# Infrastructure Victoria

## Second Container Port Advice

## Concept Options - Bay West and Hastings

May 2017

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# 1. Glossary

The abbreviations that are used throughout this report are indicated in Table 1 below.

**Table 1 Abbreviations used**

| Acronym / Term | Definition |
|---|---|
| Abutment | Structure at Landward termination of jetty. |
| ACRMG | Automated Cantilevered Rail Mounted Gantry Crane |
| AGV | Automated Guided Vehicle |
| Aids to Navigation | Markers with known charted positions located and designed to enable mariners to avoid dangers and/or fix their positions. |
| Anchorage | Area designated by the Authority for anchorage of vessels waiting for a berth or distressed or impaired vessels. |
| Approach Channel | A stretch of waterway linking the berths of a port and the open sea |
| ARTG | Automated Rubber Tyred Gantry |
| ASC | Automated Stacking Crane |
| AShC | Automated Shuttle Carrier |
| AutoStrad | Automated Straddle Carrier |
| Berth | Location(s) alongside of the Wharf where vessels berth and moor for loading, including berthing and mooring dolphins. |
| Berth Pocket | Dredged area along each side of the Wharf, with depth sufficient to accommodate fully laden vessels at Lowest Astronomical Tide |
| Berthing | The action of coming alongside and mooring the vessel to the wharf. Berthing Dolphin Supports fender and mooring line hooks. |
| Cardinal Marker | Marker that indicates the direction of the safest water. They indicate the safe side to pass a danger or a feature, such as a bend in channel or end of a shoal. |
| CAPEX | Capital Expenditure |
| Channel Marker | Marker used to show well established channels, indicating the port (left) and starboard (right) hand side of channels in accordance with IALA Maritime Buoyage System Region A (red to port), where the (fairway) direction of travel for reference is the one leading from the sea. |
| Container Exchange Rate | The average number of TEU movements onto and off a vessel as a ratio to the vessel's capacity in TEU. |
| Container Ratio | The number of TEU per container, reflective of the mix of twenty-foot and forty-foot containers. The Container Ratio is always a number between 1 and 2; 1 being a container mixture of solely twenty-foot units, and 2 being a container mixture of solely forty-foot units. |
| Crane Intensity | The total number of cranes applied to a particular vessel, divided by the vessel length. For example a 275m vessel being worked by 3 cranes has a crane intensity of 92m |
| CRMG | Cantilevered Rail Mounted Gantry |
| D%TAB | Delays as a percentage of time at berth |
| Delay as a % of Time at Berth | The Waiting Time at anchorage for inbound vessels as a percentage of total Time at Berth |
| Delays | Waiting time for both inbound and outbound vessels due to channels, swing basins or berths being occupied. Typically, vessels delayed by more than 4 hours will move to anchorage, however smaller delays can be handled through slow steaming. |
| DES | Discrete Event Simulation |
| Distribution Centre (DC) | A freight warehousing facility used for distribution into retail facilities or manufacturing centres. Full containers are destuffed at DCs into smaller consignments for distribution. |
| Ebb Tide | The falling tide |

| | |
|---|---|
| FCL | Full Container Load |
| Fleet Spectrum | The total number of projected vessels calling at a port each year, broken down into discrete vessel classes based on capacity. |
| Flood Tide | The incoming tide |
| Forecast Throughput | The projected volumes of any trade type expected to be transported through the various ports in a particular year. |
| GCR | Gross Crane Rate |
| GMBL | Guaranteed minimum breaking load of a mooring line. |
| GMPH | Gross container moves per hour |
| Gross Crane Rate (GCR) | The average number of cranes' moves per hour for a crane over a year taking into account downtime for maintenance. |
| Gross Tonnage (GT) | Formerly known as Gross Registered Tonnage (GRT) |
| HTE | Horizontal Transfer Equipment |
| IALA | International Association of Marine Aids to Navigation and Lighthouse Authorities. |
| ISA | Intermediate Stacking Area |
| LCL | Less than full Container Load |
| LPG | Liquefied Petroleum Gas |
| LOA | Length Over All |
| Lo-Lo | Lift On / Lift Off |
| Marker Buoy | A yellow marker with a cross, used to indicate a special area. |
| Maximum Design Draught | The maximum draught at which the vessel can safely sail with respect to classification rules and load line regulations. The draught is measured vertically from the lowest point on the hull to the water level when at the maximum permissible summer load line. This is sometimes referred to the scantling draught |
| Mooring Dolphin | A mooring point which supports mooring link hooks, no fender. |
| Navigation Leads | A pair of navigation marks used to indicate a safe passage for vessels entering a shallow or dangerous channel. Leads are separated in distance and elevation, so that when lined up vertically with one behind the other, they provide bearing. |
| Net Crane Rate (NCR) | The average number of container lifts per hour for a crane whilst it is working. |
| Non-working Time at Berth | The time when a vessel is at berth but no containers are being exchanged i.e. cranes are not working the vessel. This time includes time for fixing and releasing lines, lashing and unlashing containers, opening hatches and any other delays due to stevedore working practices such as changing crew work shifts. Unless specified otherwise, the value used in this report is the average for all vessels throughout each year. |
| OD | Origin / Destination |
| OPEX | Operational and maintenance costs |
| Passing Separation | Distance between two passing vessels. Measured as side to side, not centreline to centreline. |
| Pbm | Per berth metre |
| Peaking factor | The ratio of the maximum monthly throughput for the port to the 12-monthly average throughput for the relevant year |
| PIANC | PIANC is the World Association for Waterborne Transport Infrastructure (Permanent International Association of Navigation Congresses) |
| PICI | Port Interface Cost Index |
| PM | Prime mover |
| Port Marker | A red square marker indicating the port (left) hand side of the channel. When travelling upstream (or entering a harbour), leave port hand marks on the port side. When travelling downstream (or when leaving harbour), leave port hand marks on the starboard side. |

| | |
|---|---|
| Port planning factor | A reduction factor applied to the Theoretical Capacity to provide a capacity buffer which facilitates a competitive environment between the stevedores |
| QC | Quay Crane |
| Quad-lift | A quayside crane capable of lifting four TEUs (four twenty-foot or two forty-foot containers) simultaneously. |
| Quay Occupancy | The ratio of the average cumulative length of vessels alongside at any one time to the total quay length. |
| RMG | Rail Mounted Gantry Crane |
| Ro-Ro | Roll On /Roll Off |
| RTG | Rubber Tyred Gantry Crane |
| Sailing Draught | The draught of the vessel at arrival or departure from a port when it is at rest. Typically, this is measured at the bow, amidships and stern prior to departure to confirm that it can leave the port and enter the next port safely. This is sometimes referred to as the running draught |
| SC | Straddle Carrier |
| Sector Light | An aid to navigation that indicates safe channel through shallow or dangerous waters. There are usually three lights of different colours identifying a sector of an arc. The white centre sector indicates the safe water, and the red and green sectors either side indicate areas to avoid. |
| Ship Gangway | Gangway for personnel access to the moored vessel. |
| Starboard Marker | A green triangle marker indicating the starboard (right) hand side of the channel. When travelling upstream (or entering a harbour), leave starboard hand marks on the starboard side. When travelling downstream (or when leaving harbour), leave starboard hand marks on the port side. |
| STSC | Ship to Shore Crane |
| Swing basin | Designated area for turning vessels prior to/after berthing/unberthing |
| TEU | Twenty-Foot Equivalent Unit |
| Theoretical Capacity | The maximum throughput (in TEU) that can be handled by the facility before the key performance benchmark(s) is breached |
| Throughput | The number of containers (in TEU) passing through the terminal in a particular year |
| Time at Berth (TAB) | The total time between first lines on and last lines off for each vessel. Time at berth generally includes time for fixing mooring lines, transferring cargo, opening and closing hatches and administrative tasks. |
| TOS | Terminal Operating System |
| Transhipment | The use of a central aggregation/disaggregation point for the shipment of containers within a broader region. |
| TTT | Truck turnaround time |
| Twin-lift | A quayside crane capable of lifting two twenty-foot containers simultaneously |
| ULP | Unleaded Petrol |
| Unberthing | The action of removing the vessel from the wharf in preparation to depart. |
| Unitized Cellular Container ship | A type of specialised container ship |
| VBS | Vehicle Booking System used to schedule trucks at a container terminal). Similar to the TAS system which is used by Hutchison Ports Australia |
| Vessel Class | A grouping of vessels based on their TEU capacity. |
| Vessel Working Time | The time taken per vessel to unload and load all of the containers to be exchanged, i.e. the time when cranes are actively working the vessel. |

| | |
|---|---|
| Waiting Time (at anchorage) | The time elapsed whilst vessels are held at anchorage due to insufficient berth length being available to enable them to dock, or channel unavailability. |
| WCCUs | Wheeled Cargo Carrying Units |
| WT/ST | Waiting Time to Service Time ratio |
| WTST% | Wait Time to Service Time Percentage |

# 2. Introduction

## 2.1 Background

The Victorian Special Minister of State has asked Infrastructure Victoria (IV) to provide advice on the future capacity of Victoria's ports, focusing on the need for, timing and location of a second container port.

Currently all container shipping into Victoria is through the Port of Melbourne, which is Australia's largest container port. The Infrastructure Victoria Study is preparing advice on the ultimate capacity of the Port of Melbourne, when the port will reach capacity and when a second container port will be required.

The Special Minister of State has also asked Infrastructure Victoria to assess two possible sites for the second container port, one at Hastings in Western Port and one at Bay West in Port Phillip.

GHD have been appointed by Infrastructure Victoria (IV) to assist with the preparation of this Ports Advice for the Victorian Government, being engaged to provide advice on **engineering, dredging and reclamation** feasibility for two development sites in Victoria and prepare cost estimates.

This report should be read in conjunction with similar other study package reports prepared for Infrastructure Victoria covering:

- Environment and Social assessment of proposed Port development (GHD)
- Navigation and Hydrodynamics studies associated with the proposed port development (Cardno & AECOM)
- Commercial and Transport Modelling (Deloitte & Jacobs)

## 2.2 Purpose of this report

This report will provide input to the location (where) section of the advice.

The assessment of the port location options will be done through multi-criteria assessment (MCA). This report will provide information for consideration against a number of the criteria adopted in the MCA.

This report provides a description of each ‘representative’ port development concept at the site locations ‘Bay West’ and ‘Hastings’.

## 2.3 Report structure

This report is structured as follows:

**Section 3** – summarises the method and activity steps that have been undertaken as part of the ***engineering, dredging and reclamation*** part the study leading up to the multi-criteria options assessment.

**Section 4** – This section provides some background and context for this study, considering the future container freight task, previous studies undertaken to date and data / information used.

**Section 5** - This section summarises the requirements for port infrastructure as well as the key design parameters, information and assumptions that have been considered to conceptually plan the port infrastructure components at each location. This section provides the basis to the size of the future port solution being considered.

**Section 6** – This section summarises the findings of the review of opportunities, constraints and future land uses around Port Phillip to identify a site location and terminal configuration for representation of the 'Bay West' option.

**Section 7 -** This section summarises the conceptual arrangement of the **Bay West option** arising from the technical study. This addresses dredge construction methods, the channel concept design, wharf structure options, land transport infrastructure needs and proposed phasing of the development.

**Section 8 -** This section summarises the conceptual arrangement of the **Hastings option** arising from the technical study. This addresses dredge construction methods, the channel concept design, wharf structure options, land transport infrastructure needs and proposed phasing of the development.

**Section 9** – This section compares the two options, considering the estimated cost, challenges and performance.

## 2.4 Study scope and limitations

This report will provide input to the location (where) section of the advice. The study on the timing of the second container port is presented in another document prepared by GHD titled "Estimated Capacity of the Port of Melbourne".

The assessment of the port location options will be done through multi-criteria assessment (MCA). This report will be used to provide information for the MCA, including:

- Capital cost estimates
- How each option can or will be developed, to reflect staging needs
- The ability to accept foreseeable ship fleet sizes
- Its fit with future road and rail networks
- How the site development footprint fits with future land use understanding
- Construction methodologies and timing

In undertaking this task, Infrastructure Victoria and GHD have reviewed work that was completed as part of the Port of Hastings development project before it was cancelled in 2014. This document references some of the initial work undertaken for the proposed port development at Hastings. Infrastructure Victoria considers that much of the previous Hastings work, although preliminary in nature, is relevant and suitable for informing a strategic assessment. Therefore, Infrastructure Victoria has requested that preliminary and draft reports previously commissioned for the Hastings development project be reissued to form part of the evidence base on which Infrastructure Victoria will use in providing the Minister with advice.

The opinions, conclusions and any recommendations in this document are based on conditions encountered and information reviewed at the date of preparation of the document and for the purposes of the Port of Hastings Development Project.

### 2.4.1 Site envelope

For both sites, the concept design envelope is assumed to span from the deep water (Bass Strait) to existing (or planned) transport linkages with road and rail networks, including channels, berths, quay, terminal and transport corridors.

The extents applicable to both Bay West and Hastings are summarised in Section 4.3 and respectively addressed further in Section 6.3 and Section 0.

### 2.4.2 Location and configuration

For the purposes of option comparison, this study proposes a 'representative option' at each site location that promotes a 'land backed' terminal configuration together with a defined location for key infrastructure components. 'Land backed' representing an arrangement where containers are stacked on land close to the berth face. Such an arrangement may actually be detached from shore, being built as an island. Alternative forms are defined in Table 7 in Section 5.7

The option configuration and location at each site is intended to be 'conceptual' and should not be considered as final in any way. It is recognised that alternative options and solutions exist at both locations.

For each site, the study has highlighted a number of variants that could be considered and has sought to identify the key areas of consideration.

Further detailed study will be required to confirm any final option, configuration and location.

### 2.4.3 Development staging & ultimate capacity

The study considers a future 9M TEU capacity container terminal, and has considered its development across three phases aligning to capacity milestones of 3M, 6M and 9M TEU per annum.

### 2.4.4 Engineering design & land use

This engineering is developed to a conceptual level using existing data and relevant previous study findings to help define:

i. A concept for the navigation channel, turning basin and berth pockets. The concept does not include design proposals for any Aids to Navigation, although a cost provision is included.

ii. The general arrangement and features of an optimum wharf structure type at each location for the purposes of defining comparable cost estimates and work methods;

iii. The number and arrangement of engineering structures that are required at each site location to ensure transport network connectivity, mitigate flood risks and minimise impacts on identified utility and service networks. This has considered bridge connections, culverts and service crossing.

iv. The envisaged scope of earthworks and dredging activities.

v. Key risks and challenges associated with such port development at each location.

The study has considered future land use, which has included:

- A planning scheme screening check to consider potential land access constraints on transport corridors for each site, together with the identification of measures that could be contemplated to preserve options for future development, e.g. protection of land through planning scheme amendments.
- Compatibility with surrounding land uses, to consider current and future land use needs and any potential impacts that port development may have.
- Availability of land for port-centric warehouse and freight logistics precincts.
- The envisaged fit of future port development with existing (and planned) rail transport networks, and the impact on productivity and accessibility of transport networks.
- The identification of any complimentary infrastructure required remote from the port site to facilitate the envisaged volume of container throughput at each site.

A high level review of complimentary transport infrastructure required as a consequence of the port operation has also been undertaken. This considers additional road and rail network upgrades that isn't contemplated in current network planning but is critical for the operation of the port at each location.

In this regard, the assumptions set out in Table 2 have been adopted.

**Table 2 Transport infrastructure assumed to be in place**

| Transport Mode | Assumed to be in place | Not recognised and required |
|---|---|---|
| Road linkages | Outer Metropolitan Ring Road (OMRR)<br>Northeast link & Western Distributor<br>Western Port Hwy North (Freeway status) | Western Port Freeway (duplicated highway) south of Cranbourne-Frankston Rd |
| Rail linkages | Elevated rail + new stations on the Dandenong line<br>Western Interstate Freight Terminal (WIFT)<br>MIS system on existing rail infrastructure | Regional Rail East (RRE) or other solutions to provide necessary rail capacity on the Dandenong corridor<br>Standard Gauge rail linkage to Hastings from Lyndhurst |

### 2.4.5 Services & utilities

The study has not incorporated any detailed planning or assessment relating to the adequacy of future utility and services supply at Bay West. Data obtained for Bay West has been limited to a single engagement meeting with Melbourne Water who own and operate the site. Details of the infrastructure are described further in Section 5.14

Estimates of services and utility demand for the new port have been adopted from the study work undertaken for PoHDA at Hastings in 2014/15.

### 2.4.6 Dredging and reclamation

Development at both sites contemplates dredging and reclamation. This study has considered these activities to identify:

- Potential dredging volume(s) and material types;
- Potential land reclamation volume(s) and sources of material;
- Suitable ground improvement options;
- Spoil disposal strategies and estimated volume;
- Feasible dredging methodologies; and
- Estimates of cost and works duration.

The dredging volumes have been derived from the navigational infrastructure planning and engineering review of the geotechnical conditions at each site.

### 2.4.7 Cost estimates

This document presents cost estimations for the Bay West and Hastings container port options to reflect the engineering concepts with a similar sequence of staged development to reflect a consistent level of accuracy to facilitate an even-handed assessment of the options.

The capital cost estimates include an estimate of CAPEX for the provision of each stage as well as OPEX measure per container for each stage. The estimates are intended to reflect an accuracy of +60 / -40% in line with Victoria's Stage 1 high value high risk (HVHR) framework.

The achievement of this accuracy is impacted by the adequacy of information. Where this is deemed insufficient, this is noted and risk-adjustments have been incorporated.

The Cost Estimate has only been prepared for the purpose of comparing options at the two sites and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only, based on concepts and assumptions. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and should be expected to change. GHD does not represent, warrant or guarantee that the proposed development at either site can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate.

