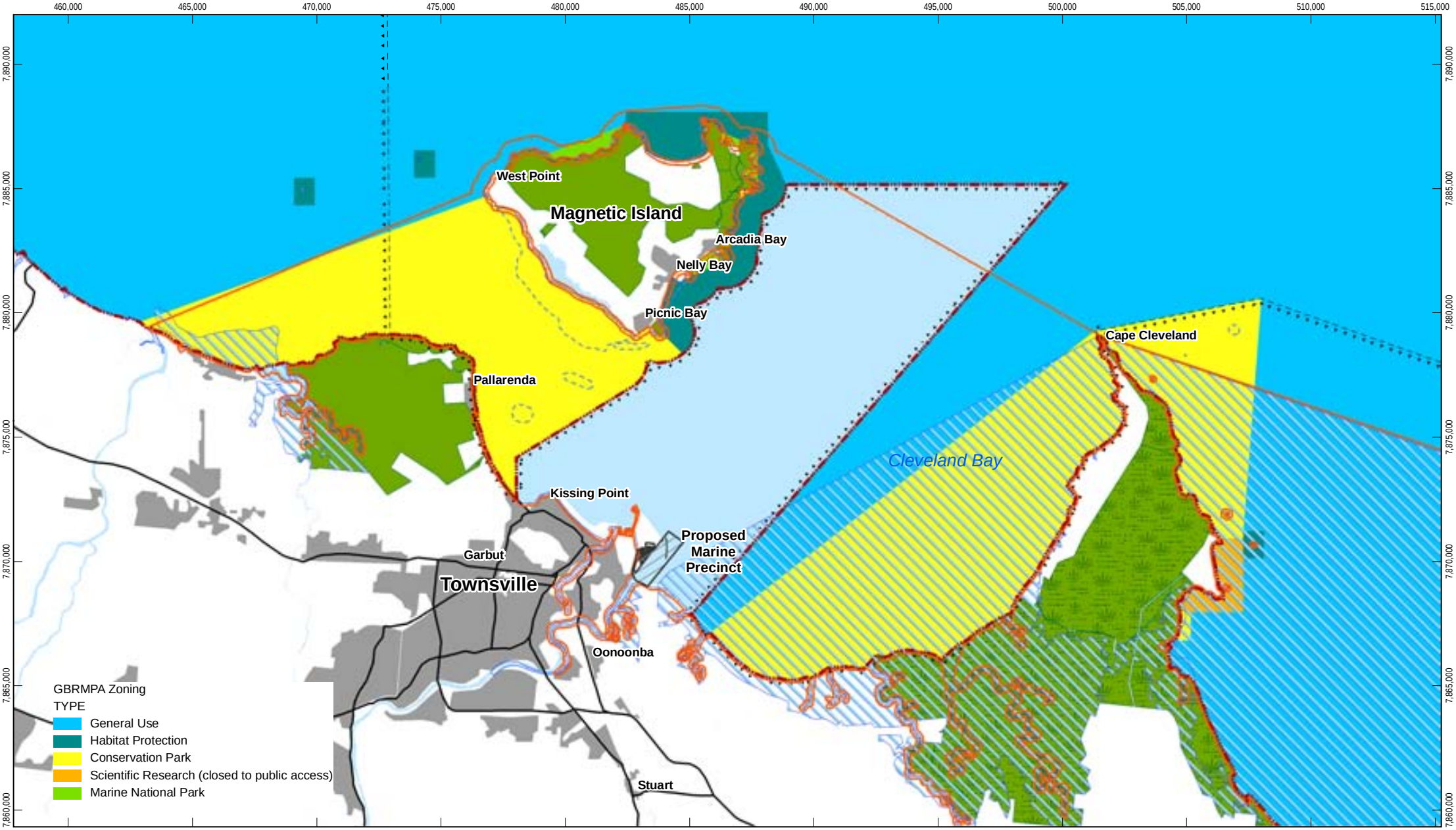
Vessel movements: It is not anticipated that the development of a marine precinct in the mouth of Ross River will substantially increase vessel numbers in the area. The majority of industries being considered for co-location in the Precinct (and their associated vessels) already exist either upstream of the proposed site in Ross River or in Ross Creek. The Ross River channel is already a restricted speed zone.

2.3 Location

2.3.1 Overview

The Port of Townsville is located within the dry tropics of the north Queensland coast (Figure 1-1). Townsville's Port represents a gateway facility not only for the adjoining Great Barrier Reef World Heritage Area (GBRWHA), Magnetic Island and the surrounding coastal environments, but also inland northern Australia. The Port of Townsville is situated at the mouth of the Ross River in Cleveland Bay, an area that is defined by Cape Pallarenda, Cape Cleveland and includes Magnetic Island. A locality map is provided in Figure 2-1.

Similar to many other port facilities throughout the world, the Townsville Port has evolved as a dynamic industrial area. The Port lies entirely within the GBRWHA in Cleveland Bay, which is characterised as a sensitive marine and estuarine ecosystem including a Dugong Protection Area 'A' (DPA). It is adjacent to the Great Barrier Reef Marine Park, a Fish Habitat Area (FHA) pending gazettal by the Department of Primary Industries and Fisheries (DPI&F) and other sensitive habitats such as seagrass beds, mangrove forests and fringing coral reefs, although many of these are some distance from the operating Port. The sensitive ecosystem receptors of Cleveland Bay adjacent to the Precinct are depicted on Figure 2-3.



1:200,000

0 1 2 3 4 5

Kilometres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

- Project Area of Interest
- Builtup Area
- National Park
- RAMSAR Wetland
- Dugong Protection Area (State Boundary)
- GBRMP Boundary
- Designated Shipping Area
- Fish Habitat Area

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	B
Date	10 Aug 2009

Sensitive Ecosystem Receptors Adjacent to the Precinct

Figure 2-3

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

The Port of Townsville is almost wholly located on reclaimed land. The present port operations precinct is situated adjacent to the central business district (CBD), which contains a significant concentration of commercial, administrative, service and cultural facilities. The Ross Creek industrial precinct also forms part of the CBD. The area extending from the Ross River precinct to Cape Cleveland is considered to be of high ecological and conservation value although the Ross River itself is a significantly modified environment.

Residential development in the Townsville region has focussed around the banks of the Ross River, expanding the city's footprint towards the dam, which was constructed in 1973. Since construction of the dam and three weirs on the river (in the 1900's) for flood mitigation virtually all bed load transport of sediments to the coast has ceased. Sediments that accumulate behind the weirs have historically been dredged and used in construction, including for reclamation work on Port land. Pringle (1989) notes that between 1968 and 1980 over three million cubic metres of sand was removed from the Ross River estuary and pumped ashore for reclamation of activities. Currently the Ross River does not contribute any bed load sediment to Cleveland Bay. However, coastal sediment movements (discussed in detail in Section 3.8) do result in the need for ongoing maintenance dredging of the channel in the mouth of the Ross River to maintain navigability for the fishing fleet, which was moved from Ross Creek to Ross River in 1983.

A key challenge for development of the Marine Precinct is to balance protection of the natural resources of this region with growing demands of regional industry.

The proposed Project area is to the south-east of the existing port operations and runs parallel with Benwell Road, South Townsville. The area is identified as Lot 773 on EP2211. The proposed Precinct will require the reclamation of Lot 773 on EP2211 and provision of a breakwater at the eastern channel entrance to Ross River (Figure 2-1).

Lot 773 total area is approximately 34 hectares (ha). The total area of development for the Precinct on this Lot will be approximately 32 ha, extending south from the Benwell Road Beach. Additionally, an area of approximately 2 ha of seabed will be developed for construction of the breakwater. The location of individual components of the project including the breakwater, marine berths and buildings is illustrated on Figure 2-2.

2.3.2 Land tenure

All the proposed works lie within the declared Port Limits of the POTL. The proposed Project area of Lot 773 on EP 2211 is under a Perpetual Lease to POTL. This came into effect following vesting of EP 2211 in 1987 from the Governor of Queensland to the Townsville Port Authority. A Lease in Perpetuity was granted by the Department of Natural Resources and Water commencing on 30/11/2000 for port and transport related purposes.

An area near the mouth of Ross River adjacent to Lot 773 will also be required for a breakwater and pile moorings (Figure 2-1). POTL is in discussions with the Department of Natural Resources and Water in regards to tenure for the seabed associated with the footprint of this facility. It is not expected that POTL will require tenure of the seabed of this breakwater location, however, a firm direction on that requirement will fall out of ongoing discussions.

2.4 Construction

2.4.1 Overview

This section describes the construction phases of the project and includes the type and methods of construction to be employed, the construction equipment to be used and the items of plant to be transported onto the construction site.