#### 2.4.8 Limitations and validation

This report has been prepared by GHD for Infrastructure Victoria and may only be used and relied on by Infrastructure Victoria for the purpose agreed between GHD and Infrastructure Victoria as set out in Section 2.2 of this report.

GHD otherwise disclaims responsibility to any person other than Infrastructure Victoria arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the limitations set out in the report and other referenced documentation.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report or as otherwise agreed with Infrastructure Victoria. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Infrastructure Victoria and others who provided information to GHD (including some other Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the preliminary cost estimate set out in Section 90 of this report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD. The supporting basis for the Cost Estimate is set out in Section 9.5.

# 3. Methodology

## 3.1 Overview

The ‘Ports Advice’ study is being completed in stages, as represented in Figure 1. This report documents the findings of the ‘Options Definition’, ‘Engineering’ and ‘Comparison’ stages associated with the **engineering, dredging and reclamation** scope of work. These findings, together with the outcomes of other study work and community feedback, will be used in the site options Multi-Criteria Assessment (MCA).

The following sections describe each part of this process.

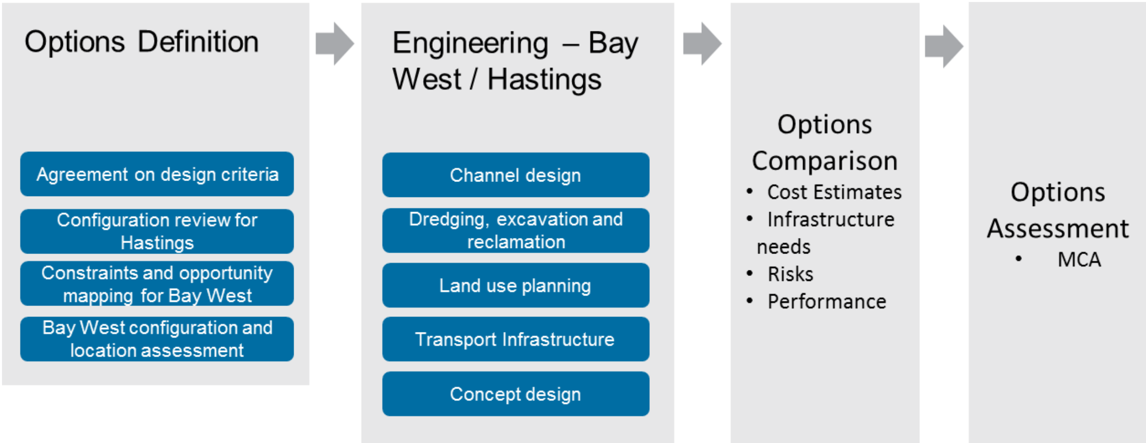



**Figure 1 Study workflow**

## 3.2 Activity step 1 - option(s) definition

### 3.2.1 Objective

The objective of this stage was to define and agree the key parameters and criteria for the study and to agree on a ‘representative’ option for each site, by defining its configuration and location.

### 3.2.2 Agreement on design criteria

Design criteria for the study were identified through:

- A review of relevant information from the recently completed studies for the Port of Hastings Development Authority (PoHDA) to define functional requirements and critical design criteria for adoption in the planning / conceptual engineering.
- The interpretation of supplementary geophysical investigation that was undertaken for the Bay west site.
- The review of other publicly available data relevant to the planning of the port at Hastings (Western Port) and Bay West (Port Phillip). This includes tidal data, met-ocean data, published port operational information and bathymetric survey data available to GHD.

Pertinent data is contained within Section 5.

### 3.2.3 Hastings option configuration review

The ‘Representative’ option for Hastings was defined through review of previous development concepts undertaken on behalf of PoHDA in 2014/15 and from discussion with Infrastructure Victoria. This evaluated the merits of a ‘dig-out’ option vs an ‘along the shore’ option. This is discussed further in Section 8.2.

### 3.2.4 Opportunities and constraints mapping for Bay West

The opportunities and constraints mapping exercise for Bay West involved:

- The production of a series of constraints & opportunity maps using publicly available spatial data, specialist inputs and through the review of data provided by Melbourne Water. These maps are presented in the Environmental & Social Report.
- In collaboration with other consultants, a comprehensive constraints & opportunity mapping exercise for the Bay West site to address:
  - Capital and maintenance dredging learnings, EMPs, DMG capacities and dredge management philosophy in Port Phillip.
  - Reclamation material supply options – including tunnelling projects, maintenance dredging, dredged material (beneficially used), quarried material.
  - Terminal siting factors around the WTP site to consider social, environmental, heritage and technical values / characteristics including land ownership and use.
  - Other capacity factors – including transport, services and utility infrastructure – specifically future plans
  - Geotechnical knowledge and understanding
  - Relevant Environmental, Social and Cultural values – noting that these are being reported separately (by others).

### 3.2.5 Terminal configuration and location assessment (Bay West)

This task was focussed on Bay West, to identify the arrangement of the 'representative' option for comparison against the Hastings alternative. This task involved:

- The definition of the principal functional needs for each of the capacity milestones using most recent data from PoHDA sources, i.e. to define the optimal terminal footprint for each capacity milestone linked to the throughput forecasts. To understand at high level, the expected requirements for terminal length, depth, width and alongside dredged depth.
- The review of geotechnical data to determine key risks & opportunities related to dredging, land reclamation and wharf construction. A particular focus was applied to determine the estimated extent of Basalt flows in the area.
- The development of a set of feasible port / terminal configurations and potential port development locations to satisfy the capacity needs but also reflect physical site attributes.
- A mini 'option location' assessment workshop to evaluate the port configurations at alternative locations. To comment on suitability with respect to proposed land use, environmental, social and cultural factors.
- The development of a dredge / reclaim optimisation tool to assist with the assessment and optimisation of proposed reclamation using potential dredge volumes. This considers material type, dredge methods and other factors.

## 3.3 Activity Step 2 - Engineering

### 3.3.1 Objective

This objective of this activity step has been to define feasible concepts for the key infrastructure components required at each site to enable cost estimates and the options comparison to be prepared.

For Hastings this task has generally been limited to the review of findings arising from the 2014/15 PoHDA studies. This is presented in Section 8.

For Bay West this has included engineering assessment of the following components with due regard to the physical attributes of Port Phillip and land along the northern shoreline between Pt Cook and Pt Lillias including the Western Treatment Plant site:

- Suitable wharf structure types - various structural forms were considered and appraised to shortlist a preferred option for costing. A shortlist was identified to outline technical advantages and disadvantages of options.
- Channel design requirements – to define the conceptual arrangement and derive estimates for dredge volumes against future vessel sizes.
- Dredging & reclamation strategies – to identify feasible methods for undertaking the dredging and reclamation works such that works durations and cost estimates can be prepared
- Land use fit – to consider the future land use designations.
- Transport & wider infrastructure needs – to consider the broad requirements for getting the port connected into the Victorian transport network and to contemplate how critical services and utilities can be incorporated.

#### 3.3.2 Channel design

At Hastings – the channel design has adopted the findings of the navigation studies completed in 2014/15. This study encompassed conceptual design (PIANC), Under Keel Clearance (UKC) analysis and vessel simulations.

For Bay West - the PIANC channel design guidelines have been adopted to prepare a conceptual channel layout, turning basin and berth pocket at the site location in the north of the Bay. The conceptual design is optimised to provide the required capacity and adequate service levels for safe navigation whilst ensuring that it minimises capital dredging and maintenance dredging costs. This has not involved any simulation work, although findings of studies undertaken as part of the Hastings port development Project have been referenced.

The review of the adequacy of existing channels in Port Phillip has been undertaken by AECOM under a separate work packages to IV. This has included navigational simulation of vessels transiting the Heads.

The concept design (as part of this report) has proposed dimensions for channel and turning basin width and depth and included recommendations for side slopes to minimise maintenance dredging.

The Bay West channel design has been completed for two design vessel sizes to reflect:

- A ‘constrained case’ – that adopted the largest ship found able to navigate the ‘Heads’ in their current arrangement (without modification, as per the Navigation work package); and
- An ‘unconstrained case’ – that adopted the envisaged future maximum size of vessel considered likely to visit Australia based on global trends.

The details of the vessel fleet under the two scenarios is provided in Section 5.5.

### 3.3.3 Dredging & reclamation

The channel design(s) for both sites were used to define dredge volumes. This includes provision for siltation, survey tolerance and over dredging. The terminal footprint requirements were used to define reclamation needs.

For each site, a range of feasible dredging and reclamation strategies have been investigated to identify suitable dredge methods, dredge material management techniques estimate production rates and unit costs. Preferable methods were identified through a preliminary assessment of their suitability with regard to overall cost, environmental impact, disposal volumes and approvals risk.

Further investigation was conducted on reclamation material supply options including other maintenance dredging (PoM), beneficially using dredged material and the use of quarried material.

Suitable ground improvement techniques and relevant cost and performance risk factors are identified.

### 3.3.4 Land use

Preliminary functional needs information from Hastings has been extracted to highlight potential complimentary infrastructure required remote from the port site (port precinct). Key issues relevant to future land use and development at each site location have been identified.

At Bay West, the study team engaged with Melbourne Water to gain an understanding of their future land use needs and completed a planning scheme check on surrounding land areas to identify suitable sites/zones for the location of such facilities. Key risks & opportunities that relate to the preservation of land use access and development are identified

### 3.3.5 Transport infrastructure

The 2014/15 development planning work at Hastings was reviewed to confirm latest thinking on preferred transport network development, capacity needs and attributable cost estimates for road and rail networks.

A functional needs statement has been prepared for road and rail operations, and at each site, critical linkages into existing road and rail networks have been identified to take account of options for future port precincts, future land use strategies, known industrial zones and future (planned) road and utility networks.

A high level capacity assessment has been completed for rail operations. This considers rail mode shares up to 20% to highlight future transport infrastructure needs to support port development.

### 3.3.6 Terminal operations

The planning has adopted the findings of the terminal systems studies that were completed as part of the PoHDA studies in 2014.

This assumes that an ASC based stacking system with Auto Shuttles would be employed at both locations. The terminal would be fitted with Super Post-Panamax cranes and have the same facilities for the exchange of containers to trucks and rail wagons. The features of these elements are described further in Section 5.7.

## 3.4 Activity Step 3 - Options comparison

### 3.4.1 Objective

To collate and prepare qualitative and quantitative material for use in the options multi-criteria assessment (MCA) which has been undertaken as a separate exercise.

### 3.4.2 Technical factors

The technical study has considered:

- Technical risks and challenges associated with each site
- The scope of development to satisfy the capacity milestone steps and consider what an ultimate development capacity might be.
- Opportunities to minimise environmental and social impacts
- Transport network capacity and the ability to connect road and rail to the port

### 3.4.3 Capital cost estimates

Capital cost estimates to +60% and -40% accuracy have been prepared for key infrastructure works. This has utilised like-for-like unit cost rates for the phased development at each location and to reflect site attributes. Capital cost estimates are summarised in Section 9.5.

### 3.4.4 Operational cost

A preferred terminal system is proposed to reflect each capacity milestone and OPEX factors were derived accordingly. This is discussed in Section 5.7.

## 3.5 Activity Step 4 – Options assessment (MCA)

### 3.5.1 Objective

To identify a preferred site for Victoria's Second Container Terminal.

### 3.5.2 Method

To adopt the findings of the associated technical and economic studies, together with community and business feedback, and conduct a multi-criteria assessment of the options for Hastings and Bay West.

The method, criteria and weightings and findings of the MCA are addressed separately under the commercial and economic work stream package.

The MCA is not documented in this report.

# 4. Context of the Study

## 4.1 General

This section provides some background and context for this study, considering:

- The future freight task
- Previous studies undertaken to date
- Data / information used

## 4.2 Freight task

The port facility being considered for Victoria's second container port is being planned on the basis that it will (at some stage) handle **9 million** international containers per year.

In planning the facility for 9 million TEU, it is recognised that the terminal may be developed in phases and function in parallel with container terminals located at the Port of Melbourne to satisfy demand. As such, the study has considered **three** throughput milestones of 3M, 6M and 9M TEU.

Whilst a focus has been applied to ultimate container capacity, it is recognised that the port will function and coexist with other port facilities in Victoria and around Port Phillip and may ultimately need to accommodate additional commodities over time.

The container forecasts through to 2066 are presented in the Commercial & economic work package reports. The cargo forecasts have been established by Deloitte as part of the overall study for Infrastructure Victoria.

## 4.3 State planning legislation and policy

### 4.3.1 Planning and Environment Act 1987

The *Planning and Environment Act 1987* provides the principle framework for land use and development control in Victoria. Planning schemes prepared under the provisions of this Act apply to each municipal area in Victoria. The provisions of these Planning Schemes apply land use and development controls within both study areas.

The Bay West study area is within the City of Greater Geelong and the City of Wyndham and adjoins the City of Hobsons Bay to the east. The Hastings study area is within the City of Casey and Shire of Mornington Peninsula, and adjoins the City of Frankston to the north.

### 4.3.2 Transport Integration Act 2010

The *Transport Integration Act 2010* outlines the vision for transport in Victoria, which is "*to have an integrated and sustainable transport system that contributes to an inclusive, prosperous and environmentally responsible state."* [s.6]. The Act requires decision makers to have regard to the promotion of inclusive, prosperous and environmentally responsible transport. It requires all Victorian transport agencies to work towards an integrated and sustainable transport system.

### 4.3.3 Plan Melbourne

Plan Melbourne 2014 – the Victorian Government's Metropolitan Planning Strategy – sets out a vision for Melbourne through to 2050. In the context of a more connected Melbourne, Plan Melbourne 2014 includes a direction to increase the capacity of ports, interstate rail terminals and airports and to improve landside transport access to these gateways.

The key initiative to support this direction in Plan Melbourne 2014 is to “ensure sufficient seaport capacity with efficient landside access” (Initiative 3.6.1). Plan Melbourne 2014 envisaged the development of the Port of Hastings to create needed capacity to supplement the increased container capacity at the Port of Melbourne. This included a commitment to investigate complementary upgrades to key rail and road links, including identification and protection of a transport corridor along the Western Port Highway for road and rail connections (in the short term), and progressive conversion of the Western Port Highway to freeway standard.

The Victorian Government is undertaking a ‘refresh’ of Plan Melbourne. The 2015 Plan Melbourne Refresh Discussion Paper recognised that progressing the development of Webb Dock and Swanson docks would provide more time to determine the best location for a second container port. This document acknowledged Infrastructure Victoria’s role in providing independent advice to government on the most appropriate site for a second container port, including locations at both Hastings and Bay West.

### 4.3.4 Victoria - The Freight State

*Victoria the Freight State (2013)* – the Victorian freight and logistics plan – sets out a long-term plan for managing the growing freight task. The key goal of the Plan is to maximise the contribution of the freight and logistics sector to Victoria’s productivity and liveability.

The Freight State supplements *Plan Melbourne* in terms of highlighting transport projects that would be complementary to the development of the Port of Hastings, which would improve road and rail infrastructure serving both the port and surrounding communities (as described in the above section).

The Plan also identifies a number of principles that are relevant to consideration of a second container port for Victoria:

- Maximising the efficiency of freight movements on the transport network
- Ensuring integration of freight and logistics activities with other land uses
- Minimising the impacts of freight and logistics activity on safety, amenity and the environment.

### 4.3.5 Green Wedge Management Plans

The non-urban areas of metropolitan Melbourne that lie outside the Urban Growth Boundary are known as Green Wedges. Councils responsible for the municipal areas containing these green wedges are required to prepare Green Wedge Management Plans to protect these rural areas and to contain the spread of development.

There are two green wedges intersecting with or in close proximity to the Bay West study area. The Western Plains South Green Wedge spans from the Western Freeway in the City of Melton to the north to the Princes Freeway in the City of Wyndham in the south, where it covers the area immediately to the east of Little River. The Green Wedge extents are defined in Figure 41A Green Wedge Management Plan has not yet been prepared for this area.

The Werribee South Green Wedge spans the City of Wyndham from Little River in the south to Altona Meadows in the north-east, within the City of Hobsons Bay. The western section of the green wedge extends south of the Princes Freeway to the coast, and includes Melbourne Water’s Western Treatment Plant. Wyndham City Council has developed a Green Wedge Management Plan for this area. The Green Wedge Management Plan refers back to Melbourne Water’s Land Use Strategy with regard to guiding principles for management of the Western Treatment Plant Precinct.

There are green wedges intersecting with or in close proximity to the Hastings study area. The Westernport Green Wedge adjoins the northern portion of the study area. It is largely within the Shire of Cardinia, with the southern coastal and rural parts within the City of Casey. Casey City Council and Cardinia Shire Council are jointly developing a Green Wedge Management Plan for this area.

The Mornington Peninsula Green Wedge is located within the Shire of Mornington Peninsula with a small portion extending into the City of Frankston. Mornington Peninsula Shire Council established an interim Green Wedge Management Plan in 2012. Key objectives of the Interim Mornington Peninsula Green Wedge Management Plan seek to:

- retain the green and rural character of the green wedge by minimising further subdivision and development
- promote and support farming and agricultural productivity in the green wedge
- protect and enhance biodiversity in the green wedge
- maintain the long term recreational value of the green wedge.

#### 4.3.6 State planning policy framework

The State Planning Policy Framework (SPPF) is contained in every planning scheme in Victoria and outlines the state-wide planning policies to be considered in relation to land use and development.

The following Clauses are considered relevant to the Project:

- **Clause 11 Settlement:** Planning is to anticipate and respond to the needs of existing and future communities through provision of zoned and serviced land for housing, employment, recreation and open space, commercial and community facilities and infrastructure.
- **Clause 12 Environmental and Landscape Values:** Planning should help to protect the health of ecological systems and the biodiversity they support (including ecosystems, habitats, species and genetic diversity) and conserve areas with identified environmental and landscape values.
- **Clause 13 Environmental Risks:** Planning should adopt a best practice environmental management and risk management approach which aims to avoid or minimise environmental degradation and hazards.
- **Clause 14 Natural Resource Management:** Planning is to assist in the conservation and wise use of natural resources including energy, water, land, stone and minerals to support both environmental quality and sustainable development.
- **Clause 15 Built Environment and Heritage:** Planning should ensure all new land use and development appropriately responds to its landscape, valued built form and cultural context, and protects places and sites with significant heritage, architectural, aesthetic, scientific and cultural value.
- **Clause 17 Economic Development:** Planning is to provide for a strong and innovative economy, where all sectors of the economy are critical to economic prosperity.
- **Clause 18 Transport:** Planning should ensure an integrated and sustainable transport system that provides access to social and economic opportunities, facilitates economic prosperity, contributes to environmental sustainability, coordinates reliable movements of people and goods, and is safe.

- **Clause 19 Infrastructure:** Growth and redevelopment of settlements should be planned in a manner that allows for the logical and efficient provision and maintenance of infrastructure, including the setting aside of land for the construction of future transport routes.

## 4.4 Site location(s)

This study focusses on two potential sites for Victoria's second container terminal – Bay West in Port Phillip and Hastings in Western Port.

## 4.5 Bay West site location

This study area for Bay West is located on the north-western section of coastline between Point Lillias and Point Cook in Port Phillip as shown in Figure 2. The study area includes land owned by Melbourne Water and private Market Gardens to the east of the Werribee River, as well as land around Pt Lillias and Avalon Airport.

The Melbourne Water land houses sewage treatment infrastructure that is recognised as the 'Western Treatment Plant' (WTP), while the 'Market Gardens' land to the east of the has some residential and leisure development but is primarily used for agricultural purposes.

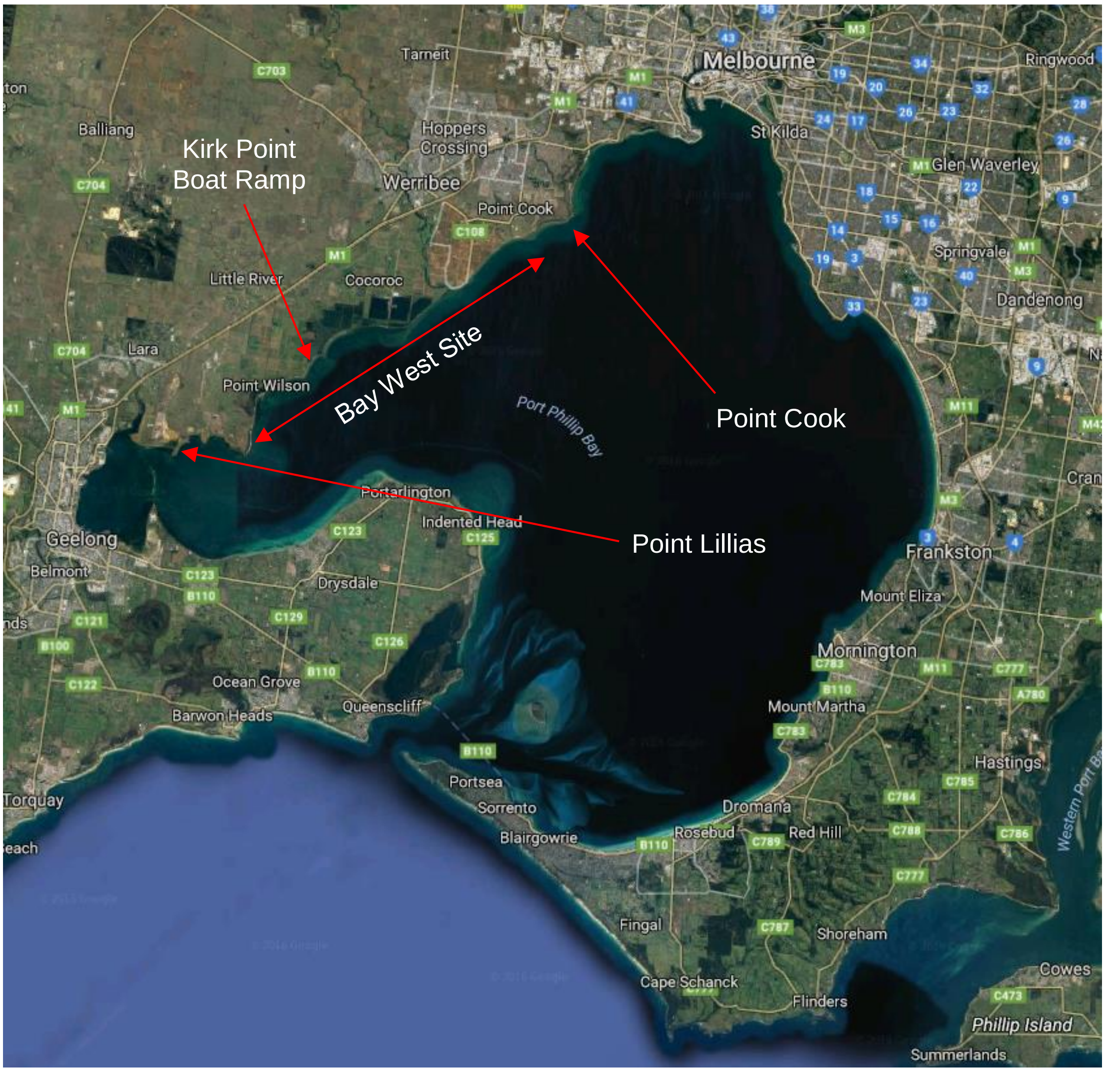



**Figure 2 Bay West location**

For the purposes of the conceptual planning and from a review of existing land use, it is assumed that existing residential and leisure zones, WTP assets (lagoons, buildings and infrastructure) and recognised high value wildlife areas are out of bounds from direct physical occupation. It is recognised that some land areas could be utilised to facilitate satisfactory transport connectivity and/or to address security and operational safety matters so long as they do not compromise the functionality and amenity of the existing areas.

### 4.5.1 Previous Bay West studies

A previous study was completed within the vicinity of this focus area in 2009 by Ernst & Young. Findings and observations are summarised below:

- The report concluded that good opportunity exists within western Port Phillip to develop a new container terminal. This being identified as a section of coastline and terrestrial land to the west of the existing WTP lagoons, and east of the Kirk Point boat ramp (Figure 2).
- The notable recommendation from the study was for the proposal of a 3000 m long detached wharf providing 8 berths. The terminal was sized by adopting a berth operating performance of 2,500 TEU per berth metre and terminal performance of 60,000 TEU/ha that was based on a non-automated RTG system;
- The study included an appraisal of future vessels and suggested a maximum design vessel of 9,100 TEU capacity and average vessel size of 6,500 TEU. The design vessel parameters were 340 m LOA, 43 m beam and 14.5 m draft.
- For navigation and dredge volume appraisal, a 1- way navigation channel of 220 m width, 16 m depth and 10 km length was proposed.

### 4.5.2 Relevant local planning policy and strategy documents

#### *Precinct structure plans*

The proposed road and rail corridors intersect with a number of Precinct Structure Plans (PSPs). PSPs are required to enable urban development on land included in the Urban Growth Zone (UGZ). The following PSPs would be intersected (from north to south):

- **Werribee Junction** (between the Princes Freeway and the Werribee railway line): Development of this PSP has not yet started; it would be led by the Victorian Planning Authority (VPA). The road and rail corridors would intersect with this PSP area
- **Mambourin East:** Development of this PSP has not yet started; it would be led by the VPA. The road and rail corridors would intersect with this PSP area, and it covers the area identified for potential port-related uses
- **Bayview:** Development of this PSP has not yet started; it would be led by the VPA. The road and rail corridors and potential future rail terminal would intersect with this PSP area
- **Black Forest Road North:** Development of this PSP has been completed by the VPA. The road and rail corridors and potential future rail terminal would intersect with this PSP area. The area provides for residential development, as well as a town centre with mixed use/commercial precincts, State and private schools, parkland and sporting facilities
- **Manor Lakes**: Development of this PSP has been completed by the VPA. The road and rail corridors and potential future rail terminal would intersect with this PSP area. The area is largely earmarked for residential development, with open spaces, State schools and community facilities
- **Quandong:** Development of this PSP and is being led by Wyndham City Council. The road and rail corridors would intersect with this PSP area

### *East Werribee Employment Precinct*

The East Werribee Employment Precinct is located across the Werribee River and Werribee South agricultural precinct, and comprises approximately 775 hectares on the site of the former State Research Farm. The VPA has prepared a Precinct Structure Plan (PSP) for this area, which was approved in October 2013. The PSP provides for a variety of office, industry, and other business precincts, together with some pockets of residential land, as well as a full diamond freeway interchange at Sneydes Road, and other arterial road upgrades. The PSP sets out a new mix of uses not previously seen in the west of Melbourne, with a focus on employment. It may have an impact on the type of land use mix in the study area given its close proximity.

### *Melbourne Water Western Treatment Plant Future Land Use Plan*

Melbourne Water's Western Treatment Plant Future Land Use Plan is a guiding document that is compatible with statutory planning provisions for the WTP site (refer to section 6.4.2). It seeks to be compatible with broader regional plans and developments, and identifies areas that:

- are set aside for wastewater treatment and resource recovery, including the main treatment precinct, an increased treatment area north of 160 South Road that would cater for future growth, renewable energy and resource recovery, and an area for recycled water plant expansion adjacent to Farm Road
- are set aside for agricultural purposes
- hold environmental value, such as the Western Grasslands Reserve (to the north-west of land owned by Melbourne Water), Northern Grasslands (north of the Princes Freeway and west of the area reserved for the Outer Metropolitan Ring Road), Ryan's Swamp (east of Little River and south of the Princes Freeway) and The Spit Wildlife Reserve
- are important to and/or service the needs of the community, including the WTP visitor and education centre, Kirk Point boat ramp, Wyndham Harbour (east of the Werribee River), Cocoroc historical area, and the Werribee River tourism precinct
- could become community space in the future – such as the provision of a green corridor along the southern side of the Princes freeway that could include cycling/walking paths.

## 4.6 Hastings site location

The site being considered is located to the north-east of Hastings township north of the existing Long Island Point tanker jetty and across and beyond the BlueScope multipurpose cargo jetty. The port location sits at the northern end of the currently designated port waters. The location is concentrated within the northern SUZ1 areas shown in Figure 3.

The Port of Hastings is an operational commercial port serving international and domestic shipping movements that include import and export of crude oil, LPG, ULP, general cargo, project cargo, ship to ship transfer, pipe laying operations and the lay-up/repair of oil rigs/floating platforms.

### 4.6.1 Current port operations

The current port facilities do not handle containerised freight. The main operations are bulk liquids and gas. Historically the port has been used to import steel slab at BlueScope but this has been discontinued. The existing port infrastructure includes berths and land in three precincts – Long Island Point, Crib Point and Stony Point.

The shipping channels are currently owned and managed by the Victorian Regional Channels Authority, however these may be transferred to the Port of Hastings Development Authority in the future.

### 4.6.2 History of port use

Following the discovery of oil and gas in the Bass Straight in the 1960s, the Mobil/Esso/BHP facility development was built at Long Island Point to export crude oil and gas. In 1970 a jetty was built at Long Island Point with a maintained depth of -15.7 m in the berth pocket and 14.2 m in the turning area.

The area on which the jetty stands is Crown Land, leased to the Port of Hastings Development Authority

In 1971, BHP set up a plant to import slab steel, roll it into sheet and then coat it to form roof sheeting. To import the slab steel they built a Roll On Roll Off (Ro-Ro) jetty and they reclaimed an area of land inshore of the jetty using material excavated when levelling the plant site.

In 1974, a second berth was built at the north end of the Ro-Ro berth to handle general cargo. Both these berths have a maintained depth of -12 m in the berth pocket and the channel and turning area has a maintained depth of 9.1 m. As the natural water depths in the area are -5 m to -10 m, the volume of dredging was not large. Unusually, the water area under and around the jetty is owned by BlueScope, having demerged from BHP in 2002.

The dredged material from the BlueScope jetties was pumped onto the foreshore and forms the area known as the Old Tyabb Reclamation. The Old Tyabb Reclamation is Crown Land leased to a local farmer who uses it to grow hay. This reclamation is proposed to be incorporated within the Hastings development (potentially as a first stage of development) and will require ground improvement work to allow it to be used for container handling. This is discussed in Section 80

Figure 3 shows the site location. Figure 4 highlights the surrounding land uses.

### 4.6.3 Previous Hastings studies

Development planning at Hastings has been ongoing for many years. Studies contemplating container operations commenced in 2008 with the Port Land Use & Transport Strategy (PLUTS) and have developed over time to consider other Port Development Strategy tasks through 2012/13. The most recent Port Development Project (business case) work was ongoing from early 2014 but stopped in early 2015.

The most recent studies (since 2013) were provided to PoHDA as part of multi-disciplinary team commissions involving specialist technical and environmental studies. These have focussed on the continual development of engineering design concepts and understanding of key environmental and technical challenges to such a development in Western Port.

These studies form the basis of the infrastructure planning contemplated in this study.

### 4.6.4 Relevant local planning policy and strategy documents

#### *Mornington Peninsula Localised Planning Statement (2014)*

The *Mornington Peninsula Localised Planning Statement (2014)* requires the protection of important recreational, natural and tourism values, the physical separation of industrial (port related activities) and transport corridors from townships and residential areas by rural buffers and management of environmental and visual impacts associated with port development.

### *Port of Hastings Land Use and Transport Strategy 2009*

The *Port of Hastings Land Use and Transport Strategy* identifies the Long Island precinct as being the future centre of port development. This also defines the requirement for access to the port that avoids impacts on the Hastings urban area, such as the use of McKirdys Road; and the need to retain the entire Special Use Zone Schedule 1 area for port and related development and buffering and interface treatments with adjoining areas.

### *Other relevant studies*

Other relevant studies include the *Mornington Peninsula Access and Mobility Study (2007)* which supports the conversion of the Western Port Highway to a freeway to access the port and the *Frankston Integrated Transport Study* which supports the development of a rail corridor along the Western Port Highway.


**Figure 3 Hasting site location**

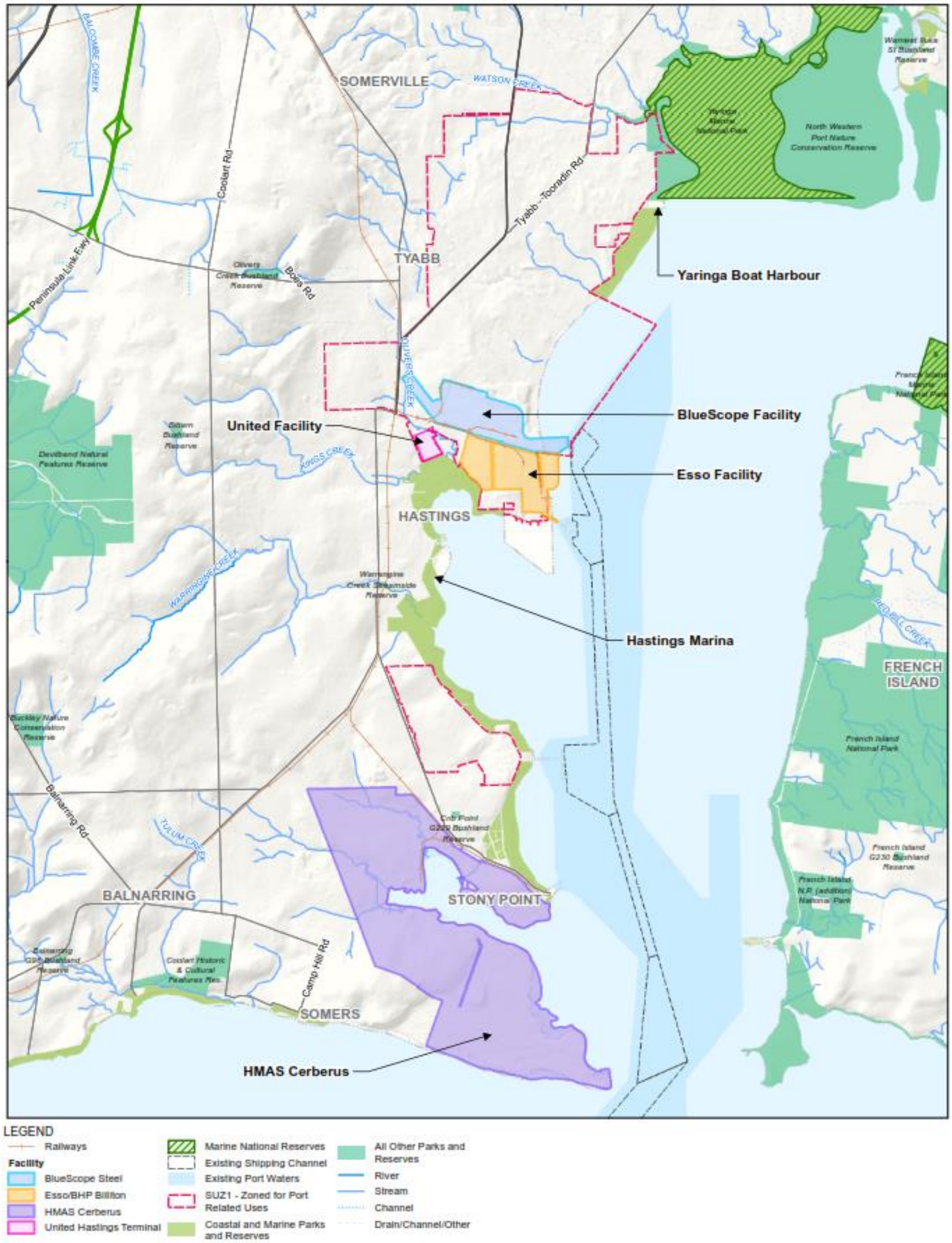



**Figure 4 Hastings surrounding land use**

# 5. Infrastructure Planning

## 5.1 Overview

This section summarises the requirements for port infrastructure as well as the key design parameters, information and assumptions that have been considered to conceptually plan the port infrastructure components at each location. For both locations it is assumed that the port will perform as an Origin-Destination (OD) type facility, as the current Port of Melbourne does.