The approaches to the construction of the Precinct reclamation and the proposed breakwater Option C are discussed including proposed dredge plant and equipment that would be employed, the estimated number of persons to be employed during the project construction phase and a description of the timing of the construction of the project. Construction methods associated with the implementation of other marine precinct infrastructure and topside construction has been deferred pending the identification of a suitable developer and finalisation of a configuration.

A detailed description of possible phasing of the project is provided under Section 1.3.2 and is summarised here with reference to related works within the region including the TPAR.

2.4.2 Timing and phasing of the project

Delivery of the Precinct is to provide opportunity to industries affected by construction of the TPAR, which closes the Ross River to vessels >6m in height mid 2011, to continue operation within Townsville unimpeded. Staging of the project and details of industries that can be supported by each stage of the development are provided in detail in Section 1.

Timing for delivery is as follows:

- Stage 1 of Marine Precinct in place and operational by 30 June 2011;
- Stage 2 to be operational by 30 June 2015; and
- Stage 3 to nominally be operational by December 2017.

This staged delivery allows for the progressive development of the Precinct as demand warrants, whilst allowing for the fast tracked development of Stage 1 to cater for accommodation of required activities prior to the TPAR bridge closure of Ross River, expected to be July 2011.

2.4.3 Disturbance to existing users

Construction of the Stage 1, Stage 2 and Stage 3 reclamation, protective rockworks and inner harbour navigation dredging will be conducted adjacent to but off the line of existing navigation channels and are not expected to cause interference to other operations.

The majority of the works associated with bed preparation and construction of the offshore breakwater will be conducted remotely from the main navigational access except for the northerly section of the offshore breakwater and the re-alignment of the Ross River channel. The latter two operations will be conducted within and in close proximity to the existing navigation channel. However, the works will be conducted using relatively small dredging plant, and only minor constraint to the operation of existing commercial, defence or recreational users is envisaged. In the event that marine construction operations do lead to partial blockage of the

channel the plant will be able to be periodically pulled aside to allow access to other traffic. Provision can be made within the construction contracts to manage potential navigation constraint including the placement and management of spoil pipelines.

Dredging operations can be shut down and the dredge moved to the side of the channel relatively quickly (approx 10 minutes) to facilitate emergency access to the channel.

2.4.4 Construction workforce

The average workforce onsite during dredging and filling construction works is envisaged to be between 30 – 50 people. Depending on the staging of the works a peak workforce in excess of 100 people may be expected for the concurrent construction of the stage 2 reclamation works and the construction of the offshore breakwater.

- Dredging operations (Stage 1, Stage 2, and Offshore Breakwater preparation) 25 – 35 ppl
- Rockworks (Stage 1 Breakwater, Stage 2 and 3 rockworks) 20 – 70 ppl
- Reclaim and filling (Stage 2 and 3 reclamation) 30 – 70 ppl
- Offshore Breakwater foundation preparation 80 – 110 ppl
- Offshore Breakwater Construction 60 – 80 ppl

Depending on the staging of the works these workforces may be concurrently deployed. Additional information with regard to workforce requirements and economic impacts of the project is provided under Section 5.

The Precinct is located in close proximity to the CBD of Townsville and is readily accessible for locally based construction workforce. There is no anticipated need for worker accommodation on site. The additional labour force needs are expected to be mostly met from existing residents of the region. However, if a portion of the workforce is temporarily required from elsewhere that portion will not be of material concern to Townsville's existing accommodation capacity (see Appendix BB).

2.4.5 Pre-construction activities

2.4.5.1 Overview

This section should set out a description of the pre-construction activities, including:

- Any land acquisitions required, be it in full or as easements, leases;
- Vegetation clearing;
- Site establishment requirements for construction facilities;
- Temporary works; and
- Upgrade, relocation, realignment or deviation of roads and other infrastructure.

2.4.5.2 Land acquisitions

There are no land acquisitions required as the entire Project will occur on POTL land or on seabed designated for the breakwater. Leasing arrangements will be required for the proposed

facilities to be included within the Precinct. These leasing arrangements will be managed by the developer and the POTL. Tenure for the project has been discussed in Section 2.3.2.

2.4.5.3 Vegetation clearing

The majority of vegetation adjacent to the Precinct has been identified as being located under the Port Access Road services corridor. A very small section of mangroves at the northern end of Lot 773 (approximately 0.5 ha) falls within the TMPP area. Impacts to the vegetation in the Services Corridor will occur at the same time as reclamation work for the TMPP. This section of vegetation has, therefore, been assessed under the terrestrial ecology component of this study (refer Section 3.10.4).

2.4.5.4 Upgrade, relocation, realignment or deviation of roads and other infrastructure.

POTL will need to consider the facilitation of appropriate access to the site during construction whilst maintaining security of the Port facilities. This will primarily include traffic corridors, including possible temporary access during construction. The construction workforce is not anticipated to require access the Port security zone.

Upgrade, relocation, realignment of roads and other infrastructure will be required for the project. These works will consist of:

- Reclamation of the Eastern Access Road Service Corridor;
- Provision of access to a temporary hardstand area within the eastern reclaim area at the Port of Townsville if required;
- Provision of project access corridors at the Boundary Street and Benwell road Intersection and entrance corridor off Benwell Road, North of Archer street;
- Provision of temporary access, routed outside the Port security zone, to the temporary hardstand area to facilitate Stage 1 construction and operation; and
- Provision of power, water, sewer and communications headworks at the marine precinct boundary.

2.4.5.5 Temporary works and site establishment

The Construction Contractors will require an area to accommodate their operations during the works. Some of the principal activities that would occur within the construction works area may include:

- Office, staff amenities and administrative functions;
- Vehicle parking for construction vehicles and contractors staff;
- Workshops and maintenance area;
- Stockpiling and handling of rock and fill for revetment and reclamation purposes; and
- Temporary Barge loading facility.

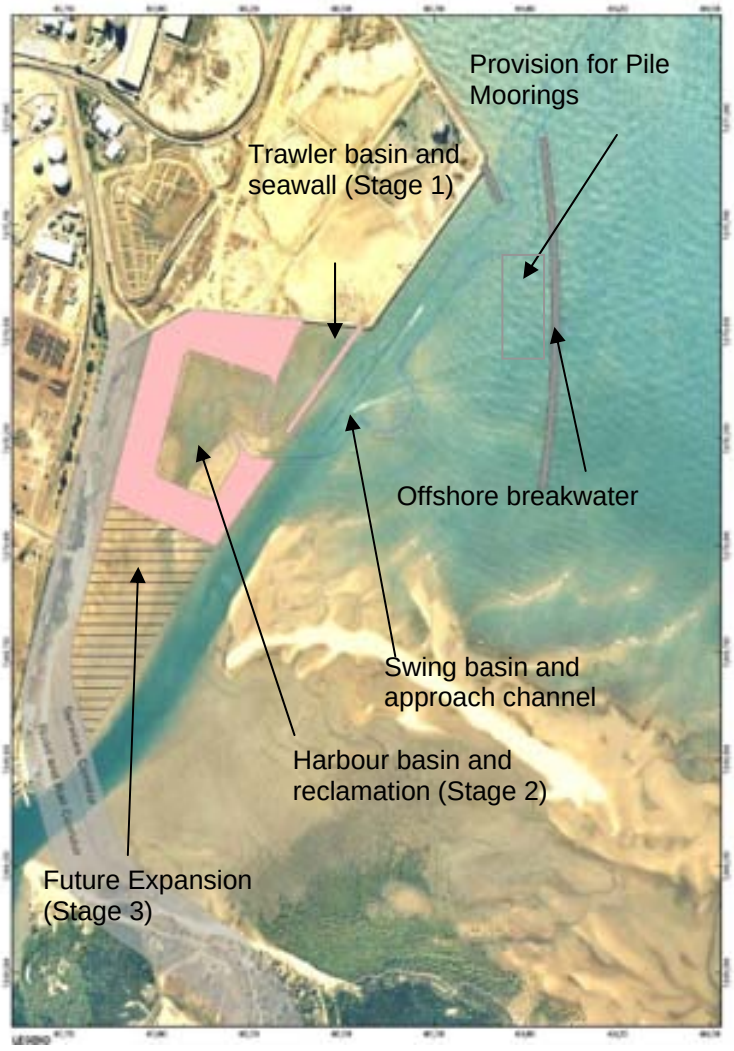
It is expected that the Contractor would construct an area within either Lot 773 or the temporary hardstand area as appropriate to accommodate these operations and that an additional area outside the project footprint will not be required.

2.4.6 Tidal works – dredging and reclamation

2.4.6.1 Location and area of dredging and reclamation

POTL currently undertakes an approved program of maintenance dredging to maintain the navigability of channels within the port and Ross River areas. The development of the Precinct and associated infrastructure will require capital dredging and reclamation works and maintenance dredging works. A plan of work areas is provided as Figure 2-4.

Figure 2-4 Plan showing works areas



In terms of dredging and reclamation, the Precinct development involves:

- Deepening of the existing levels to shipping channels, berth pockets and a swing basin;
- Provision of a navigable area to accommodate pile moorings;
- Removal of any soft sediments below rock revetment and breakwater footprints;
- Placement of fill below breakwater footprints to replace dredged soft sediments;
- Placement of rock materials to form rock revetments and breakwaters; and

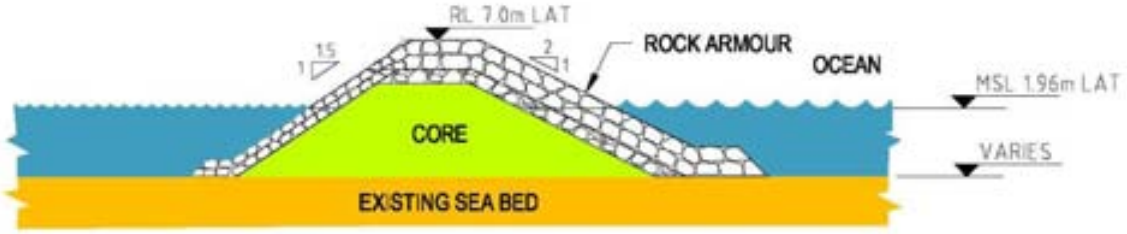
- Filling behind rock revetments to form reclaimed land.

Dredge levels for shipping channels and harbour basins have been determined separately based on ship sizes and maintenance dredge requirements. The following scope of dredging and/or filling works is required at each works area in order to accommodate the ground conditions encountered.

Table 2-1 Anticipated scope of dredging and filling works

Location	Summary of dredging and filling work
Trawler basin (Stage 1)	Dredge soft clay and silt from below north side of revetment footprint. Construct revetment (using imported land based source of rock armour and rock core). Dredge trawler basin area to -3.5mLAT.
Offshore breakwaters	Dredge soft clay and silt from below the breakwater footprint. Refill dredged trench to seabed level using imported sand fill (from marine or land based source). Construct revetment (using land based source of rock armour and rock core).
Swing basin and approach channel	Dredge approach channel and basin area to -3.0mLAT.
Harbour basin (Stage 2)	Construct revetment (using land based source of rock armour and rock core). Dredge harbour basin area to -4.5mLAT. Filling to form precinct reclamation area using imported non-cohesive fill.
Future Reclamation (Stage 3)	Construct revetment (using land based source of rock armour and rock core). Filling to form precinct reclamation area using imported non-cohesive fill.
Pile Moorings	Dredge navigable area to -3.0mLAT.

Typical sections of the finished reclamation, dredged levels and protective rock works relevant to the construction assessment are included below.

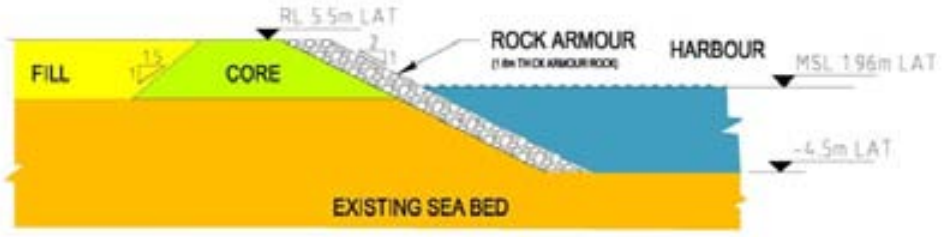


OFFSHORE BREAKWATER

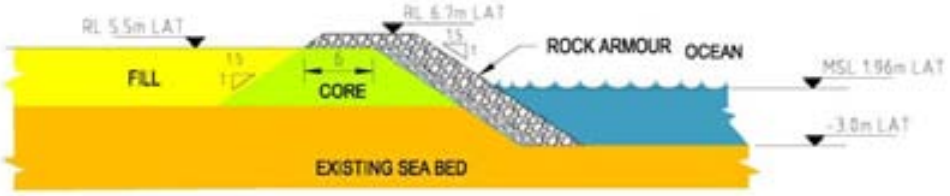
The offshore breakwater section is typical of the breakwater construction including the stub section attached to the Eastern Reclaim Area.

CHANNEL CROSS SECTION

The channel cross section is typical of the design navigation depths for the realigned channel which locally widens to accommodate the dog leg through the offshore breakwater opening. The swing basin and pile mooring are dredged to similar depths with similar design batters.

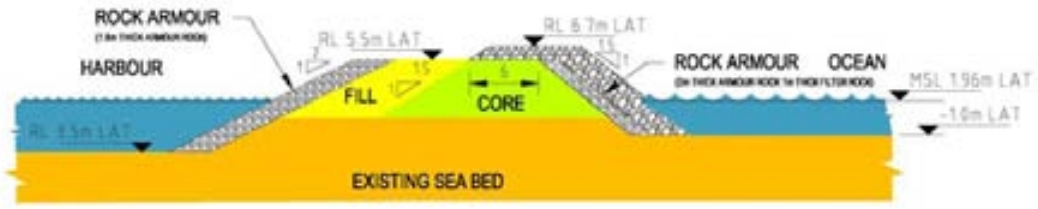


The inner revetment section is typical of the rockworks on protected faces such as the Stage 2 Inner harbour Basin (Peron, 2008).



OUTER REVETMENT

The outer revetment section is typical of the rockworks on exposed external faces of the Marine Precinct (along Stage 2 and Stage 3) and includes a protective crest wall (Peron, 2008).



TRAWLER BREAKWATER

The Trawler Breakwater is typical of the Stage 1 breakwater Section and includes a protective crest wall (Peron, 2008).

2.4.6.2 Volume of Dredging and reclamation

The volume of dredging required for the marine precinct development reference design is estimated to be 951,000 m^3. The volumes of dredging works are summarised in Table 2-2 below.

Table 2-2 Summary of Dredge Volumes

Dredge (in-situ)	Reuse	Dispose to spoil	Comments
Trawler Basin (Stage 1)	95,000* m^3	0 m^3	95,000 m^3	Approx. 15,000 m^3 of soft silty clay below northern part of the revetment. Elsewhere, sand over silty clay. Estimated approx. 30% will be reusable sand. However, sand is potential acid sulfate soil and there is limited opportunity to reuse within the project (Stage 1 is constructed in advance of filling in other areas).
Offshore breakwaters	262,000 m^3	0 m^3	262,000 m^3	Soft silty clay below breakwaters.
Swing Basin and Channel	185,000*m^3	0 m^3	185,000 m^3	Mixed sand, silt and mud. Separation of materials not likely to be feasible.
Harbour Basin (Stage 2)	340,000* m^3	85,000 m^3	255,000 m^3	Sand (1-2m thick) overlying silty clay. Estimated approx. 25% will be sand and reusable within the Project provided it is placed below water.

Dredge (in-situ)	Reuse	Disposal to spoil	Comments
Future Reclamation (Stage 3)	0 m^3	0 m^3	No dredging required for this stage of works
Pile Moorings	70,000* m^3	0 m^3	70,000 m^3 Soft silty clay
Totals 952,00	**0 m^3 85,000**	**m^3 867,00**	**0 m^3**

** includes overdredging provision*

This estimation was based on the following parameters:

- Navigation Channel = 50m wide, dredged to -3.0 mLAT (-4.86 mAHD);
- Swing basin = 150m diameter, dredged to -3.0 mLAT (-4.86 mAHD);
- Depth of unsuitable material beneath the breakwaters requiring removal and spoiling to sea varies from 1m to 7m depth below seabed;
- Stage 2 precinct inner harbour basin - depth of -4.5mLAT (-6.36 mAHD);
- Stage 1 trawler basin - depth -3.5mLAT (-5.36 mAHD); and
- It is assumed that all the soil types found in the areas to be excavated are potential acid sulfate soils and have to be treated accordingly.

The volumes of reclamation works are summarised in Table 2-3 below.

Table 2-3 Summary of Fill Volumes

Non - Cohesive fill	Rockfill (core + armour)	Comments
Trawler Basin (Stage 1)	0 m^3	39,000 m^3 Stage 1 Breakwater-
Offshore breakwaters	262,000 m^3	147,000 m^3 Backfilling dredged trench refilled using 262,000m^3 of imported non cohesive fill. Offshore Breakwater construction.
Harbour Basin (Stage 2)	394,000 m^3	118,000 m^3 85,000 m^3 sand fill available for reuse from Stage 2 dredge operations reducing total amount of imported sand required from 394,000 m^3 to 309,000 m^3
Future Reclamation (Stage 3)	351,000 m^3	44,000 m^3
Totals 1,007,00	**0 m^3 348,00**	**0 m^3** Import requirements 922,000 m^3 sand fill and 348,000 m^3 rock fill.

Volumes are in situ volumes – a bulking factor has been included for transportation and handling assessment.