An OD type port is characterised by the fact that the majority of trade is taken either in through the port for local consumption or out through the port as a consequence of local manufacture or production. An OD type port typically has a minority share of ‘transhipment’ cargo (transhipment cargo being cargo destined for another location but is transferred through that port, without passing beyond the port boundary).

The cargo trends through an OD port are important, as the characteristics for an OD type port are different to those of a transhipment hub. Typical differences include the share of containers that are exchanged on each call, the relative importance of the terminal ‘gate’ and the landside container transfer systems, the adequacy of the land transport connections and the ultimate land use efficiency.

## 5.2 Functionality

The planning and design is intended to:

- To produce a development that will be attractive to shipping lines and hence be of interest to stevedores. This requires a layout and an operating system that produces an efficient terminal at a commercially attractive cost. To provide flexibility for a range of possible terminal operating systems and different degrees of technology.
- Satisfy environmental, safety and operational criteria and minimise environmental impact. The study work has focused on dredging and reclamation techniques that minimise plume dispersion and damage outside the immediate construction site.
- Provide adequate landside road and rail ‘transport connectivity’ to meet projected demands
- To take account of the local seabed conditions and hydrodynamics so that the changes away from the immediate site are minimised.
- To select a terminal operating system that minimises noise, light spill, air emissions, energy consumption and the risk of surface water pollution while maximising safety.
- To design the terminal to take account of climate change.
- To design the terminal to give a design life of 100 years for the fixed structures and the optimum balance between capital expenditure and maintenance cost for the paving, services and other fittings.
- To design a terminal that is easy to construct within the limits of the site constraints and in particular minimises the import of materials by land to avoid impacting local communities.
- To maximise safety in design, construction and operation. Even the preliminary level of engineering undertaken so far can have a major effect on these issues.

## 5.3 Performance and scale

The future facility has been planned to provide 9 M TEU capacity and be able to satisfy future expansion needs to meet changes in demand and container handling trends.

A development comprising just over 4 km of quay line and 240 Ha of terminal is envisaged for 9 M TEU container operations. The basis for this footprint is described further in Section 5.7.

The concept of operation and future adaptability is expected to incorporate:

- Shipping channels sized to accommodate vessels up to 14,000 TEU capacity potentially to 18,000 TEU, perhaps being deepened in phases and/or over time to suit vessel spectrum trends. The selection of design vessels considered is presented in Section 0
- Quay structures that can accommodate future ship to shore gantry cranes sized to accommodate super post-panamax vessels, and ultimately be able to be deepened or dredged in steps up to the maximum design case;
- A terminal layout and configuration that is suitable to accommodate both semi-automated or fully automated systems for handling and sorting containers, with in built adaptability to allow improvement and refinement over time;
- Provision or opportunity to be able to provide customs, quarantine clearance facilities, warehousing and intermodal connection close to the port;
- An integrated intermodal zone facilitating the efficient transfer of containers to trucks and rail freight wagons allowing for automated or remote operations. Truck loading facilities should be able to accommodate HPFV size vehicle and rail infrastructure should be able to accommodate Metropolitan Shuttles (600 m trains).
- A rail marshaling facility to accept Regional and Interstate trains before breaking them up and shuttling them into the port.
- Access to high capacity transport corridors to and from the port.

## 5.4 Anticipated phasing

The port is expected to be developed in phases that will be aligned to either when the PoM reaches capacity and/or for other economic justification purposes.

Given the recent lease agreement that has transpired at the Port of Melbourne, the existing port is expected to be provide an ongoing contribution to Victoria's container capacity. Hence, two scenarios are recognized, as depicted in Figure 5 and Figure 6. These consider an 'early' and 'delayed' second port.

Figure 5 illustrates the 'delayed' scenario. This considers the ongoing use and development of the PoM up until it reaches its defined maximum capacity. This could be sometime into the future, potentially out to 50 years.

Figure 6 illustrates the 'early' scenario. This reflects the transition of some container capacity from PoM to a second container terminal at an earlier date. This scenario, for example, reflecting the closure or inability of Swanson Dock to undertake container operations.

In this regard, the initial phases of a 2$^{nd}$ port are expected to function in-conjunction with a component of the existing Port of Melbourne container operations for a number of years.

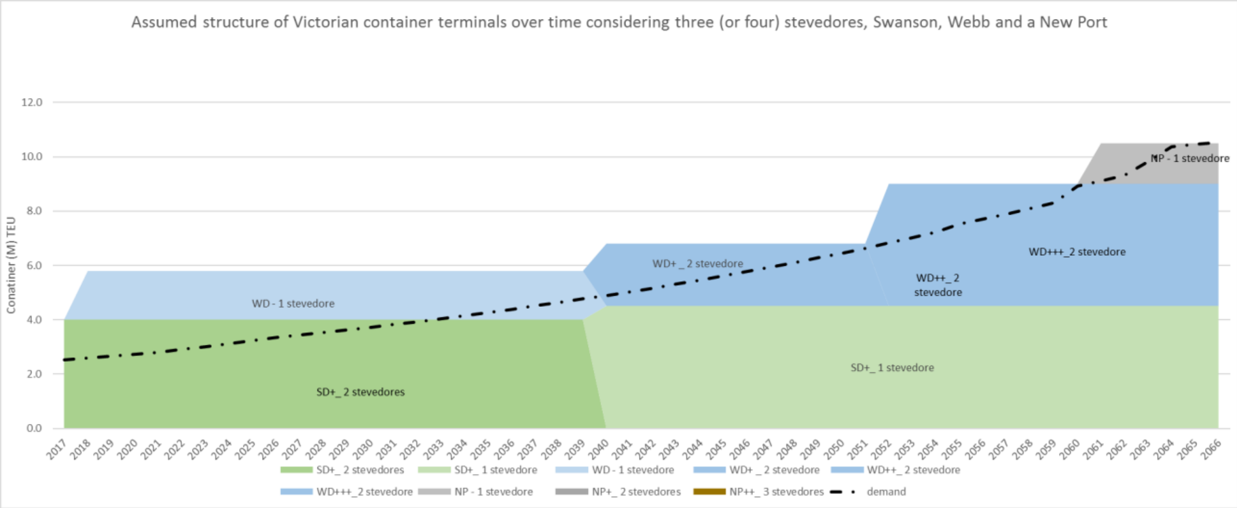



**Figure 5 Indicative scenario of the 'delayed' 2nd container terminal**

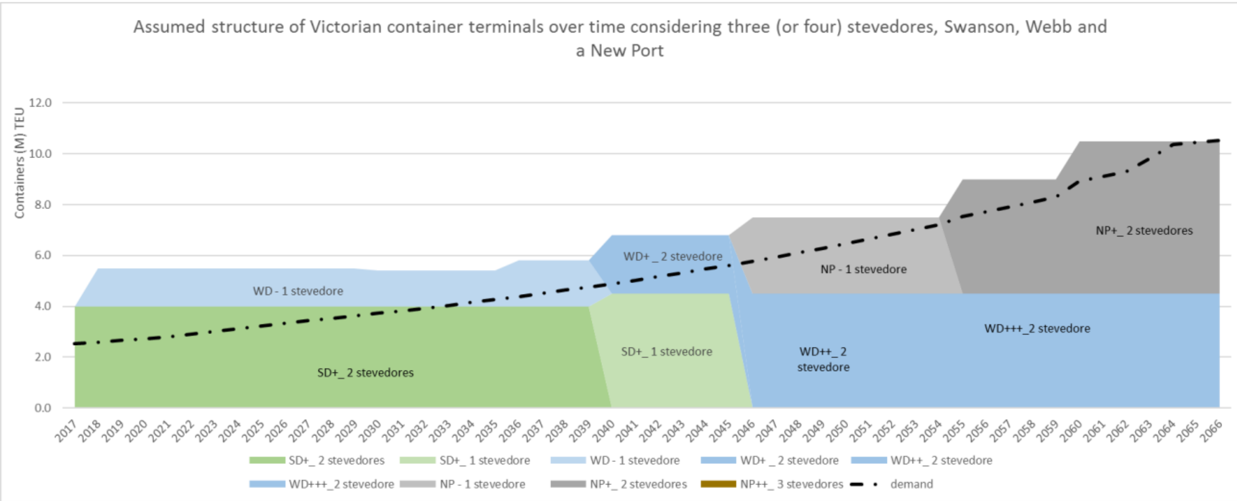



**Figure 6 Indicative scenario of an 'early' 2nd container terminal**

Note: NP = New Port; WD = Webb Dock; SD = Swanson Dock

## 5.5 Shipping characteristics for Melbourne

This section looks considers the possible future scenarios of container ship size development given forecast trade growth, potential shipping line consolidations, and the future development of the Port of Melbourne with constrained and unconstrained ship access.

The work looks at future fleet spectrum scenarios and how these define the design vessel for the future port. This information draws on study work that is presented in the document titled "Estimated Capacity of the Port of Melbourne" (GHD, 2017).

### 5.5.1 Introduction

Given economies of scale of larger ships, and with sufficient trade volumes, container ship sizes will tend to increase until an infrastructure constraint is reached, as is currently the case with the Port of Melbourne (Swanson Dock).

In the absence of the unlocking of the constraint, the response will be an increase in the shipping supply, and the addition of more shipping services that will result in more ship calls at a port.

Shipping line and market share consolidation tends to accelerate container ship size increases as more container volumes become available over and above underlying trade growth.

To estimate the range and timing of the possible future containership sizes serving Victoria, we have modelled several Fleet Spectrum Scenarios to highlight ship size development possibilities. Four scenarios are considered, which are presented in Table 3.

All scenarios reflect a 'constrained' and 'unconstrained' vessel scenario which is linked to the ship size that is able to Navigate the Great Ship Channel without the need to modify its arrangement through dredging (14,00 TEU vessel) and that the largest sip (18,000 TEU) which currently exists now. Different rates of ship size growth are then overlaid on the 'constrained' and 'unconstrained' vessel.

The key information for the port planning, is the confirmation that two maximum design vessel sizes are relevant and realistic, together with the estimate of ship calls. The timing and balance of trade considered through the existing PoM terminals is relevant to the Port of Melbourne capacity assessment task, which is addressed separately.

The features of fleet growth scenario (3) and (4) that are relevant are described further below.

**Table 3 Range of fleet spectrum scenarios used for ship size modelling**

| Fleet Spectrum Scenario | Containership Size Growth | Containership Port Access Constraints | Use of Swanson Dock Capacity | Use of Webb Dock Capacity |
|---|---|---|---|---|
| **1 – Less Rapid Ship Size Growth / Unconstrained Ship Access** | Organic Trade Growth Only (No Service Consolidations) | Unconstrained up to maximum 18,500 TEU ship size | Not applicable | Not applicable |
| **2 – Less Rapid Ship Size Growth/ Constrained Ship Access/ Equal Dock Capacity Use** | Organic Trade Growth Only (No Service Consolidations) | Constrained: (1) Swanson Dock max. 7,500 TEU ship size, (2) Webb Dock & Heads max. 14,000 TEU ship size | Full use of available capacity (i.e. Asia Services remain) with no Large Ship migration to Webb Dock | Equal use of available capacity to Swanson Dock |
| **3 – Rapid Ship Size Growth / Unconstrained Ship Access** | Organic Trade Growth Only + Capped Service Consolidations on Asia trades* | Unconstrained up to maximum 18,500 TEU ship size | Not applicable | Not applicable |
| **4 – Rapid Ship Size Growth / Constrained Ship Access / All Large Ships to Webb** | Organic Trade Growth Only + Capped Service Consolidations on Asia trades* | Constrained: (1) Swanson Dock max. 7,500 TEU ship size, (2) Webb Dock & Heads max. 14,000 TEU ship size | Only services with ships <7,500 TEU call at Swanson (i.e. smaller, non-Asia trades) resulting in redundant capacity | All services with ships >7,500 TEU call at Webb (i.e. Asia trade) and capacity increased to match demand |

(*) Assumed to be two services consolidated every five years on Australia / N&E Asia and Australia / SE Asia trades with capped resulting market share per service of around 33% for assumed regulatory competition approval, plus an assumed market service-level requirement on N&E Asia trade of minimum 6 services to cover long port range.

### 5.5.2 Container vessel fleet spectrum scenario 3 - unconstrained

The **average** size of international container ships that may possibly visit Victoria in the Fleet Spectrum Scenario 3 (unconstrained port / rapid ship size growth) is estimated to increase from a current 4,035 TEU to 9,200 TEU by 2036 and 14,529 TEU by 2066 (see Table 4).

The **maximum** size of international containerships to visit Victoria is estimated to increase from a current 5,779 TEU to 18,500 TEU by 2036 and continue at 18,500 TEU to 2066 driven by the Asian shipping routes (see Table 4 and Figure 7). The smallest international vessels are assumed to be deployed on the North America and Oceania (NZ/South Pacific) shipping routes.

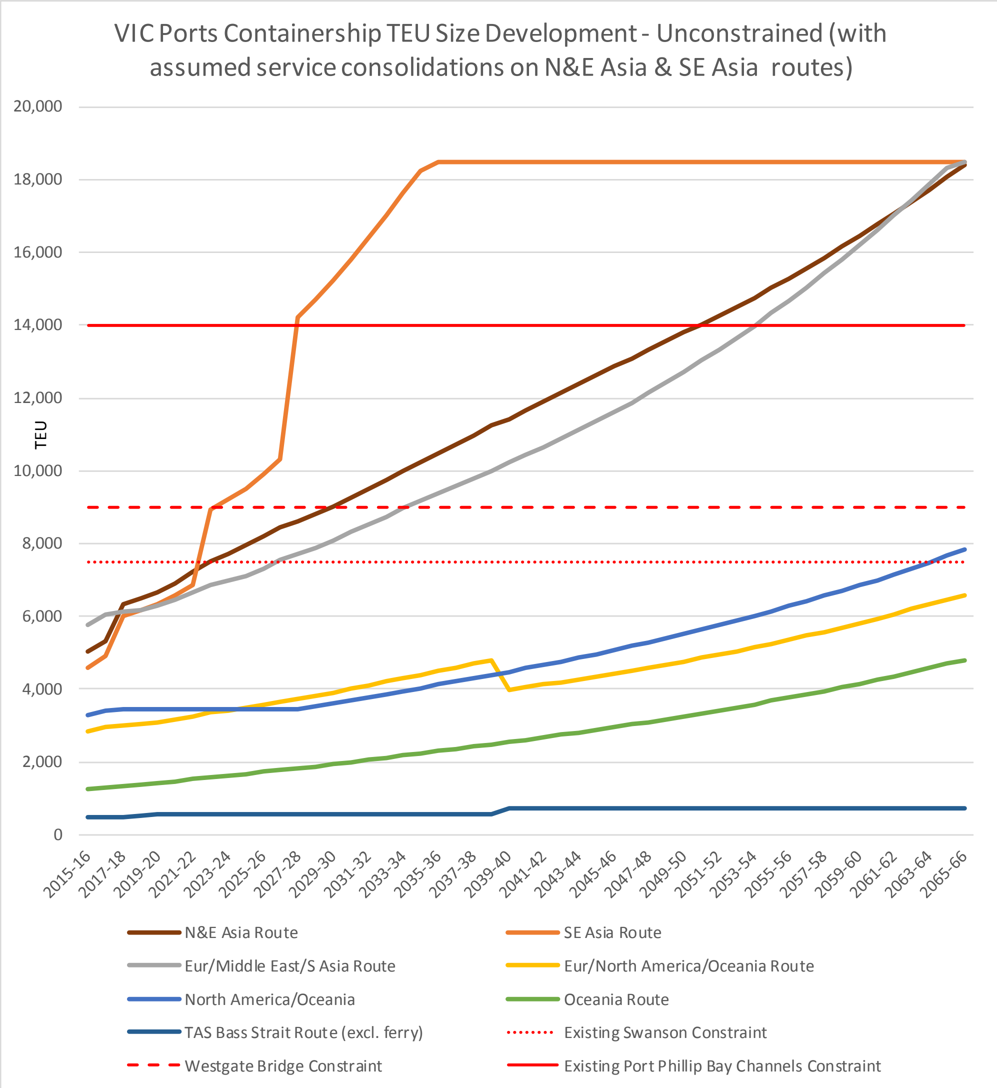



**Figure 7 Fleet spectrum scenario 3 - Containership size development by shipping route, Source: GHD analysis, 2016**

**Table 4 Fleet spectrum scenario 3 - Summary of potential future container ship sizes calling Victoria, 2016-2066, Source: GHD analysis, 2016**

| FY End | Unconstrained Average Ship TEU Size | Unconstrained Maximum Ship TEU Size |
|---|---|---|
| 2015-16 | 4,035 | 5,779 |
| 2020-21 | 5,122 | 6,912 |
| 2025-26 | 6,272 | 9,895 |
| 2030-31 | 7,605 | 15,826 |
| 2035-36 | 9,200 | 18,500 |
| 2040-41 | 9,650 | 18,500 |
| 2045-46 | 10,683 | 18,500 |
| 2050-51 | 11,325 | 18,500 |
| 2055-56 | 12,335 | 18,500 |
| 2060-61 | 13,360 | 18,500 |
| 2065-66 | 14,529 | 18,500 |

The Fleet Spectrum Scenario 3 with unconstrained ship access generates estimated total ship calls (incl. Bass Strait freight-only container ro-ro ships) of 1,755 as of 2016, 1,625 by 2036, and 1,912 by 2066 – see Figure 8 for breakdown of forecast ship calls by ship size classes.

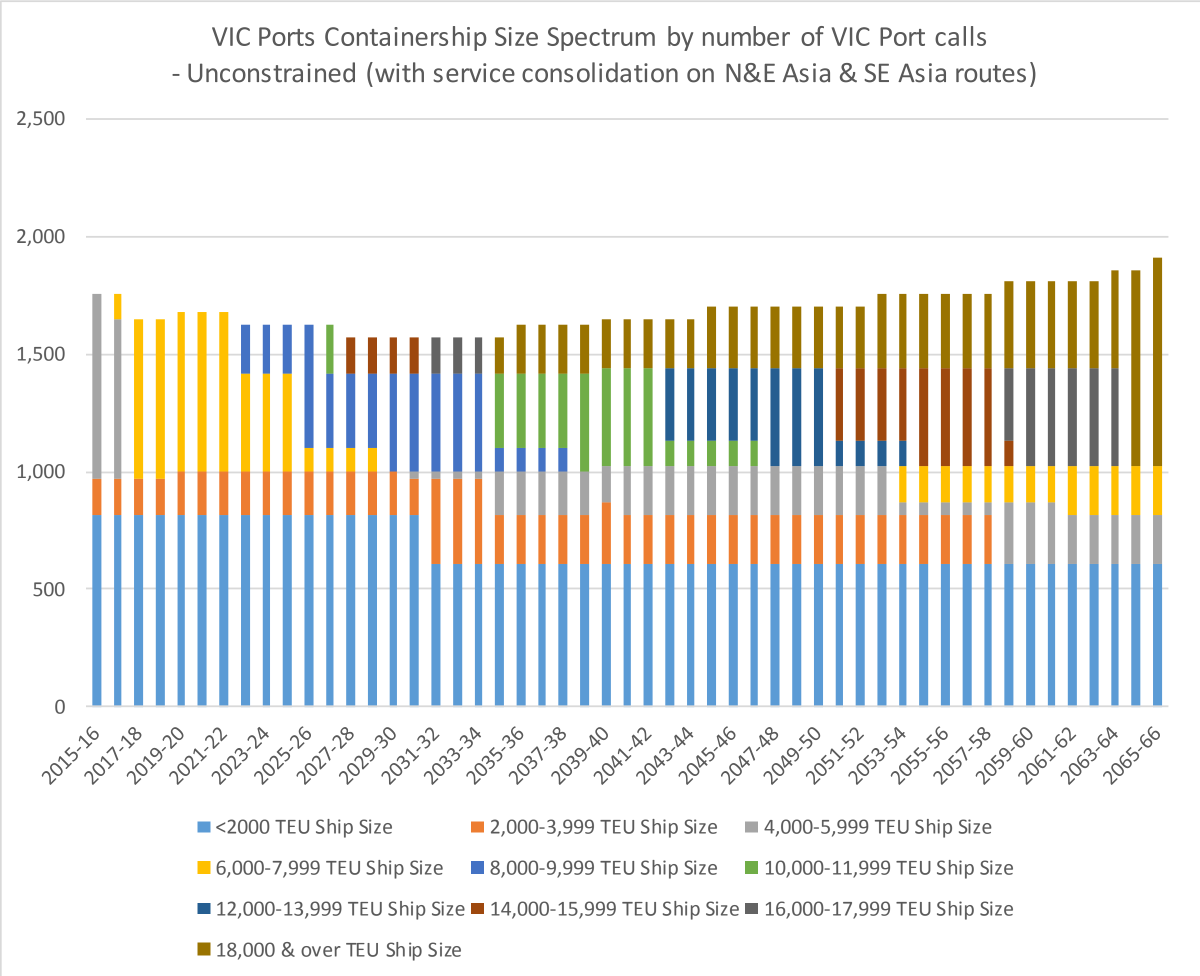



**Figure 8 Fleet scenario 3 – Containership calls by ship size classes, 2016-2066, Source: GHD analysis, 2016**

### 5.5.3 Container Fleet Spectrum Scenario 4 - constrained port access

The **average** size of international container ships that may possibly visit Victoria in the Fleet Spectrum Scenario 4 (constrained port access / rapid ship growth) is estimated to increase from a current 4,035 TEU to 8,556 TEU by 2036 and 11,838 TEU by 2066 (see Table 5).

The **maximum** size of international containerships is estimated to increase from a current 5,779 TEU to 14,000 TEU by 2036 and continue at 14,000 TEU to 2066 driven by the Asian shipping routes (see Table 5 and Figure 9).

The smaller international vessels are assumed to be deployed on the North America and Oceania (NZ/South Pacific) shipping routes.

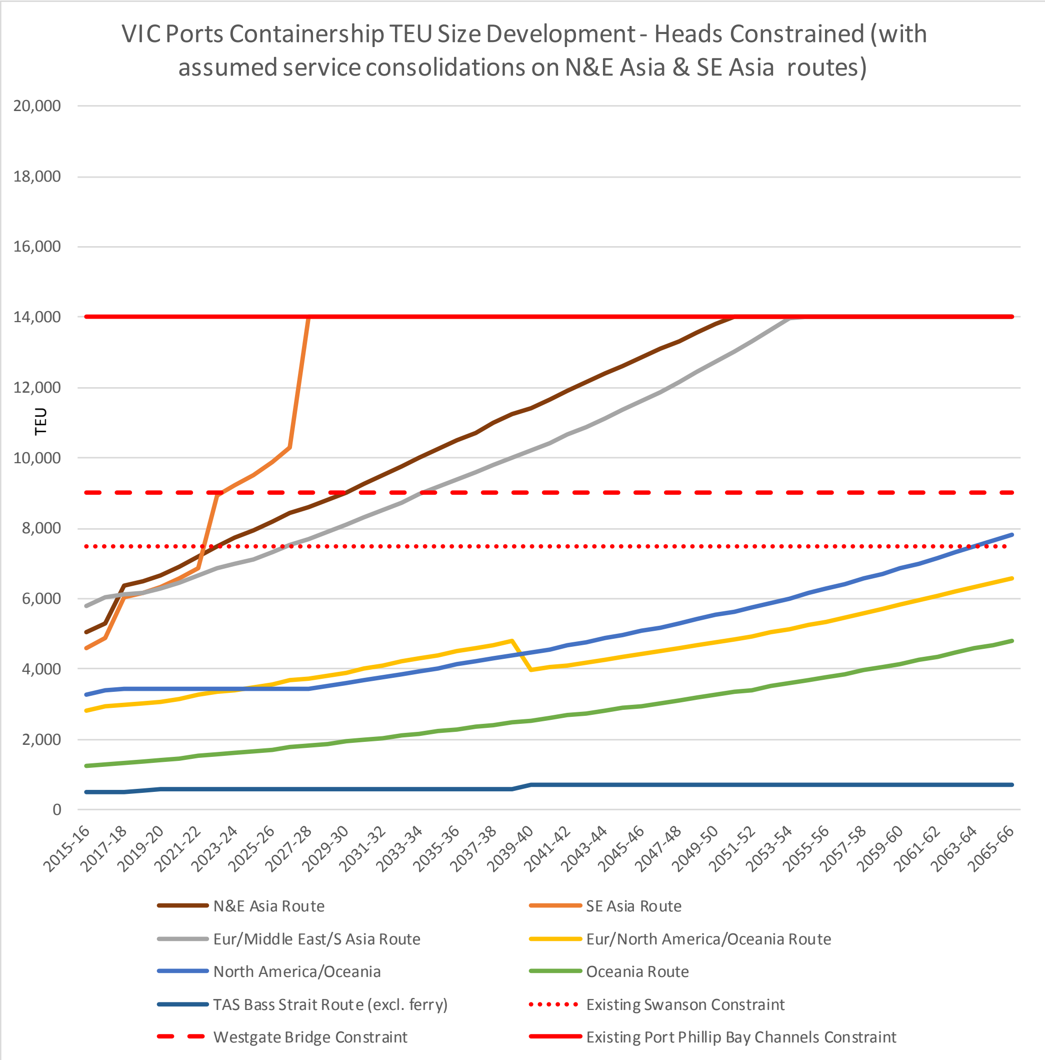



**Figure 9 Fleet spectrum scenario 4 - Containership size development by shipping route, Source: GHD analysis, 2016**

**Table 5 Fleet spectrum scenario 4 - Summary of potential future container ship sizes calling Victoria, 2016-2066, Source: GHD analysis, 2016.**

| FY End | Constrained Average Ship TEU Size | Constrained Maximum Ship TEU Size |
|---|---|---|
| 2015-16 | 4,035 | 5,779 |
| 2020-21 | 5,122 | 6,912 |
| 2025-26 | 6,272 | 9,895 |
| 2030-31 | 7,652 | 14,000 |
| 2035-36 | 8,556 | 14,000 |
| 2040-41 | 9,000 | 14,000 |
| 2045-46 | 9,811 | 14,000 |
| 2050-51 | 10,579 | 14,031 |
| 2055-56 | 11,201 | 14,000 |
| 2060-61 | 11,569 | 14,000 |
| 2065-66 | 11,838 | 14,000 |

The Fleet Spectrum Scenario 4 with constrained ship access generates estimated total ship calls (incl. Bass Strait freight-only container ro-ro ships) of 1,755 as of 2016, 1,677 by 2036, and 2,120 by 2066 – see Figure 10 for breakdown of forecast ship calls by ship size classes.

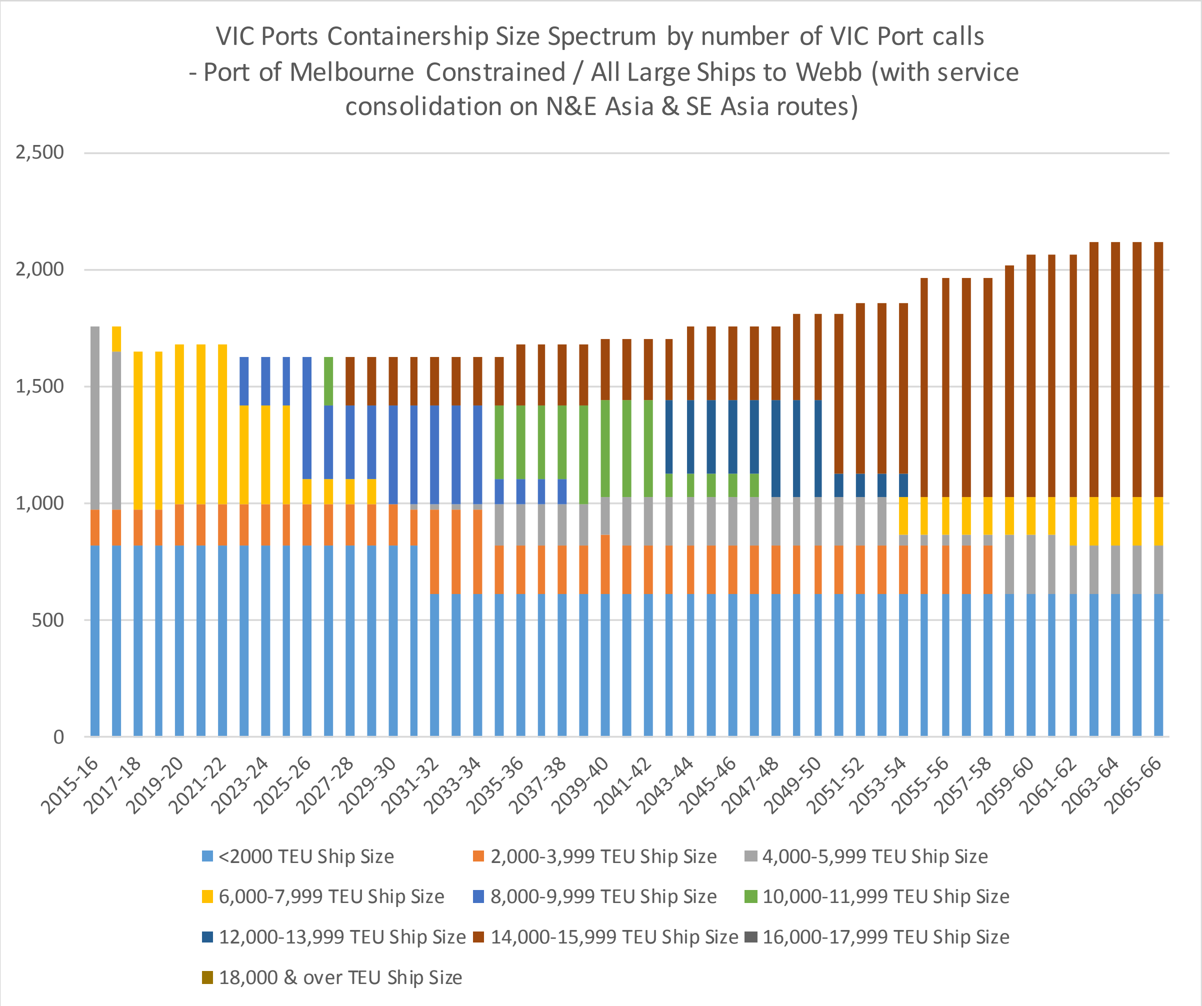



**Figure 10 Fleet Scenario 4 – Containership calls by ship size classes, 2016-2066, Source: GHD analysis, 2016**

### 5.5.4 Design container vessel characteristics

Table 6 highlights the characteristics of the design vessels that are recognized in the fleet spectrum studies. The highlighted rows identify where the ‘constrained’ and ‘unconstrained’ vessels sit in a size hierarchy, and represent the vessels that have been considered as part of the concept planning.

Preliminary feedback on the vessel simulation work undertaken by AECOM for IV indicates the ‘Large Post Panamax’ (14,000 TEU) vessel was able to navigate the Heads (Great Ship Channel) in its current arrangement (i.e. without widening or deepening of the current Great Ship Channel), while the Ultra Large Containership (ULC) could not, and widening of the channel would be required.

On these findings, the planning has adopted the ‘Large Post Panamax’ vessel (14,000 TEU vessel) as the ‘constrained’ maximum ship size. While the ULC (400m long,18,000 TEU) is considered as an ‘unconstrained’ maximum size.

The implications of both have been considered for the Hastings & Bay West options.

The ship draught adopted for each has been adjusted from its maximum, to account for the fact that a large percentage of the containers on ship leaving Victoria are empty or are not loaded to their maximum on arrival. An analysis of shipping records indicates that actual ship draughts in and out of Melbourne are typically around 85 – 90% of maximum draughts. Hence, a design draught of 14 m is proposed.

**Table 6 Vessel classifications recognised in the study**

| Vessel Classification | Nominal TEU Capacity | Typical dimensions | | | | Comparative Vessel Used in the Vessel Simulations |
|---|---|---|---|---|---|---|
| | | LOA (m) | beam (m) | max. draught (m) | sailing draught (m) | |
| Small / feeder | 100 - 2,999 | 222 | 30 | 11.5 | 10 | Current Vessels that visit the Port of Melbourne |
| Old Panamax | 3,000 - 4,999 | 294 | 32 | 13.5 | 11.5 | Current Vessels that visit the Port of Melbourne |
| Old Post Panamax | 5,000 - 7,499 | 300 | 43 | 14 | 12 | Current Vessels that visit the Port of Melbourne |
| Old Post Panamax Plus | 7,500 - 9,999 | 335 | 46 | 15 | 13 | Ital Cortesia (334m LOA, 42.8m beam) |
| Bosphorus-max (new) | 9,000 - 9,500 | 300 | 48 | 14.5 | 12.5 | |
| New Panamax | 10,000-12,999 | 366 | 48 | 15 | 13 | |
| New Post Panamax | 13,000-15,999 | 398 | 56 | 15.5 | 13.5 | MSC Daniela (366m LOA, 51.2m beam, 14,000 TEU), at the lower end of range |
| Ultra Large Containership (ULC) | 16,000 – 20,000 | 400 | 59 | 16 | 14 | Superium Maersk (398m LOA, 58.2m beam,18,500 TEU) |

### 5.5.5 Other vessels

Container vessels calling at the new port will need to navigate in existing channels that will alsobe used by other vessels transferring alternative cargo.

Whilst other vessels and cargo are expected to grow in volume over time, it is assumed, that the other vessels will not override or drive the anticipated design requirements of any shared infrastructure, and hence the requirements for the largest container vessels will govern for the planning and assessment of channel requirements and dredge volume estimates.

The capacity of the existing channels, considering all vessel movements have been undertaken by AECOM for Infrastructure Victoria.

## 5.6 Container flow characteristics for Melbourne

These findings are presented in the document “Estimated Capacity of the Port of Melbourne.”

## 5.7 Terminal concept planning

A ‘land backed’ form of terminal (built as an island) has been adopted in the planning for both sites. This is distinctly different to a ‘detached’ terminal, as follows:

- A ‘land backed’ arrangement features containers stacking that is closely integrated with the container berth, such as that existing at the Port of Melbourne now. This results in very short transfer distances for containers from ship to stacking area.

- A ‘detached’ arrangement features a berth that is separated from the main container stacking area, often to the extent a bridge link may be required between berth and container stacking areas. This results in longer transfer distances for containers from ship to stacking area.

The principal features of both land backed systems and detached wharf systems are described in Table 7 to highlight perceived advantages and disadvantages. An example configuration of a land backed terminal is provided in Figure 11.