2.4.6.3 Grading and composition of likely dredged materials

A number of intrusive investigations for the marine precinct have been carried out since 2007. These include:

- Preliminary Geotechnical and Acid Sulfate Soils Investigation, by Golder Associates (report dated July 2008) comprising 23 cone penetration tests (CPT's) and boreholes; and
- Acid Sulfate Soils Investigation, by GHD (report dated January 2009) comprising 72 vibrocores (23 vibrocores in Lot 773, and 49 vibrocores in the Harbour Area). Appendix H.

The various investigations indicate that the near surface marine ground conditions comprise relatively recent marine deposits overlying an older firm to stiff silty clay. The near surface marine deposits are mostly loose sandy deposits in the proposed precinct area (Lot 773), although soft marine clay was encountered in a number of places, notably in the outer section of the development, under the breakwater footprint and the northernmost area of Lot 773.

Particle size distribution (PSD) plots of samples above -6mLAT (i.e. just below the planned dredge limit) are included in Appendix G. These suggest the upper (1-2m) sand layer is likely to have a percentage of fines (< 0.075 mm) in the order of 20%, whilst the underlying clay layer is likely to have a relatively high 70% of fines.

In addition, the results of acid sulfate soil testing suggest that all of the material disturbed as part of the development should be assumed to be potential acid sulfate soils (PASS) and, subject to detailed assessment, managed accordingly.

Geological cross-sections and indicative gradings through the various areas of proposed work are shown in Appendix G.

The ground conditions are briefly summarised below.

Table 2-4 Composition of likely dredged materials

Stage 1 Trawler Basin	Subsurface conditions at the proposed trawler basin area comprise up to 2m of loose sand (with zones of silty clay) over firm to stiff clay. A zone of soft silty clay is present at the north-east end, adjacent to the existing revetment.
Offshore Breakwaters	Investigation at the breakwater has shown subsurface conditions below the breakwaters comprise very soft clay overlying firm clay. The thickness of soft clay varies between 1m and 7m.
Swing Basin and Approach Channel	The inferred subsurface conditions below the swing basin comprise between 1m and 2m of loose sand (with zones of silty clay) over firm to stiff silty clay.
Stage 2 Harbour Basin, Revetment and Reclamation	The inferred subsurface conditions at the proposed Stage 2 area comprise up to 2m of loose sand (with zones of silty clay) over firm to stiff clay.
Stage 3 Future Reclamation	The inferred subsurface conditions at the proposed Stage 3 area are similar to those determined for Stage 2.
Pile Moorings	Material similar to that determined for Offshore Breakwaters is expected. Consisting of soft clay over firm clay. The thickness of soft clay is expected to extend to full dredging depths.

2.4.6.4 Proposed disposal methods

There is potential for some dredged material to be re-used within the project. This potential will be affected by the composition of the material and its suitability for re-use as engineering fill, staging of the works and the availability of reclaim areas for onshore disposal concurrent with dredging activities coupled with successful management of potential acid sulfate soils.

Due to the presence of Potential Acid Sulfate Soils and geotechnical suitability of the material, it is anticipated that a significant volume of material will need to be disposed of to spoil and is likely to include ocean disposal pending approval of an Ocean Disposal Permit.

The breakdown of material for re-use within the project and disposal to spoil is indicated in Table 2-2.

2.4.6.5 Maintenance dredging

Maintenance dredging requirements are informed by:

- Historical dredging requirements;
- Assessment of impact of the development on coastal and littoral processes; and
- Assessment of impact of the development on the sedimentation potential (hydrodynamic, wind, wave regime).

The assessment undertaken for the EIS has the following key outcomes;

- Dredge records for maintenance of the Ross River channel go back to 1971. Over the record period, an average of approximately 37,000 m^3/annum has been removed from the existing Ross River navigation channels. In recent years (since 1990) the dredging has reduced in frequency and magnitude (campaign occurring every 2-3 years) with an average of 25,000 m^3/annum maintenance material removed.
- Coastal assessment (Section 3.8) has concluded that;
  - The littoral transport rate in Cleveland Bay is low with the majority of material transported in the littoral zone currently being trapped by the Ross River Channel;
  - Coarse sediment contributions from Ross River are essentially source limited due to infrastructure (dams and weirs) blocking the riparian sediment transport.; and
  - The offshore breakwater has the potential to cause the littoral material transported along the shoreline to accumulate in the lee of the breakwater on the existing sandbank to the east of the river mouth. This effect will occur in the short to medium term.
- Hydrodynamic modelling (refer Section 3.8.4) has established that;
  - The opening of the breakwater (to the north and east) is likely to be self scouring;
  - Under the existing conditions bed shear stress resulting from tidal exchange in the Ross River is below likely sediment remobilisation thresholds and the siltation response is predominantly depositional;
  - Under the developed configuration the bed shear stress resulting from tidal exchange in the Ross River is in a similar range to the existing conditions except around the toe of the breakwater where increased potential for scouring is expected on spring tides. No significant reductions in bed shear stress have been identified that would lead to large increased sedimentation potential;

- Under the developed configuration the currents within the inner harbour are significantly lower than those occurring across the existing Lot 773 and there is a potential to trap suspended material within the inner harbour; and
- Under significant flood discharge events from Ross River both the existing and developed channels demonstrate bed shear stresses greater than re-suspension thresholds and are expected to flush or scour.

The existing siltation regime is driven by the rate of supply of material to the site and the development will not impact this mechanism. Consequently, it is concluded that the magnitude of maintenance dredging of the Ross River Channel is unlikely to increase as a result of introduction of the offshore breakwater or the reclamation of the precinct area. Notwithstanding, the distribution of maintenance material may be affected by the wave shadowing effect of the breakwater structure and lead to potential accretion of the existing sandbank to the east of the Ross River in the short to medium term.

The maintenance dredging requirements for the Ross River channel will be 25,000 – 40,000 m^3/annum, typically with maintenance dredging conducted biannually or every 3 years. In past campaigns this material has been re-used in port reclamation.

There is potential to accumulate fine silt within the marine precinct inner harbour and trawler basin due to reduction in bed shear stress in this area and trapping of suspended sediment. Due to the relatively high background turbidity measured a provisional estimate of 200 - 300 mm / year is projected for this accumulation based on trapping of fine sediments within the inner harbour (allow as much as 15,000 – 20,000 m^3/annum). Dredging will likely be completed in conjunction with the maintenance of the Ross River Channels (every 2 – 3 years) and spoil will consist of finer silts which are unlikely to be suitable for reclamation.

A provisional allowance for maintenance dredging over a 20 year life is estimated to be in the range of 800,000 m^3 to 1.2 Million m^3.

Similarly, provisions for emergency dredging in the event of a large storm event are anticipated to be similar to those currently experienced for the Ross River channels. A severe storm event with elevated water levels and higher waves has the potential to mobilise a very large volume of sediment and reshape the sandbars and seabed. It is anticipated that the offshore breakwater will potentially stabilise the existing sandbank and mudflats immediately to the east of the Ross River.

2.4.6.6 Dredging methods

The majority of the dredging work for the TMPP is expected to be conducted by a mechanical Backhoe Dredge with a small proportion of the material suitable for reclaim expected to be conducted by Cutter Suction Dredge.

A backhoe dredge (BHD) is in principal a mechanical excavator on a pontoon equipped with hydraulically operated spuds. It is one of the most commonly used mechanical dredging techniques for smaller projects and is particularly effective when there is limited water depth and manoeuvrability and the spoil disposal location is greater than 1-2 km from the dredging site.

The spoil is relocated by the excavator into a hopper barge and then transported to the disposal site. Split hopper barges are commonly used to transport spoil and range in capacity from 100 m^3 to 1,000 m^3 and operate by splitting the hull to dispose of the dispose of their material by

bottom dumping. For the marine precinct project, it is estimated that two 500 m^3 capacity barges would be required. Assuming 5 hours to fill the barge and a 5 hour return trip to the offshore disposal site (15 – 20 km), two barges and 100 m^3 per hour filling rate would allow continual 24 hours operations.

Figure 2-5 Typical backhoe dredge with split hopper barge being loaded

A proportion of the dredge material has been identified as geotechnically suitable for reclaim (Refer Table 2-2 proximate (within 1 – 2 km) to a reclaim / land based disposal site and consistent with the construction staging for the development. A Cutter Suction Dredge (CSD) will be the appropriate plant to dredge and reclaim this material.

A Cutter Suction Dredge (CSD) is a stationary hydraulic dredge which makes use of a “cutter head” to loosen the material to be dredged and pumps the dredged material to the disposal area via a sunken or floating pipeline. A key feature of a CSD is a rotating cutter. The loosened material enters the suction mouth, passes through the suction pipe and pumps and then into the delivery line.

A more detailed summary of the application of the various dredging plant is incorporated in Appendix G.

Figure 2-6 Typical cutter suction dredgers

Small sized cutter suction dredge

Medium sized cutter suction dredge

2.4.6.7 Reclamation and Rockworks Methods

Breakwaters and revetments are required to protect the precinct from the potential adverse effects of waves, particularly during storm events. The walls typically consist of a rock armour

layer over a core of quarry material. The width of the bund crest is usually dictated by sufficient space to allow the passage of trucks to build the bund while maintaining working room for plant to lay the armour layers.

A total of 348,000 m^3 imported rock fill (Table 2-3) is required for the project. It is understood that sufficient quantity/ quality of rock armour (typically 2 -5 tonne size offshore) and rock core material (typically quarry run size) can be sourced from local quarries located within 60km from the marine precinct site.

This material must be delivered from the quarry to the site by road in a fleet of road-registered haulage trucks. The trucks will haul the material from the quarry to the bund site and continue out to the bund and end tip material into place allowing progressive bund construction nearest-shore to furthest from shore.

For the offshore breakwater construction, the trucks will dump the rock fill directly into barges, which will transport the rock to the breakwater location, where it will be placed by barge mounted grab crane.

Alternately, the road-registered fleet could dump fill at a stockpile and the material can be rehandled and placed by dedicated on site plant. Photographs of the indicative method are shown in Figure 2-7.

Figure 2-7 Breakwater Construction

Excavator and grab barge placing rock offshore

Loader rehandling armour to offroad dump truck

A similar process is required for filling of the reclaim with terrestrial fill. A total of 1,007,000 m^3 imported non cohesive fill (Table 2-3) is required for the project (up to 922,000 m^3 imported from terrestrial source). This material would be delivered to site using a fleet of haulage trucks and spread on site using conventional swamp dozers and earthmoving plant.

Some ground improvement or consolidation / compaction works will be required before construction on reclaimed land, this may include; dynamic compaction, vertical drains or surcharging. The actual method adopted will depend on the ground conditions, required speed of construction and the contractor's plant.

2.4.6.8 Summary of construction plant

The actual equipment adopted will depend on the final configuration of the development, plant availability and the Contractors preferred working method. An indicative list of equipment is provided below based on the identified construction method above.

Table 2-5 Construction Equipment on Site – Dredging and Reclamation Works

Phase of Works	Equipment	Number	Activity
End Dumped Revetment / Breakwater construction			
Trawler Basin revetment 18 weeks *(prior to opening TPAR)*	Trucks	24/ day	Delivery of Revetment core material and armour
	Excavator:	1	Handling / placing rock fill
	Loader:	1	Rehandling / Stockpiling fill
	Offroad Dump Truck	1	Rehandling / Transporting fill
	Dozer:	1	Trimming / Level finished surface
Stage 2 revetment 10 weeks Stage 3 revetment 4 weeks *(post opening TPAR)*	Trucks	140/ day	Delivery of Revetment core material and armour
	Excavator:	3	Handling / placing rock fill
	Loader	2	Rehandling / Stockpiling fill
	Offroad Dump Truck	3	Rehandling / Transporting fill
	Dozer:	3	Trimming / Level finished surface
Offshore Breakwater Construction			
Offshore Breakwater Construction 14 weeks	Trucks	140/ day	Delivery of Breakwater core material and armour
	Excavator	1	Handling / placing rock fill
	Dozer:	1	Trimming / Level finished surface
	Loader	1	Rehandling Fill / Loading barges
	Bobcat	2	Rehandling Fill onboard barges
	Transport Barge	2	Transporting core and armour
	Grab Barge	1	Placing Breakwater armour
	Survey Boat	1	Hydrographic Surveys
	Work Boat	1	General support

Phase of Works	Equipment	Number	Activity
Backhoe Dredging			
Trawler Basin 7 weeks	Backhoe Dredge	1	Dredging
Stage 2 Inner Harbour 19 weeks	Split Bottom barge	2	Transporting and dumping dredge spoil
Channel + swing basin re-alignment 14 weeks	Tug	1	Supporting dredger and split bottom barges
Under Offshore breakwater foundation 22 weeks	Workboat	1	Supporting dredger and tug
	Survey Boat	1	Hydrographic survey
Pile Moorings 6 weeks	Support Boat	1	General support / provisioning / fuel / transport
Cutter Suction Dredging			
Dredging of Stage 2 Inner Harbour 7 weeks	Small Cutter Suction Dredge	1	Dredging to reclaim
	Floating spoil pipeline	1	Spoil transport
	Adjustable weir box	1	Tailwater management
	Dozer / loader	1	Spoil pipe handling
	Support Boat	1	General support / provisioning / fuel / transport
Reclamation using imported fill			
Stage 2 33 weeks Stage 3 30 weeks *(post opening TPAR)*	Trucks	140/ day	Delivery of sand fill material
	Excavator	3	Placing and handling fill
	Dozer:	3	Trimming, Placing and compacting fill
	Loader	2	Placing and rehandling fill
	Offroad Dump truck	3	Rehandling and transporting fill
Backfilling dredge trench			
Reinstatement of foundation under offshore breakwater	Trucks	140/ day	Delivery of sand / quarry run fill material
	Loader	1	Loading barges

Phase of Works	Equipment	Number	Activity
24 weeks	Survey Boat	1	Hydrographic survey
	Drag bar / bed leveller	1	Finishing / levelling
	Split bottom Barge or transport barge	2	Transporting and dumping fill
	Spreader barge	1	Placing / dumping fill

2.4.7 Structures

The structures proposed for the Precinct include;

- Offshore Breakwater
- Protective rockworks and reclamation
- Marine infrastructure
- Buildings and other facilities

Details of the proposed infrastructure, operations and configuration for the Reference design are provided under Section 1.2 and elsewhere within Section 2. Information on the metes and bounds for each stage of the TMPP are provided on Figure 2-9. The coordinates provided on this figure are against the Reference Design. Detailed survey of the site prior to construction activities will be required and metes and bounds for the TMPP will be refined at that stage of the project to be accurate against detailed design footprint.

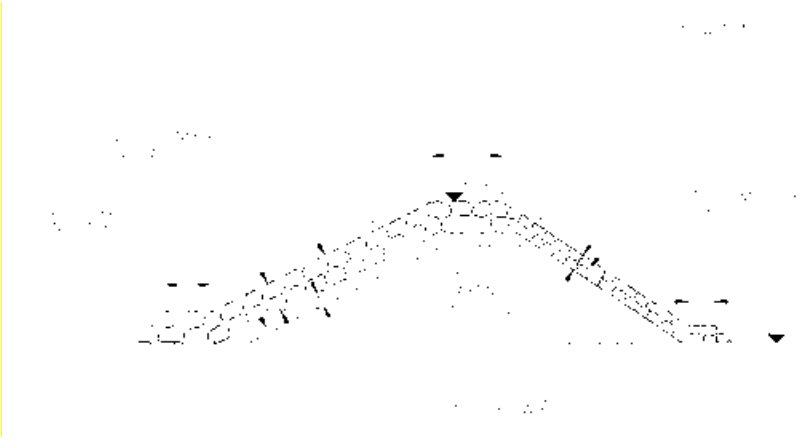
2.4.7.1 Offshore Breakwater

It is anticipated that the Breakwater structures will be constructed using imported fill material sourced from quarries within the greater Townsville Area. Additional details are provided under the previous section (Section 2.4.6) including volumes of imported fill and construction methods.

The typical cross-section for the external breakwater is shown in Figure 2-8 below.

The seaward side is sloped at 1v:2h, with two layers of 2 to 5 tonne armour rock (typical) and a filter layer of 0.2 to 0.4 tonne rock (typical). The lee side of the breakwater has a slope of 1v:1.5h and uses two layers of 0.3 to 1 tonne armour rock. The breakwater has a crest level of +7.0 mLAT (5.14 mAHD).

Figure 2-8 Offshore Breakwater – Typical Section



Preliminary design for the Offshore Breakwater has been undertaken using the following criteria:

Water level = 4.85 mLAT (1 in 100 yr storm tide including surge) (GHD. 2007 – Townsville Thuringowa Storm Surge Study)

Incident wave = H_{sig} = 3.4m – 2.6m depending on location (greater waves at outer end)
T_p = 9 seconds (I in 100yr wave event)

Resulting Damage = intermediate for offshore end (5-10% armour damage), acceptable for middle and inshore section (<5% damage).

The offshore section of the breakwater will be subject to some damage requiring maintenance under 100 year design conditions (including sea level rise provision). Detailed design will require the rationalisation of the armour size distribution along the breakwater and revetments.

2.4.7.2 Protective rockworks and reclamation

It is anticipated that the reclamation area will be constructed using some material from dredge spoil sourced from within the footprint of the inner harbour excavation but predominantly from imported fill. Imported fill will be sourced from quarries within the greater Townsville Area. Additional details are provided under the previous section (Section 2.4.6) including volumes of imported fill and construction methods.