**Table 7 Features of a detached wharf and land backed terminal**

| Factor | Detached Wharf | Land Backed Wharf |
|---|---|---|
| Advantages | Smaller footprint needed in water space, thus minimising direct impacts on the loss of foreshore or sea bed through development; | Improved operational efficiency,<br>lower Operational costs (OPEX) as a consequence of the reduced terminal equipment needs<br>Does not occupy existing land<br>Dredged material re-use opportunities exist – sustainable solution |
| Disadvantages | Higher OPEX solution - more equipment needed due to longer travel distances<br>Reduced operational efficiency<br>Greater volume of dredge material disposal | Greater footprint required<br>Rail and road bridge connection needed to terminal where located offshore.<br>Larger scale marine construction |
| Common considerations | Significant dredge volumes may still be required due to vessel access requirements<br>Long straight quay faces preferred and similar berth length needed.<br>Risk to existing foreshore areas from secondary effects of marine structures and dredge zone created in main channel<br>Container stacking and intermodal operations can be similar for both options.<br>Integrated intermodal zone can be located near terminal | |

A land backed terminal is considered best for operational efficiency and a detached wharf, best for reducing the physical footprint of development in the foreshore and water space.

A benefit of a land backed terminal, where it is built from the dredged material, exists in terms of sustainability. A proportion of the dredged material can be used beneficially to create land.

Figure 11 depicts the indicative arrangement of a land backed terminal – this shows how vessels are serviced at the berth and import containers are transferred via container stacks to intermodal transfer zones (truck and rail) that are located at the rear of the terminal. Export containers traverse the other way, arriving on rail wagons or trucks for transfer to the ship via the container stacks.

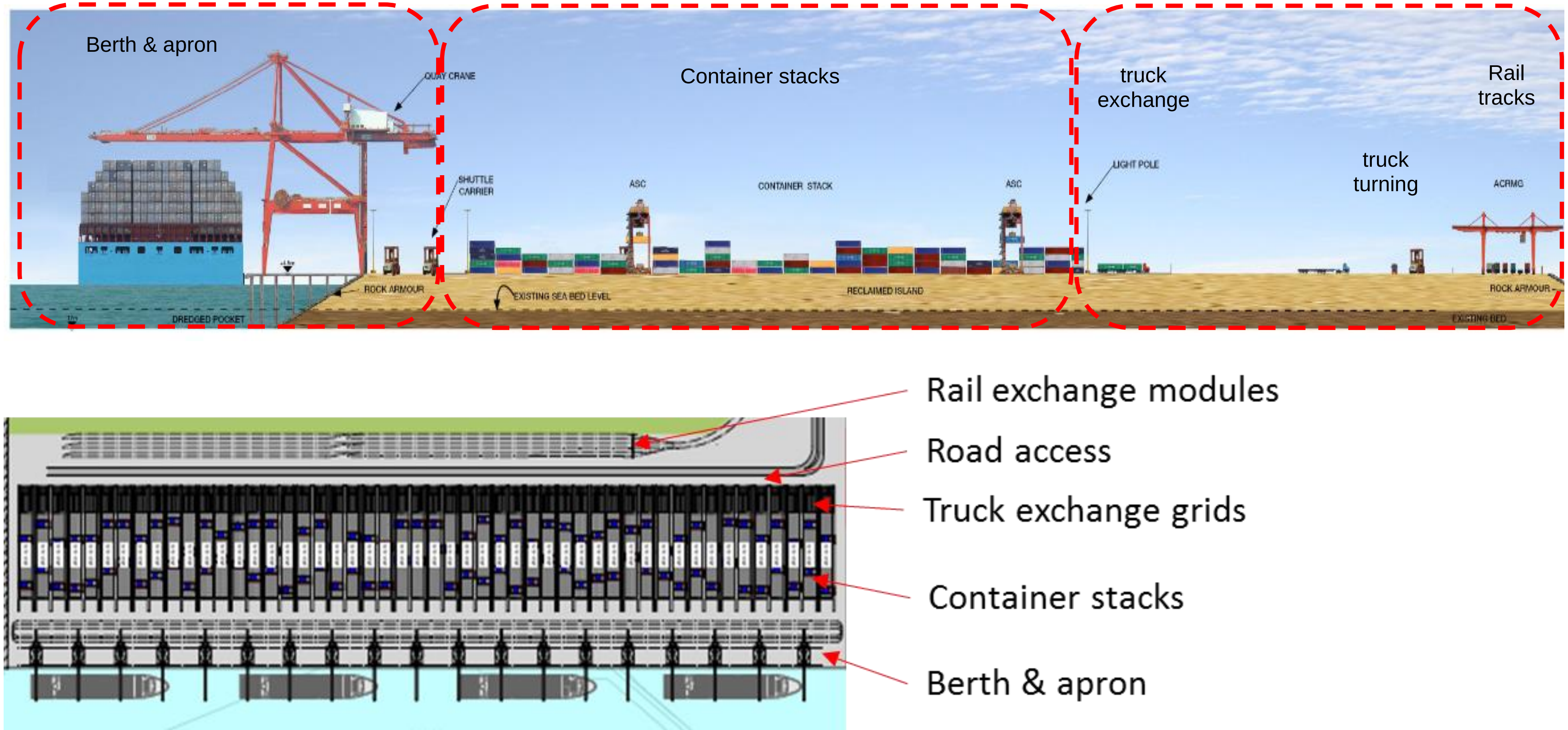



**Figure 11 Example configuration of a land backed terminal development (cross section and plan)**

## 5.8 Terminal operational factors

### 5.8.1 Introduction

When planning a container terminal, it is vital to consider the type and variability of terminal operations that could occur at the facility to ensure land and berth provisions are adequate.

The study work has considered a range of alternative operating systems in order to define an appropriate footprint and identify a safe, efficient and productive operating system that offers low capital and operational cost.

The appraisal of alternative operating systems has included the review of necessary terminal footprint and involved a comparative analysis of system features to shortlist options. This has been followed by a more detailed review of short-listed options, including analysis of equipment requirements, with capital and operating cost estimates for the preferred option.

This study has subsequently adopted a single terminal system for consideration at each port location. This is described further in Section 5.8.3.

### 5.8.2 Container (TEU) dimensions

ISO containers are recognised in terms of Twenty Foot Equivalent Units (TEU). Container details are presented in Table 8.

**Table 8 Container Details**

| | 20' | 40' | 45' | Out of Gauge (OOG) |
|---|---|---|---|---|
| Length | 6.096 m | 12.192 m | 13.716 m | Limited only by shipping lines |
| Width | 2.438 m | 2.438 m | 2.438 m | Limited only by shipping lines |
| Height | 2.591 m | 2.896 m | 2.896 m | Limited only by shipping lines |
| Weight empty | 2,400 kg | 4,300 kg | 4,800 kg | Limited only by shipping lines |
| Weight full | 30,480 kg | 30,480 kg | 30,480 kg | Limited only by shipping lines |
| Payload | 28,080 kg | 26,180 kg | 25,680 kg | Limited only by shipping lines |

### 5.8.3 Terminal systems – operational assessment

Container terminal operating systems combine alternative types of task specific equipment together to make a complete 'through terminal' operation as efficient as possible. The equipment types can vary in size and capacity depending on their task. Melbourne's' Swanson docks currently use manual straddle carriers (SC), while Webb Dock has been fitted out with automated shuttles (ASch) and Automatic Stacking Cranes (ASC's).

This section describes some of the systems and equipment options that have been considered as part of the concept planning.

#### Option overview

Figure 12 summarises seven terminal systems types that have been considered; which highlights the equipment choice mix considered for three container handling points:

- ‘STS’ is the ship-to-shore transfer from ship to land;
- ‘Horizontal Transport’ – represents the land based transfer mode; and
- ‘Yard’ represents the equipment choice for stacking and shuffling containers.

An objective of the study was to appraise operational needs and identify a suitable footprint that would allow for a cost efficient infrastructure solution, but not constrain the choice or efficiency of the future terminal system. A focus has been applied to land area needs vs. expected operating cost. The assessment highlighted the key differences between manned and automated systems.

Further information on the system and equipment types is contained in Appendix A.


**Figure 12 Terminal system options**

Note: AGV = Automatic Guided Vehicle; RTG = Rubber Tyred Gantry Crane; PM = Prime Mover

The assessment or system types indicated Automatic Stacking Cranes (ASC) options with either Automatic Guided Vehicles (AGVs) or Auto shuttles as most favourable. The horizontal transport modes were noted to result in low emissions.

When disregarding the emissions aspect, all the automated options were considered to be more advantageous than manual options.

Consequently, the assessment highlighted the following:

- The straddle carrier option (as currently adopted at PoM Swanson Dock) is not advantageous given its significantly increased space (footprint) requirements
- Systems with AGV's or Autoshuttles offer a low emissions solution with high performance
- A 500-metre-deep terminal footprint appears to satisfy the broad requirements of the other systems under the envisaged container stacking and truck exchange considerations. An additional 100 m space allowance would be needed for future rail operations. Hence a terminal of 600 m depth is proposed
- A quay length of between 4000 to 4250 metres would satisfy the anticipated 9 m TEU, while extra berth length would provide a longer term option to either grow beyond 9 million TEU or to also accommodate other cargoes
- Twin ASC systems and Auto straddles is expected to offer an optimum solution.

### 5.8.4 Terminal operating criteria

The 'terminal-operating capacity' is normally expressed in TEUs per hectare per annum. This performance measure is influenced by different factors and variables, of which some, are outside of an operator's control, these typically include factors relevant to the characteristics of the container flows.

The factors that have been considered in the concept planning are listed in Table 9.

**Table 9 Terminal operating criteria considered**

| Factor | Adopted in study |
| --- | --- |
| Seasonal peaking effects | 12% is assumed |
| Amount of equipment that can be allocated to each crane | To suit target productivity of max 85% |
| Vessel exchange size (number of container moves per vessel call) | Exchange (unloaded and loaded) assumed to be 30% – 40% of vessel capacity (60% - 80% exchange) |
| TEUs ratio (% of 40' containers) | Current 50% trending to 55% in future |
| Equipment working rates | Automatic Stacking Cranes are assumed with a gross handling rate of 15 to 18 moves / hr |
| Container stacking patterns | Perpendicular to berth, maximum 1 over 5 high. 25 TEU long x 10 TEU wide |
| Equipment availability | 98% |
| Labour work arrangements | 24x7x365 days |
| Arrival patterns for imports and exports (dwell times) | Import: 2.6 days; Empty: 13.7 days; Export : 3.5 days; Reefer: 3.0 days |

Through application of the above parameters, the concept planning study work has determined that a terminal operating capacity benchmark of 40,000 TEUs per ha (based on 600 m terminal depth) is expected to be achievable for the given container characteristics, equipment parameters and assumptions.

### 5.8.5 Berth operating capacity

Another significant design aspect of any marine container terminal is berth-operating capacity. This is normally expressed in TEUs per berth metre per annum.

This performance measure is also influenced by many factors and variables; of which some are outside of an operator's control. A selection of typical factors and the variables that have been considered in the concept planning are listed in Table 10.

In assessing the conceptual capacity, it is worth noting that many current major multi-million TEU container terminals are being designed with state of the art operating systems, and are anticipating super post-panamax Ship to Shore Cranes (STSCs) capable of twin and tandem lifting. It is common for the largest ships, such as those proposed within the future container ship fleet, to be operated with up to 7 STSCs working simultaneously.

**Table 10 Berth operating capacity factors and parameters**

| Factor | Adopted in study |
|---|---|
| Future maximum vessel length (m) | 400 |
| Constrained vessel length | 370 |
| Number of cranes possible per vessel (crane intensity) | Based on 90 m centres |
| Vessel exchange size (number of containers moved per call) | 60-80% of capacity |
| Off-berth / on-berth downtime (unmooring / mooring etc.) | 4 hrs per call |
| Berth length suitability (To match vessel lengths) | No restrictions |
| TEUs ratio (percentage of 40' containers) | 50% to 55% |
| STSC fleet size | Super Post Panamax |
| Net STSC working rates | 35 moves / hr |
| Container stowage patterns (heavy crane implications) | Not considered |
| Berth occupancy limit (assumes 3 or more berths) | Target 65% |
| Crane availability | 95% |
| Crane utilisation | 55% assumed |
| Labour work arrangements (meal breaks etc.) | 24x7x365 operations |
| Vessel spacing on berth | 10% of LOA |
| Berth availability | >95% |
| Multiple lift share (twin 40' / quad 20' lifting benefits) | 1.26 containers per move |

Through application of the above factors, the concept planning work has determined that a future berth operating capacity benchmark of 2000 to 2,400 TEUs per berth metre is achievable and appropriate for best practice future planning.

This benchmark is considered relevant for the stated cargo characteristics, parameters, assumptions and the target berth occupancy of 65% (based on multiple operators), which is recognised as a rate of occupancy above which potential vessel berthing delays would occur through berth unavailability.

The mid-range berth operating capacity benchmark of say 2,200 TEU per berth metre compares favourably with a number of the highest performing origin-destination (OD) container terminals in the World, but is lower than the reported maximums for dedicated transhipment terminals.

The proposed Net STSC work rate of 35 container moves per hour and the vessel sizes being considered are slightly higher than STSC rates and vessels sizes currently accommodated at terminals used to the benchmark berth capacity per berth metre. However, the proposed TEUs ratio is lower than those considered, which will in part offset the above.

### 5.8.6 Terminal equipment requirements

Table 11 provides a summary of the estimated terminal equipment needs for the 3M, 6M and 9M TEU capacity steps and the proposed system of ASC cranes, Auto shuttles and Super Post Panamax ship to shore cranes (STSC).

**Table 11 Estimated amount of terminal equipment for 3M, 6M and 9M TEU**

| Component | 3M TEU | 6M TEU | 9M TEU |
|---|---|---|---|
| Berth length | 1450 | 2800 | 4100 |
| STSC (No) | 15 | 24 | 36 |
| ASC's (in pairs) | 58 | 110 | 162 |
| Auto Straddles | 41 | 74 | 112 |
| Labour (admin/Ops/tech) | 700 | 1100 | 1550 |

## 5.9 Rail network, port rail interface terminal & intermodal facility

This section summarises the design criteria and findings that has been adopted for the planning of rail infrastructure connecting to each port facility.

This covers rail network, port rail interface (marshalling facility) and the rail terminal at the port.

The details that relate to network capacity at each port location are discussed separately below. The components of the port rail (on-dock) terminal are discussed in Section 5.10.

Figure 13 provides an example of rail network corridors, rail transfer terminal and intermodal facility that will be at the port location.

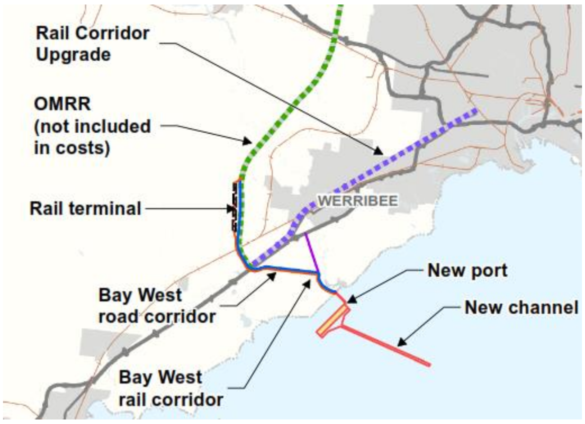



**Figure 13 Components of the rail network servicing the port**

### 5.9.1 The rail task

If volumes are to exceed 2-3 million TEU at the port at any time in the future rail should be planned from day one. Based on the preferred port being the longer term port which provides for Victoria's total port requirements (ie port of Melbourne at some stage closes) the port should provide rail access for trains up to and including 1800 m trains. Interstate trains are not planned at this stage however regional trains for the export of bulk products and containers using the national ARTC network (SG) will have will have an ability to utilise trains to this size.

Trains to the container terminals should align to the Victorian Government planning for Rail Port Shuttles of 600 m in length. This length provides for flexibility on proposed wharf design which may include long wharf faces with alternative rail interface/loading areas. Rail Port Shuttles are discussed further in Section 5.9.4.

The distance of the rail shunting yard from the port is critical to the efficiency of the operations the shorter distance travelled by smaller configurations (each with a train crew) impacts the efficiency of scheduling of trains and movements in and out of the port.

Regional container trains operate currently operate to the Port of Melbourne with up to nine daily services (18 one way trips) and metropolitan Rail Port Shuttles will be in addition to this task.

The daily rail port shuttle train task varies from approximately 9 trips for a 10% mode rail mode share for 3.0 M TEU for a stand-alone port to 55 daily trips based on a 20% rail mode share at a 9.0 M TEU port.

The train trip requirements for specific network links vary significantly between a port at Hastings and a port at Bay West with a higher volume of rail network impact closer to the port location and a tapering of demand as the task is disseminated to terminals across the network. Figure 14 below indicates the number of Rail Port Shuttle daily trips on rail network links based on a Bay West or Hastings stand-alone port (growth scenarios included)

### Figure 14 Indicative rail shuttle trips for network links (Baywest or Hastings)


As with regional train services the Rail Port Shuttles service terminals on both broad and standard gauge networks. The Lyndhurst terminal is planned as broad gauge, Altona, standard gauge and the Somerton terminal is dual gauge and can operate on either gauge. These requirements reinforce the need for a dual gauge access to the port location to provide for servicing of regional and metropolitan rail task.

### 5.9.2 Rail network serving Hastings

The current rail network connection to the Hastings port utilises the metropolitan electrified Frankston corridor, with a regional non-electrified Broad Gauge section from Frankston to the port along the Crib Point Corridor. These corridors are constrained by residential and commercial buildings along much of the length of the corridor limiting the ability to widen the corridor or add sufficient capacity to provide for the future needs of a large container port at Hastings.