The typical cross-section provided from the commercial development process for the revetment armouring are shown in Section 2.4.6 above.

The nominated reclamation level is 5.5 mLAT (3.64 mAHD) with internal harbour sloped at 1v:2h, with 600mm thick rock layer for protection for vessel wake waves. The external rockworks include a crest wall to 6.7 mLAT (4.84 mAHD) with a single layer of 2 to 4 tonne armour rock.

An assessment of the nominated design has been undertaken using the following criteria;

Water level = 4.85 mLAT (1 in 100 yr storm tide including surge) (GHD. 2007 – Townsville Thuringowa Storm Surge Study)

For the reference design including an offshore breakwater the harbour is protected from larger waves and wave modelling indicates an attenuated wave height of;

Incident wave = Hsig = 0.3m, Tp = 9 seconds (I in 100yr wave event)

Resulting Damage = very low (no damage).

With the provision of an offshore breakwater no damage is expected. Detailed design will require the rationalisation of the armour size distribution along the revetments.

2.4.7.3 Marine infrastructure

An indicative layout for the Marine Infrastructure relevant to the reference design is provided under the project description (Section 2).

A number of vessel lifting facilities are expected and are likely to consist of driven steel piles supporting a concrete superstructure to accommodate travelling shiplifts.

The works will involve marine pile installation and overwater concrete work requiring a floating barge to support piling work followed by construction of suspended formwork and concreting. Structures would be of a standard form and require delivery of materials to site up to 10 trucks per day.

Vessel work berths are expected to be constructed to accommodate trawlers and work berths within the inner harbour of the stage 2 reclamation. These facilities are expected to consist of floating pontoons tethered by driven steel piles.

The works will involve marine pile installation followed by installation of pre-fabricated pontoon and walkway infrastructure and require a floating barge and work boats to support piling works and installation of floating infrastructure. Structures would be of a standard form and require delivery of materials to site up to 10 trucks per day.

Pile moorings are proposed for the lee of the breakwater and these structures are likely to consist of driven piles. Pile moorings would require marine pile installation similar to the construction of the vessel works berths.

2.4.7.4 Buildings and other facilities

A number of buildings will be required by the operators of the precinct facilities, these are expected to consist of maintenance sheds up to 6-7 storeys in height constructed predominantly from steel frame and metal cladding, and supported on raft or piled foundations.

An indicative layout for the topside works relevant to the reference design is provided under the project description (Section 2).

The works will involve minor excavation, foundation concrete works including bored piers and erection by mobile crane. Structures would be of a standard form and require delivery of materials to site up to 10 trucks per day.

Internal roads, pavements and hardstand areas are expected to be constructed from concrete or asphaltic pavement.

Construction will involve levelling, importation and compaction of sub base material and placing and construction of the pavement wearing surface. Importation of materials may require delivery traffic of up to 10 trucks per day.

2.4.7.5 Pollution control during construction

Construction works will be undertaken in conformance with a Construction Management Plan prepared by the Developer and Contractor and specific to the construction procedures to be adopted for the works. This plan will address pollution control issues under plans for:

- Erosion and sediment control;
- Emergency and incident response;
- Waste management, and
- Air Quality and Noise impacts.

Further details relevant to the development of this plan are provided under Section 3.16 and Section 6.

2.4.7.6 Summary of construction plant

The actual equipment adopted will depend on the final configuration of the development, plant availability and the Contractors preferred working method. An indicative list of equipment is provided below in Table 2-6 based on the identified construction method above.

Table 2-6 Construction Equipment on Site – Structures

Offshore Breakwater and Protective rockworks - Refer Table 2-5			
Marine Infrastructure			
Trawler Basin 20 weeks	Trucks	10/day	Delivery of construction materials
Stage 2 Inner Harbour 30 weeks	Barge	2	Pile transport and Installation. Floating crane platform
Pile Moorings 12 weeks	Pile Hammer / leader:	1	Installation of Piles
	Crane	1	Pile handling, installation, prefab unit handling
	Work Boat	1	General support
	Concrete Truck / Pump	5/day	Transporting / Pouring concrete
	Work Boat	1	General support
Buildings and Other Infrastructure			
Stage 1 Hardstand development 30 weeks	Trucks	10/day	Delivery of construction materials
	Excavator	1-2	Excavation to install services and building foundations
Stage 2 Development progressively	Piling Rig	1-2	Installing bored piles

constructed Stage 3 Development progressively constructed	Concrete Truck / Pump	5/ day	Transporting / Pouring concrete
	Crane	1	Building erection
	Grader	1	Levelling / trimming surface
	Water Truck	1	Dust Control
	Asphalt Paving machine	1	Laying Asphalt
	Rollers	2-3	Compacting subgrade / finishing surface

2.4.7.7 Modifications for sea level rise and climate change

Water levels for analysis have been derived from the Townsville-Thuringowa Storm Tide Study, undertaken in 2007. The levels presented are a statistical combination of tide, storm tide and sea level rise where applicable for Ross River, Townsville. The report is consistent with the changes proposed by DERM to the State Coastal Management Plan in that it allows for a static sea level rise of 500 mm over 50 years and 900 mm over 100 years.

Table 2-7 Design Water Levels

Scenario Wa ter Level (m AHD)	Water Level (m LAT)	Components
Present day	+2.94	+4.85	100yr ARI storm tide including surge
2050	+3.1	+4.95	100yr ARI storm tide including surge and 50yr allowance for sea level rise
2100	+3.5	+5.35	100yr ARI storm tide including surge and 100yr allowance for SLR

In addition, increased water levels allow a slightly greater wave height to propagate to the site, with assessment showing the design incident wave height increasing from H_{sig} = 3.4m (present day) to H_{sig} = 3.6m (year 2100).

For the combination of increased water levels and incident waves the offshore breakwater damage factors increase as follows:

Table 2-8 Typical Breakwater – Impacts of Sea Level Rise and Climate Change

Water Level	Present Day	2050	2100
Central Section			
% Damage	0 – 5	0 – 5	0 – 5
Implications	Acceptable	Onset of damage	Onset of damage

Offshore Breakwater overtopping is within acceptable limits for all cases and the breakwater effectively protects the precinct from wave penetration.

Damage levels will increase as a result of increased water levels and propagation of large waves to the site however the damage on the typical breakwater section is considered to be within allowable limits (<5% damage). As previously indicated the detailed design will require the rationalisation of the armour size distribution along the breakwater and revetments and this process should be undertaken considering the impacts of climate change and sea level rise.

For the reference design (incorporating an offshore breakwater) the wave height penetrating to the precinct is not increased and damage to the revetment armour is not impacted.

However, for the nominated Precinct revetments and reclamation levels (Peron, 2008), the 2050 storm tide levels reduce the reclamation freeboard to 50 mm and the 2100 storm tide levels are expected to inundate the precinct reclamation by 350 mm.

Detailed design of the reclamation levels should be undertaken utilising a risk based approach and rationalising the potential damage to infrastructure against the probability of inundation. Whilst flooding of the hardstand and pavement areas is not considered to be a major problem, consideration should be made to locating infrastructure sensitive to flooding (eg hazardous material storage, mechanical and electrical plant, services and structures with finishes / fittings subject to damage in the event of inundation) clear of the projected storm tide levels. In addition, selection of the final reclamation level must consider constraints related to operation of the shiplifts and vessel transfer with the levels and flood immunity for the various operations, along with the containment of waste. Options may include raising the reclamation level to accommodate future potential sea level rise as well as refining the crest wall height and armour in the event the development does not incorporate a protective breakwater.

Other impacts of climate change and sea level rise are dealt with in Section 3.6.

2.4.8 Commissioning

The commissioning process will occur for each stage of the Precinct. For each stage a detailed commissioning or start-up plan will be prepared to provide that all safety, environmental and operating procedures are being complied with.

Two types of commissioning will occur for the Precinct:

- Building/structure commissioning – refers to the physical facility completion for occupation by the contractor. The activities include the successful running of all plant and equipment; and
- Operational commissioning – refers to activities undertaken leading up to handover of the building to the users. Typical activities include familiarisation of staff with safety, environmental and security and communications systems (DHS 2008).

The commissioning process will most likely be undertaken by the assigned construction contractor. The POTL will be responsible for ensuring that commissioning is effectively completed as detailed in a commissioning or start up plan (DHS 2008).

The main objectives of the commissioning or start up plan will be to:

- Ensure the new facilities and equipment are ready for occupancy and use, with approvals and verification in accordance with the Building Code;

- Ensure that the new equipment meets all Government legislative requirements and prescribed energy levels under the relevant greenhouse policy/guidelines;
- Train staff in the operation of new equipment and safety procedures;
- Identify any minor defects which require rectification by the Contractor; and
- Receive all warranties and procedure manuals (DHS 2008). .