In addition to the port of Hastings, development a metropolitan intermodal terminal with significant warehousing and distribution centre development is being built at Lyndhurst with plans for rail access links. This terminal is planning to operate rail shuttles for containerised freight to the port of Melbourne (in the immediate term) and Victoria's second container port (Hastings or Bay West) as a second port develops. Rail mode demand for this facility is an additional factor in the assessment and planning for South East rail connections.

Freight rail connections from Lyndhurst to the South Dynon area, port of Melbourne and to the west of Melbourne are proposed to utilise existing network capacity that exists between passenger services on the current Dandenong and Cranbourne rail corridors in the short term. In the longer term, the rail infrastructure will require significant redevelopment along the corridor to provide sufficient capacity for a full port operation with rail access. This is discussed further in Section 8.8 as it is a key issue in the development of the Port of Hastings.

The future rail task requires a capability of two rail tracks to cater for anticipated demand for a new port, which provides services to all of the regional and metropolitan rail terminals in situ today and planned for the future.

Dependent on the staging of the development of the port of Hastings, the rail links may not be required in the first stage (3.0 M TEU) however, if Hastings is to be a port of 6.0-9.0 M TEU there will be a requirement for rail to balance the landside transport task. A movement of stevedores to a new port would require access to the total export market and if the port of Melbourne is no longer operational this would be the only port which can cater for broader regional and interstate services.

Trains will initially operate in off peak periods on the Dandenong Rail Corridor however, as growth occurs in both passenger and freight traffic on this corridor there will be a need for progressive development of a Regional Rail East rail connection. This development would progressively separate the freight task from the metropolitan passenger task and provide for an increase in demand along this alignment.

Rail infrastructure configuration options for Hastings are discussed in Section 8.8.5.

### 5.9.3 Rail network serving Bay West

The Baywest Port will require a rail corridor connection on an east to west alignment from the port location avoiding Melbourne Water expansion areas to cross the Princes Highway and connect directly with the Melbourne to Geelong rail corridor at the proposed intersection with the OMRR alignment and planned rail corridor northwards around the Melbourne city areas. This connection wold provide flexible routing options based on operational corridors north east/south west on the Geelong Melbourne corridor for most metropolitan demand and north/south around the OMRR corridor for northern and interstate regional demand.

The Melbourne to Geelong corridor and OMRR connections provide direct access to major rail corridors however the future scope of development for the Bay West port and other rail developments including Inland rail connections to Brisbane and the development of a Western Intermodal Freight Terminal planned for Tarneit will also impact capacity on these corridors.

The option of routing trains along the OMRR corridor has potential to ease congestion from regional areas north of the port however, most demand remains within the metropolitan area and will need to be directed east along the Melbourne Geelong corridor.

Freight rail services to Bay West will need to cater for regional and metropolitan demands utilising the main Melbourne to Geelong corridor and through the highest growth metropolitan area in Australia at the current time. The broad gauge network demand in this area is growing quickly with a likely inclusion a new electrified link to outer western suburbs in the short to medium term impacting capacity opportunities on this network

The standard gauge network (ARTC) also operates along this corridor and diverts freight rail traffic north from Newport through Tottenham, away from passenger trains. This provides an opportunity for greater capacity in the longer term. The current ARTC network is single line with passing loops. Limited capacity is available in the short to medium term and upgrades will be required. A dual gauge second line with passing loops between the Bay West network connections with the Geelong /Melbourne corridor and Tottenham would provide a key initial capacity improvement to cater for port demand. Progressive improvements including dual gauging the current standard gauge line will be required as the port expands.

Changes to both the broad and standard gauge networks to the west of Melbourne are subject to a number of other development projects that will also interface to these capacity scenarios and infrastructure needs. The volume of the port task will be a significant driver for additional rail freight capacity demand along the network to Tottenham, with further upgrades likely north to Somerton and through Melbourne towards the Lyndhurst terminal. In the scenario of a Bay West port, developments on the Dandenong rail corridor for freight may not be sufficient to drive capacity upgrades alone and there may be limitations on freight capacity until overall freight and passenger demands drive new infrastructure on this corridor.

Rail infrastructure configuration options for Bay West are discussed in Section 7.3.2.

### 5.9.4 Metropolitan Intermodal System (MIS)

The Department of Transport is developing concepts for a Metropolitan Intermodal System (MIS) to transfer containers around metropolitan Melbourne. In this context it is appropriate for the rail design for Victoria's 2nd Container Port to be consistent with the concept of operations for the MIS, with capacity for locomotive "run arounds" should these be required.

MIS Trains would typically be of 590 m in length with an indicative 42 wagons (84 TEU capacity) and a two locomotive configuration. The longer term growth of the MIS system envisages that trains within this system may grow to 900 m in length with two locomotives in push /pull configuration and this configuration also needs to be catered for within the port terminal.

In addition to the MIS system, trains from regional areas and interstate will deliver export containers to the port. These trains are currently 1200 to 1500 m in length and design capacity should allow for up to 1800 m for the future. Trains are expected to be utilised by 80 – 90% and be single stacked.

### 5.9.5 Port rail interface terminal (Marshalling Yard)

The concept assumes a rail marshalling yard will be available for handling regional / interstate trains and potentially holding shuttles until a port terminal rail slot is available. The facility would ideally be located close to the port (< 5 km), and be used to break up long trains.

It is envisaged that trains in excess of 600 m (900 m future) will arrive at the marshalling terminal (close to the port) and be broken down to 600 m (or a maximum length of 900 m) for travel to and unloading at the port terminal. "run around" capability will be required for these trains in the medium term and flexibility for more automated options in the future.

In functional terms it is expected to incorporate / be:

- Up to 5 km long x 250 m wide based on study work undertaken by others for PoHDA in 2014. Although in the case of Bay West, this may be less (up to 3 km length), as there is opportunity to utilise the proposed Western Interstate Freight Terminal for handling some of the longest Interstate trains.
- A transfer area where train operations (from various operators) are handed over to port operations with relevant control equipment and systems in place.

## 5.10 Port intermodal facility (On-dock Rail)

### 5.10.1 Overview

The port intermodal facility is the area where containers are loaded on and off trains and transferred to / from container stacks. This area benefits from being located as close to the main container yard as possible. An indicative arrangement is shown in Figure 11 and Figure 16.

The port planning has considered alternative rail handling systems that could be utilised at the proposed port, which has involved the appraisal of three alternative systems to handle a potential 30% rail share (3M TEU).

### 5.10.2 Port rail handling system options considered

The options considered included:

- Reach stacker operations (No.1 in Figure 15);
- Wide span crane with interim container storage (No.2 in Figure 15);
- Wide span crane with direct load (No.3 in Figure 15).

The reference to 'interim storage' relates to the option for container stacking at the rail terminal, while 'Rail Supply' relates to the transfer of containers to/from the rail facility form the main container stacks.

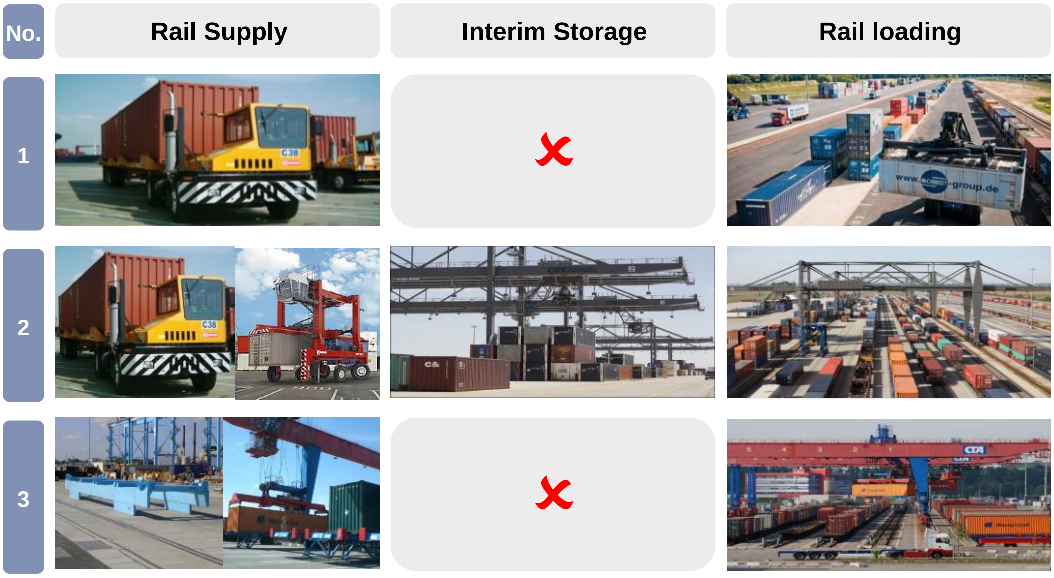



**Figure 15 Rail Integration Options**

### 5.10.3 Recommended port rail system

The assessment of the rail integration into the Port identified a wide span crane solution being necessary to satisfy the 20- 30% rail mode share. A reach stacker system was considered to be sufficient only for a throughput of 200-300,000 TEU depending on configuration and operational arrangements. The option without interim storage was noted to offer a lower operational cost, as a consequence of the expected saving in container lifts.

Under a wide span rail mounted crane scenario, the terminal would incorporate 2 large rail modules featuring up to six tracks of 600 to 900 m length for container loading, with each module being equipped with up to four wide span cranes to achieve full capacity.

The modules would be positioned at the rear of the terminal in series, with the overall length of the track being considerably longer as a number of turnouts are required beyond the length occupied by the container train.

In reality, the port rail zone is envisaged to span the full length of the terminal and occupy an overall width of approximately 100 m allowing for safety zones and equipment lay down areas. A typical arrangement of wide span crane rail modules, truck grids and the stacks on the terminal is presented in Figure 16.

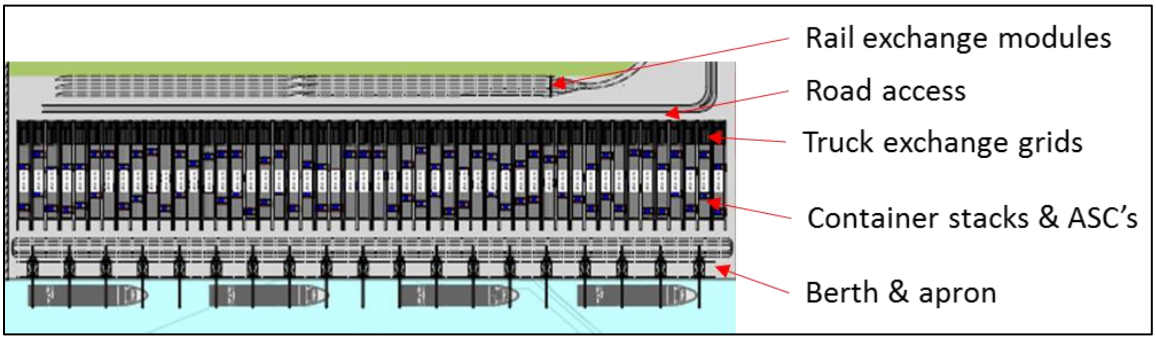



**Figure 16 Indicative arrangement of the rail modules**

### 5.10.4 Phasing considerations

The phasing of the rail capacity at the terminal is expected to grow in line with demand, network capacity and actual rail mode share.

It is recognised that the phasing will need to consider an approach that allows for flexible capacity development through the gradual addition of modules and/or equipment type is proposed.

The concept planning has assumed a staged development comprising:

(1) an initial set of tracks in their future alignment with a lower cost reach stacker system

(2) The addition of extra tracks with the phased integration of the wide span cranes at later stages, in line with increasing demand.

The indicative development of the wide span crane setup is presented in Figure 17.

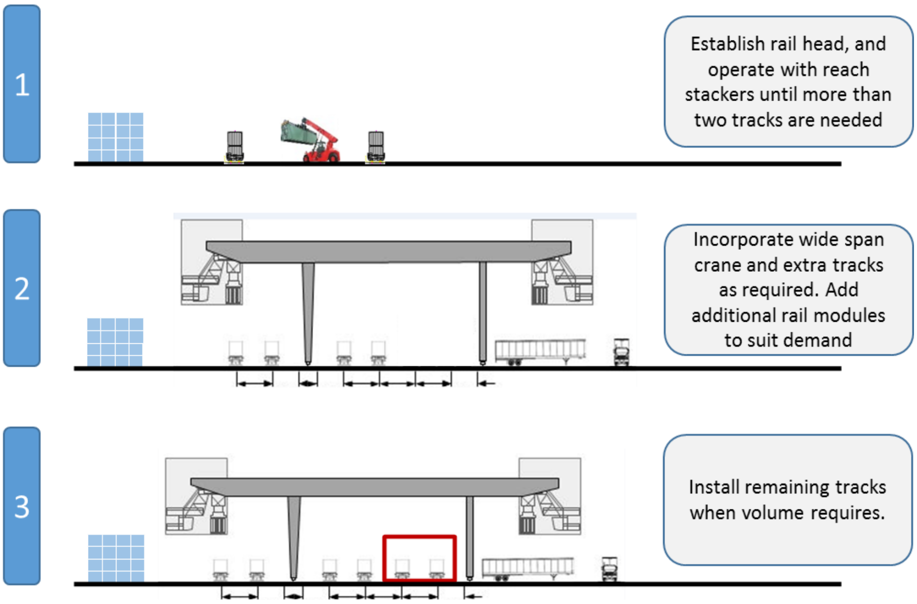



**Figure 17 Example rail module development**

### 5.10.5 Port rail terminal planning criteria

The criteria adopted for the planning of the on-dock rail terminal are presented in Table 12.

**Table 12 Planning criteria adopted for the on-dock rail facility**

| Criteria | Value |
|---|---|
| Train length | 600 m (up to 900 m) |
| Peaking factor / TEU factor | 1.4 / 1.5 |
| Gross TEU per train | 68 with 80% utilisation |
| Optimum cranes per rail module | Up to 4 |
| Crane moves per hour | 25 – 30 |
| Crane utilisation | 70% |
| Operating hours (per annum) | 8500 |

## 5.11 Road network & truck exchange

### 5.11.1 Overview

Road infrastructure will be based on the proposed maximum size of the port, network capacity needs and resulting mode share. The components of the road network will comprise:

- Truck circulation and exchange grids in the container terminal
- Terminal entrance gates / control area and truck marshalling areas
- Road network connection (freeway standard)

Figure 18 presents an indicative arrangement of the highway infrastructure at the port.

### 5.11.2 Truck circulation & exchange at the port

The transfer of containers from port equipment to/from trucks is undertaken at the container terminal. Where ASC systems are used, this is usually undertaken at designated exchange grids at the landward end of the stacks.

Trucks access the container terminal via truck gates that are usually located outside the main container terminal yard and reverse into the grids to have containers loaded or unloaded. An indicative arrangement is presented in Figure 18. The turning provisions for the largest trucks can be onerous and options are retained for the integration of HPFV's within the rail terminal.

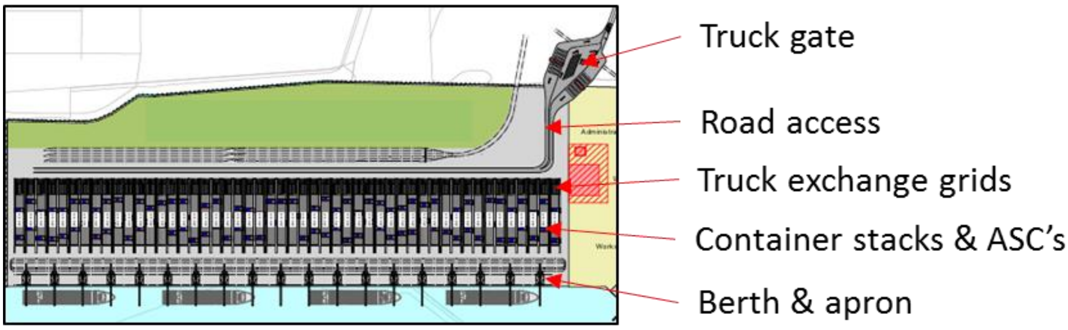



**Figure 18 Indicative arrangement of the port gate for receiving trucks**

### 5.11.3 Gate requirements

The gate complex, controls the entry and exit of trucks to the container terminal. This study has considered the requirements for the truck gates for each of the three capacity milestones.

In the planning we have assumed that the gate complex will be remote from the container terminal and incorporate temporary truck parking areas and incorporate automated, paperless processes that will facilitate uninterrupted truck movement throughout the port. Such infrastructure includes optical character recognition (OCR) systems (Figure 19), gate pedestals, and a manual processing area in which trucks can park to be remotely assisted in their gate clearance process.

Where multiple terminals are expected, it is assumed that each terminal will have its own dedicated gate facility to comply with efficient information processing and the International Ship and Port Facility Security (ISPS) Code requirements, although these can be co-located.

In addition to the gate hardware installation, it is anticipated that the port will feature a mandatory pre-announcement system similar to the established 1-stop system presently used across Australia.

### 5.11.4 Gate lane requirements

Table 13 summarises the gate lane requirements for both port locations.

**Table 13 Estimated truck gate requirements**

| | 3M TEU | 6M TEU | 9M TEU |
|---|---|---|---|
| Gate lanes | 12 | 22 | 34 |
| Holding slots | 6 | 12 | 18 |

**Figure 19 Truck gate with OCR**

### 5.11.5 Design criteria for the gate & exchange analysis

The factors that have been adopted to shape these facilities as part of the concept planning and cost estimate are presented in Table 14.