2.5 Operations

2.5.1 Overview

This section describes the location and nature of the processes to be used during operation of the Precinct. Operational issues addressed include:

- A description of plant and equipment to be employed;
- The capacity of plant and equipment;
- Maintenance dredging requirements;
- A description of arrangements for long-term maintenance of the marine facilities including details of the responsible parties;
- Details of the predicted usage of the marine facilities;
- Detailed requirements of vessel operations including tugs, pilotage, channel closures, quarantine and security arrangements etc; and
- The numbers of people to be employed in the project operations.

Concept and layout plans are provided highlighting proposed buildings, structures, plant and equipment associated with the processing operation. The nature, sources, location and quantities of all materials to be handled, including the storage and stockpiling of raw materials, is described.

2.5.2 Proposed operations

The proposed operations and facilities to be included at the Precinct provide commercial marine capabilities consistent with those currently in operation within the Townsville region. Stage 3 of the Precinct facility (Stages described under Section 1.3.2) provides expansion potential of industries to match increases in trade, commercial and residential growth in Townsville.

As noted above, a number of industries currently housed in facilities up Ross River may be affected by construction of the TPAR. The Precinct facility provides an alternative location for those industry types. Whether existing businesses choose to relocate into the Precinct is a matter for individual negotiations with the developer of the Precinct facility and POTL. For the purposes of undertaking a robust EIA process a number of operational industry activities were identified as part of the Reference Design for this project. The Reference Design is described in Section 1.2 and above. Table 2-9 summarises the types of industries and activities to be undertaken on the site as per the Reference Design. Figure 2-2 provides a visual estimate of the layout of the operational industries within the Precinct according to the Reference Design.

Table 2-9 Industries Supported by the Precinct

Type of business	Activities to potentially be undertaken on site
Commercial marine construction and maintenance	◗ Large workshop; ◗ Yard storage; ◗ Fully serviced office facility; ◗ Full access wharf facility nearby; and ◗ Diving and marine plant.
Commercial Marina	◗ Management operation and maintenance of a Marina for use by owners and operators of a licensed fishing vessel and for purposes related to activities associated with the commercial fishing industry; ◗ Packaging and wholesaling agency service for seafood trading, sale of fuel and chandlery and casual mooring services; ◗ Commercial marina; ◗ Seafood sales; ◗ Products/Services including gasoline; mooring services refrigerated storage facilities; seafood distribution; ships chandlery; and ◗ Industry operations for trade in chemicals, food / beverage, marine technical and engineering supply, transport services / storage and marine industrial wholesale supply.
Boat building operation	◗ Boat hauling and lifting, small craft repair, rigging and servicing facility, small boat storage and marine retail sales; ◗ Boat repair facilities- small pleasure craft to military and commercial vessels up to 500T; ◗ Boilermaking/engineering; ◗ Shipwright work; ◗ Abrasive blasting; ◗ All types of painting above and below the waterline; ◗ Versatile Marine Shiplifters capable of 70T and 180T; ◗ 500T Slipway; ◗ Floating pontoons capable of supporting vessels up to 25m in length; and ◗ Diesel refuelling.
Commercial Trawler Base	◗ 50 trawler berths; ◗ Two transfer / maintenance berths; ◗ Waste management facilities; and ◗ Diesel refuelling.

Type of business	Activities to potentially be undertaken on site
Commercial Barge Operation	◗ Barge terminal including facility for receiving, processing, storing and distribution of seafood as well as providing consultancy and management services to external companies.
Passenger Barge Operation	◗ Freight terminal, including vessel mooring.
Chandlery	◗ Provision of supplies such as wire, rope and lifting equipment to the fishing industry.

Other proposed facilities

Along with the industries mentioned above the following facilities will be included in the Precinct:

- Marine industrial allotments for industries similar to those mentioned above;
- The full range of site services (power, water, sewerage, stormwater drainage and telecommunications); and
- A sullage pump out facility may be required.

There is potential for other, relevant, service groups, including the Queensland Police Service Water Police facility, to be located within the Precinct. Consideration of the occupants to be housed within the Precinct will be undertaken by the developer to ensure an appropriate mix of facilities within the industrial area.

2.5.3 General operating procedures

General operating procedures to be employed for the Project are expected to be similar to those procedures in place for the existing industries in the Townsville region, including those that may choose to relocate to the Precinct. The developer and/or subsequent managing contractor will manage the general operating procedure for the new facilities.

Operating times will reflect the existing businesses hours and some aspects of the Precinct will require 24 hour, 7 day a week operation.

2.5.4 Environmental management procedures

A site-specific EMP has been prepared for the Project. The aim of the EMP is to:

- Facilitate the development and operation of the Precinct in accordance with applicable environmental laws, policies and procedures;
- Integrate environmental considerations into the development and operation of POTL planning;
- Provide a framework for continual improvement to environmental performance and strive for best practice; and
- Provide a platform for integration with the POTL Environmental Management System (EMS).

All users of the Precinct will accommodate the EMP.

2.5.5 Rehabilitation

As this Project is not likely to be decommissioned in the foreseeable future (not less than 75 years), detailed rehabilitation information can not be provided at this time. It would be expected that a decommissioning plan would be required to be developed at a later stage.

It is noted however, that rehabilitation of small components of the project during construction may be required. This may include any proposed vegetation removal and dredging impacts. Details regarding rehabilitation that may be required for the project are detailed further in the Section 8.

2.6 Associated infrastructure requirements

2.6.1 Overview

The following section identifies the infrastructure requirements for the Project. The proposed Precinct infrastructure, including location of roads, pathways, buildings, power lines and other cables, wireless technology is illustrated in Figure 2-9.

The full range of site services including power, water, sewerage, stormwater drainage and telecommunications will be provided to the proposed development. Detailed information regarding infrastructure requirements on site is provided in Section 3.4.

2.6.2 Workforce and accommodation

A detailed assessment of the economic impacts of this project on the Northern Statistical Division (SD) has been undertaken and is presented in Section 5. The Northern SD includes Hinchinbrook Palm Island, Townsville, Burdekin and Charters Towers and is the smallest region for which many statistics are prepared by State Departments and the Australian Bureau of Statistics. Section 2.4 describes the construction requirements for the project. Both of these sections provide further information with regards to the employment needs and opportunities of the TMPP during construction and operational phases.

The total (direct and indirect) additional labour force needs created by the construction activity and eventual potential expansion of activity at the Precinct are summarised in Table 2-10.

The Northern SD currently (September Quarter 2008) has an estimated labour force of 118,759 workers (smoothed data series) and according to the 2006 Census was home to 8,492 persons employed in the construction industry (of a total estimated Northern SD workforce by the 2006 Census of 94,375 persons). The additional employment created by the construction and operating phases of the project should easily be met by the region's existing labour force, particularly given the current easing in the jobs market due to the economic downturn.

Label	Easting	Northing
A	483579.39	7870512.18
B	483315.93	7870193.11
C	483158.01	7869996.28
D	482811.23	7869543.80
E	482767.53	7869718.98
F	482869.45	7870104.19
G	482986.15	7870502.05
H	483091.81	7870552.32
I	483392.19	7870528.56
J	483290.72	7870277.75
K	483879.36	7870884.71
L	483931.87	7870801.56
M	484050.04	7870954.73
N	484041.28	7870127.60

LEGEND

- State Controlled Road
- Road
- Breakwater
- Stage 1
- Stage 2
- Stage 3
- Industrial Shed
- Potential Temp. Hardstand Site
- Maintenance (Open Hardstand)
- Marine Infrastructure

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Reference Design
Infrastructure Plan

Job Number 42-15399
Revision C
Date 08 Aug 2009

Figure 2-9

G:\42\15399\GIS\Projects\EIS\42-15399_023_rev_c.mxd

Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct, Aerial Imagery, Road Layout - ©The State of QLD (Port of Townsville LTD) 2009. Created by: TH

Table 2-10 Estimated total employment impacts from the construction and operating phases of the Precinct

Year	Additional Employment Generated
2008-09	0
2009-10	64
2010-11	78
2011-12	115
2012-13	58
2013-14	59
2014-15	117
2015-16	100
2016-17	75
2017-18	18
2018-19 and each year beyond (Estimated 'maximum' employment – likely to be achieved in entirety a number of years after 2018-19	258

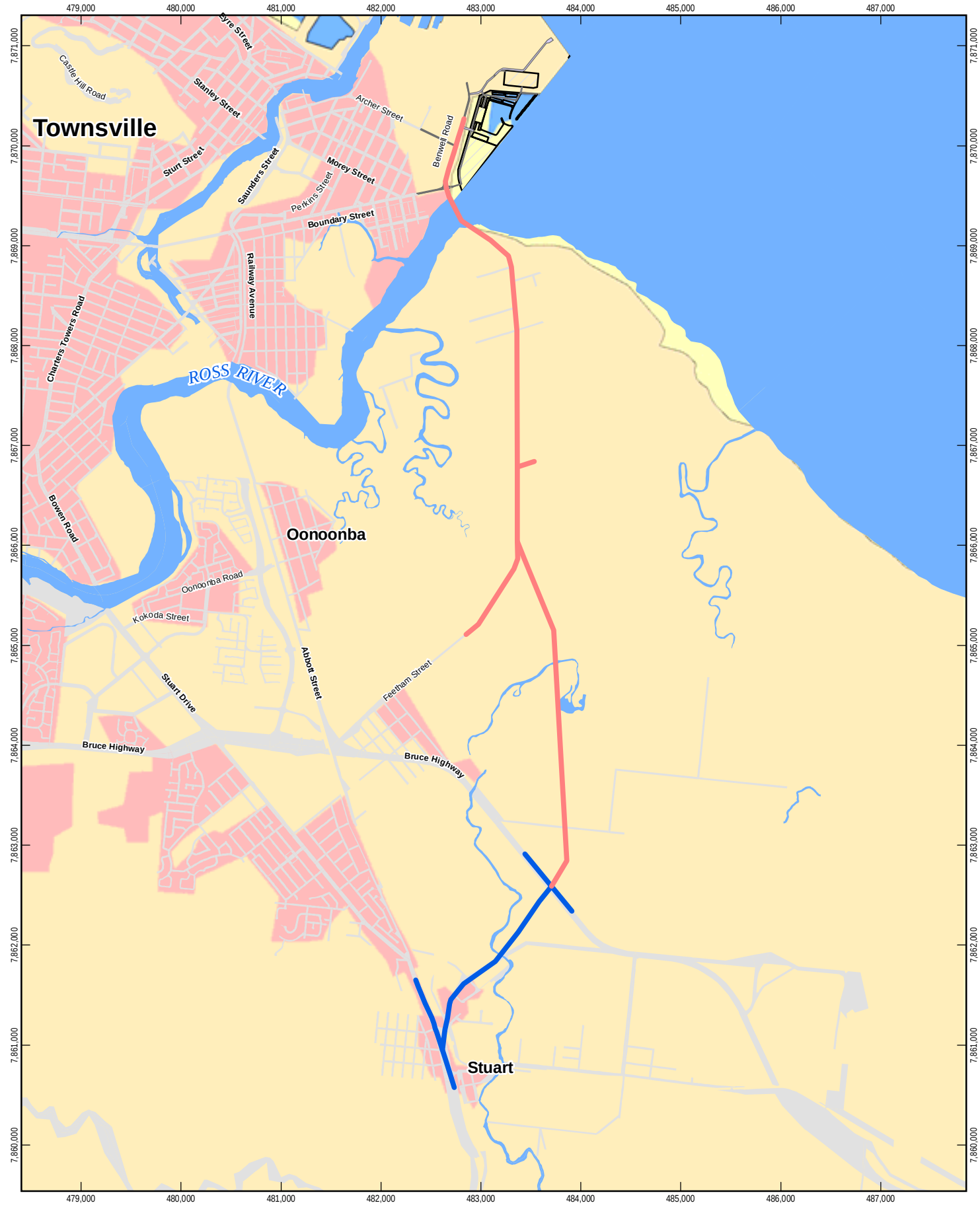
(Source: AEC*group*, Appendix BB)

The skills requirements for the construction phase of the project should be easily met from within the region's existing construction workforce. The skills needs for any expansion of Marine Industries at the Precinct are more specialised and less common in the region and will likely take a period of time to acquire / develop post 2018-19.

The existing and proposed new marine industry precinct are located near to the CBD of Townsville and is easily commutable for the majority of the region's labour force. There is no anticipated need for worker accommodation on site. The additional labour forced needs are expected to be mostly met from existing residents of the region however, if a portion of the workforce is temporarily required from elsewhere the temporary portion of the workforce will not be of material concern to Townsville's existing accommodation capacity.

2.6.3 Transport

Existing access to the Project site is via Benwell Road, South Townville. In 1996/97, a study into a new port access road/rail link from the eastern bank of Ross River was commissioned. This link, now known as the TPAR will require new road and rail links to be built over the mouth of Ross River (Figure 2-10).



LEGEND

- Stuart Bypass
- Eastern Access Corridor
- Builtup Area
- Road
- Water
- Foreshore Flat

1:50,000 (at A4)

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	A
Date	28 May 2009

Proposed Port Access Routes

Figure 2-10

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2 / 100 Goondoon Street Gladstone QLD 4680 Australia T 61 7 4972 6377 F 61 7 4972 6236 E gltmail@ghd.com.au W www.ghd.com.au

Data source: NRW (DCDB: road, water - February 2009); NAVTEQ (waterbodies - November 2008); GA (250k topo data: Builtup Area - 2006); GHD (Proposed Port Access - May 2009).

Created by: NDB

Both Boundary Street and Benwell Road form part of the 'Principal Road Freight Network' as defined in Townsville City Council's City Plan 2005. A future access route to the site will be via the Stuart Bypass and proposed Port Access Road. The proposed Port Access Road Corridor will provide a direct transport connection along part of Benwell Road and across Ross River to the State Development Area. No transport infrastructure currently exists on the Project site. Construction of the Stuart Bypass and Port Access Road commenced in August 2008. Further information regarding transport impacts and management measures are detailed further in Section 3.4.

2.6.4 Energy

Electrical energy supply infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. Ergon Energy is the local Distribution Network Service Provider (DNSP) for the area. There is an existing Ergon Energy 66kV/11kV zone substation located on Hubert Street, this substation has recently been upgraded from a 66kV switching only station to include 2 step down transformers to improve supply to the local area. 11kV underground cabling is located in the vicinity of the Project site feeding residential and commercial loads in the area. There is also a recently constructed Powerlink bulk supply substation located on Archer Street. It is likely that Precinct load will be supplied from these substations and negotiation of the supply of services to the Precinct will be required with the DNSP.

The likely electrical demand for the site is estimated as 840kVA based on 16800m² of light industrial facilities at approximately 50VA/m². Based on the present site layout it is anticipated that this would be serviced by a minimum of two separate distribution substations. This will however required further information during detailed design based on actual occupancy and intended use.

Release of some loading on the local electricity grid may occur as a result of industries re-locating from upstream sites into the Precinct facility.

The detailed design phase should also consider abilities to use renewable energy sources within the Precinct.

2.6.5 Water supply and storage

Water supply infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. Council records indicate a 300mm diameter AC water main in the Benwell Rd corridor. It is possible this main has sufficient capacity to service the development (expected to be in the order of an additional 12.8 L/s peak hour demand), however further information will be required to determine this, and liaison will be required with the service owner/operator.

2.6.6 Stormwater drainage

Stormwater infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development.

Council records indicate several stormwater flow paths through the proposed site, including a 1350 mm diameter RCP along Archer St, and a 1500 mm diameter RCP along Boundary St.

These flow paths will need to be preserved within the proposed layout. In addition to this, stormwater quality improvement will be required within the proposed layout, and possibly quantity reduction to prevent upstream and downstream impacts from flooding. This will have to be considered during the detailed design phase of the Precinct.

Due to evolving legislative changes to wastewater requirements in the Great Barrier Reef World Heritage Area, a sullage pump out facility may also be required. Requirements at the time of construction will need to be met.

2.6.7 Sewerage

Sewerage infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. Council records indicate a 150 mm diameter sewer main on the southern side of Boundary St. It is unlikely this main could service the development (expected to be in the order of an additional 4800 EPs). There are no other Council sewerage mains in the vicinity of the site, and as a result it appears a pump station and rising main will be required to convey the sewerage to the nearest Council gravity main, or alternatively an on site treatment plant will be required.

2.6.8 Telecommunications

Telecommunications infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. During detailed design consideration will need to be given to each occupants requirements and appropriate routing of supply of infrastructure from existing telecommunications infrastructure (such as optical cables, microwave towers, etc.). Consultation with the owners of that infrastructure will be required.

2.6.9 Waste management

Solid, inert waste from Precinct activities are expected, based on the Reference Design, to include waste metal, timber, packaging materials (including plastic pallet wrap), office waste and other general solid waste. The majority of solid inert waste from POTL is land-filled at TCC's municipal facility, although scrap metal associated with pile renewal is segregated for recycling. Waste transporters are contracted to remove this material.

There will be a need to manage the collection and containment of wastes derived from vessels berthed in the Precinct or moored in Ross River. Regulated wastes generated by port users include waste oils, old batteries, oily rags, tyres, chemical containers, obsolete light fittings and sewage sludges. Regulated wastes require special disposal arrangements due to their hazardous or toxic nature. The likely wastes generated from the Project and recommendations made for appropriate disposal are detailed further in Section 3.14.