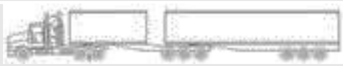
### Table 14 Design criteria adopted for the truck exchange at the port

| Factor | Adopted in study |
|---|---|
| TEUs per truck | Average of 1.6 TEU per call. |
| ASC Exchange grid process times | Arrival period 7 mins; departure period 6 mins; handling period 7 mins |
| Operating hours per annum | 8760 |
| Peaking factor | 1.4 |
| Gate process | Truck gate dispatch 2 min in / 1.8 min out |
| Trucks requiring manual process | 10% each of 10 minute duration |

### 5.11.6 Truck fleet profile

The types of vehicles to be accommodated at the future port are presented in Table 15

### Table 15 Vehicle Fleet likely to serve Hastings

| Vehicle | TEU Capacity | Vehicle Length[1] | Turning Circle[2] | Schematic of Vehicle |
|---|---|---|---|---|
| Semi-Trailer | 2 | 19 m | 26 m |  |
| B-Double | 3 | 26 m | 26 m |  |
| Super B-Double | 4 | 36 m | 31 m |  |
| Super B-Triples | 6 | 53 m | 31 m |  |

Notes: 1 Source Austroads; 2 Turning circles are diameters and are based on a speed of 10km/hr, source Auto Turn V8.2

## 5.12 Navigational infrastructure

### 5.12.1 Overview

This section summarises the criteria and assumptions that have been adopted to allow vessels to safely navigate to and from the facility, including:

- Approach channel(s) and fairway(s);
- Swing basin and anchorages;
- Berth pocket and Navigation aids including beacons, channel markers and Vessel Traffic Management Systems (VTMS); and

### 5.12.2 Key terms

The depth of the channel required for safe navigation of the vessel is referred to as the declared depth, while for construction there are additional factors for sounding (survey) accuracy and siltation to ensure that the declared depth can be guaranteed. Additionally, there is usually an over dredge allowance which the contractor cannot exceed during the dredging works.

These terms and their components are outlined in Figure 20 and Table 16.

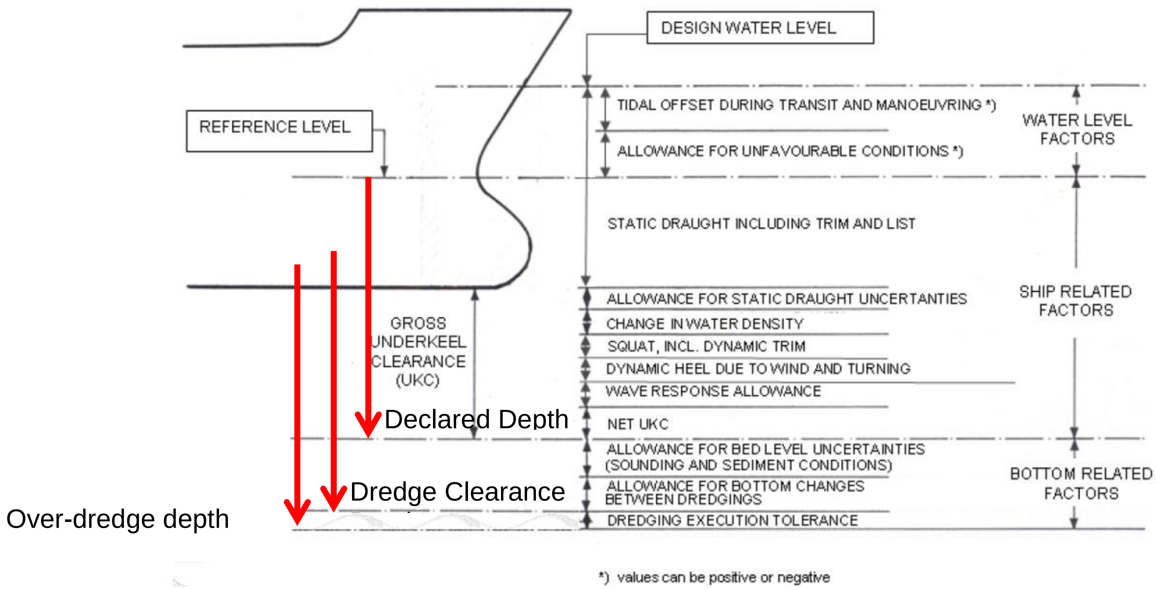



**Figure 20 Channel depth factors (modified from PIANC 2014, Figure 2.1)**

**Table 16 Components of depth terminology used**

| Key Terms | Components | Definition |
|---|---|---|
| Declared Depth | Vessel Draught + UKC | The minimum level guaranteed available to vessels as declared by the Harbourmaster |
| Dredge Clearance Depth | Declared Depth + Survey Allowance + Siltation | The minimum level to be achieved by the dredging Contractor |
| Over Dredge Allowance | Over Dredge Allowance | The maximum allowed vertical allowance below the Dredge Clearance Depth available to the Contractor to ensure that the Dredge Clearance Depth is achieved. |

### 5.12.3 Navigation channel

In planning the physical aspects of the navigation channels it is assumed that channels will be configured in a simple fashion, to minimise the number of bends and dredge volumes.

The new channel to the proposed port facility in Port Phillip considers the criteria indicated in Table 17. This reflects a different site setting for Hastings in Western Port.

The criteria that were used for Hastings are defined in the relevant PoHDA study report - AGH-CEP0-EG-REP-0024 - Channel Design for Navigation Report.

**Table 17 Criteria used in the channel concept design for Bay West**

| Factor | Value / purpose |
|---|---|
| Vessel dimensions: LOA, Draught, Beam | As defined for constrained and unconstrained vessel - adopting running draught |
| Tidal level | LAT |
| Ship manoeuvrability | Moderate, straight channels assumed |
| Vessel speed | Moderate (8-12 knots) |
| Cross wind speed | Moderate (15-33 knots) |
| Current speed (cross & longitudinal) | Cross: Low (0.2 - 0.5 knots)<br>Longitudinal: (<1.5 Knots) |
| Significant wave height | 1 m |
| Aids to navigation | Excellent |
| Bottom surface profile | Rough and hard |
| Cargo hazard density | Low evaluated. |
| Traffic type | 1 way |
| Traffic density | 1 to 3 vessels per hour assumed (peak). |
| Bank characteristics | Sloping channel edges assumed |
| Tidal assistance / Sea level rise | Not considered |

### 5.12.4 Turning basin

A vessel turning basin is required at the end of each navigation channel.

For Hastings, this has been dimensioned to reflect the findings of the navigation studies that were completed for PoHDA in 2015. This resulted in an elliptical swing basin broadly dimensioned to 1.75 x LOA wide by 3.0 x LOA long. The elongated basin arrangement arises from the strong current effects that are applicable to that site in Western Port.

For Bay West, this has been taken as a circle formed of diameter equal to the design vessel LOA multiplied by a minimum of 1.75. This takes into account the simulation findings, recommendations of PIANC and the negligible current. It assumed the largest vessels will be turned with tug and piloted assistance.

In defining the swing basin for Bay West, it is recognised that the dimensions would be refined further through design development. It is observed that swing basins at the Port of Geelong and Port of Melbourne are a considerably smaller (< 1.5 LOA); as currents are considerably lower in Port Phillip than at Hastings.

The turning basin will be connected to the berth pocket in the manner indicated in Figure 21. This reduces the central manoeuvring area width over the length of the terminal until it meets the berth pocket.

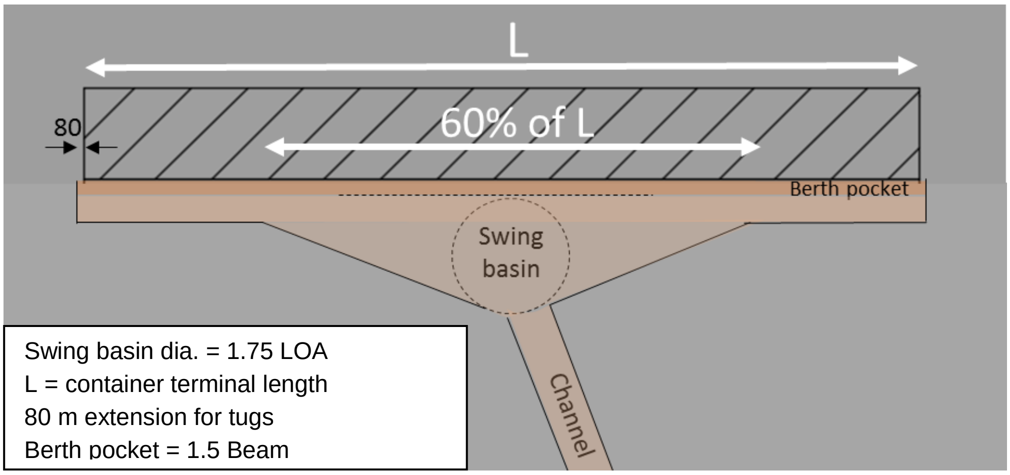
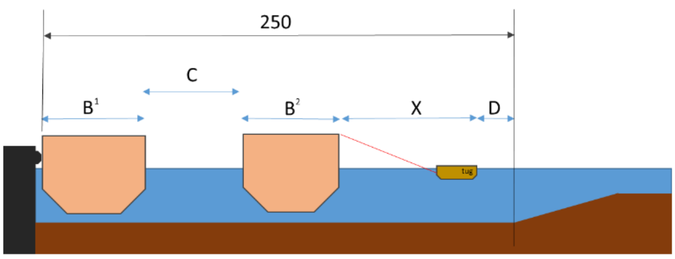



**Figure 21 Indicative arrangement for connecting the turning basin to the berth pocket and vessel manoeuvring areas**

### 5.12.5 Berth pocket

A berth pocket and manoeuvring area will be provided alongside the full length of the quay at each location with a local extension of 80 m at each end for tugs. The pocket allows vessels to be berthed in all environmental conditions and have vessels manoeuvred past berthed vessels.

For Bay West this area been taken as a rectangular pocket of minimum width 250 m. This takes into account the recommendations from PIANC and BS 6349, low tidal current speeds and from findings of a review of worldwide ports. A pocket of this minimum width allows all design vessels to be able to pass with others with a minimum clearance of 1 vessel beam. Figure 22 depicts the proposed arrangement.




| Basin | Beam ($B^1$) | Beam ($B^2$) | Dim (C) | Dim (X) | Surplus (D) |
|---|---|---|---|---|---|
| 250 | 48 | 48 | 50 | 75 | 29 |
| 250 | 48 | 56 | 50 | 75 | 21 |
| 250 | 48 | 59 | 50 | 75 | 18 |
| 250 | 56 | 59 | 50 | 75 | 10 |
| 250 | 59 | 59 | 50 | 75 | 7 |

X =75m (45m line + 30m tug) + min clearance = 50 m

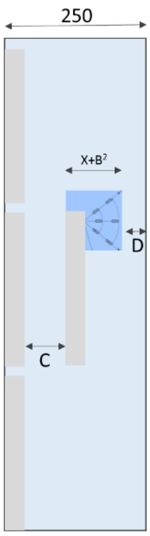



**Figure 22 Berth pocket dimensions for Bay West (not to scale)**

For Hastings the arrangement arising from the navigational simulation modelling which has been retained. This is documented in PoHDA study report - AGH-CEP0-EG-REP-0024 - Channel Design for Navigation Report and Section 8.3. This maintains a 1.5 times beam berth pocket along the quay but incorporates a wider manoeuvring area to account for the higher current speed and longer drag distances for vessels from the designated swinging area.

The depth of the berth pocket needs to provide safe water to cater for all environmental conditions, and the declared depth must accommodate provision for static draughts in combination with vessel movement effects during loading.

For Bay West, the lowest tide has been taken as 0.0 mCD with a UKC dimension of 1.0 m. The UKC value of 1 m has been adopted to allow for a roll angle of 1.6 degrees in normal conditions and up to 2.1 degrees in extreme conditions. The normal maximum ship out of trim during loading is 1.5 degrees, which equates to a UKC of 0.75 m with a bottom clearance of 0.25 m.

For Hastings, the lowest tide has been adopted at -0.5 mCD (based on historical records) with a UKC dimension of 1.0 m. The lower tide level reflects the findings of 1% of the time series data.

### 5.12.6 Resulting dredge depths

A simplified spreadsheet model has been used to estimate the dredge volumes at both locations. All volumes are in situ volumes and include the declared depth provisions at each site with provision for survey accuracy, siltation and over dredging. The depth adjustment provisions and resulting depths are discussed below.

#### Survey accuracy

A survey accuracy of -/+0.25 m has been used based on preliminary advice from Hadyn Pyke of Baggerman Associates.

#### Siltation allowance

For Hastings, a siltation depth of 0.3 m or 50 mm/year by 6 years has been assumed for the purposes of estimating dredge volumes in the North Arm and the Port Area. This provision isbased on the findings reported in the Preliminary Siltation Analysis Report (HAS-CEP0-HY-REP-0016-B). This report suggests that sedimentation in the Western Channel is expected to be insignificant.

For Bay West, a siltation depth of 0.1 m has been adopted. This reflects a minimum provision for this aspect. It is noted however, that siltation in the Geelong Port Channels is historically recorded as being very low, and the last instance of minor maintenance dredging is in 2003.

#### Over-dredge depths

For the purposes of estimating ‘actual’ (gross) dredge volumes, the calculations include a provision for over dredging. A vertical dimension of 0.5 m and width of 3.0 m has been assumed as outlined in Table 18. These provisions align with the recommendations made as part of the dredging feasibility studies at Hastings.

**Table 18 Over-dredge provisions included in the dredge volume estimates**

| Over dredge maximum dimension | | Average used in Volume Estimates | Comments |
|---|---|---|---|
| Vertical | 0.5 m | 0.3 m | Assumed average resulting across area |
| Horizontal | 3.0 m | 1.8 m | Avg. dim used in all areas outside toe line |

### Batters

At Bay West, it is assumed that the channel side slopes are battered at 1V to 3H, as indicated in Figure 23. Such batters have been formed successfully in similar material at Geelong.

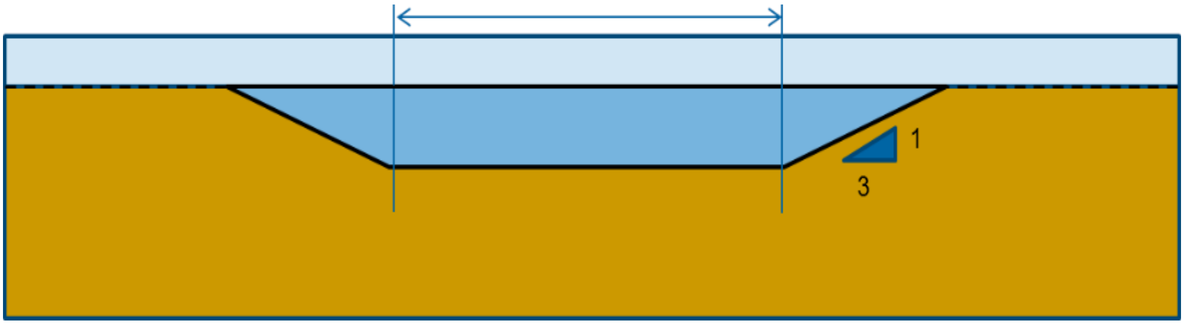



**Figure 23 Indicative configuration of batter slopes adopted at Bay West**

For Hastings, the batter slopes outlined in Table 19 have been adopted. These reflect the variability in material that is expected to be encountered across the channel and port footprint.

**Table 19 Batter slopes adopted for Hastings**

| Location | Slope |
|---|---|
| Port Area (Baxter or Sherwood Formation) | 1V:4H |
| Port Area (Baxter or Sherwood Formation) – At northern end of channel approximately perpendicular to direction of current | 1V:5H |
| North Arm (Baxter Formation) | 1V:4H |
| Western Channel (Residual Soil) | 1V:3H |

### Dredging depths – Bay West

Table 20 outlines the depths that have been adopted to derive dredge volume estimates at Bay West.

These are termed:

- To Dredge Clearance Level – to reflect the volume of material that is required to be removed to provide a navigable channel with a siltation allowance. Depending on the contractual arrangement this may also be the volume the Contractor is paid for.
- Over-dredge depth – to reflect he potential total volume of material that will end up being dredged and taken to disposal. It should be noted that this value will vary depending on the exposure in the channel, dredging methodology and material type.

For Bay West, the UKC provisions in the swing basin and channel have been reviewed against the findings of the vessel simulations conducted at Hastings, and adjusted accordingly.

The UKC provision for the section of new channel connecting the terminal to deep water has been matched with that identified for the northern section of the North Arm at Hastings, which is considered to be most similar.

### Table 20 Estimated dredged depths for Bay West berth pocket, swing basin and channel

| Parameter | Depth (m or mCD) | | |
|---|---|---|---|
| | Berth pocket | Swing basin | Channel |
| Tide Level | 0.0m | 0.0m | 0.0m |
| Vessel Draught | 14.0m | 14.0m | 14.0m |
| UKC | 1.0 m | 1.1 m | 1.5 m |
| **Declared Depth** | **-15.0 mCD** | **-15.1 mCD** | **-15.5 mCD** |
| Survey accuracy | 0.25m | 0.25m | 0.25m |
| Siltation Allowance | 0.1m | 0.1m | 0.1m |
| **Dredge Clearance Level** | **-15.35 mCD** | **-15.45 mCD** | **-15.85 mCD** |
| Over dredge Allowance[1] | 0.5m | 0.5m | 0.5m |
| **Max Over Dredge Level** | **-15.85 mCD** | **-15.95 mCD** | **-16.35 mCD** |

### Estimated depths - Hastings

The design depths adopted at Hastings are extracted from the 2015 PoHDA studies.

These resulting volumes are presented in Section 8.3.

Table 21 summarises the depths that results for the 14 m design draught condition.

### Table 21 Berth pocket depth provisions for Hastings

| Parameter | Depth (m or mCD) |
|---|---|
| Tide Level and Residuals | -0.5m |
| Maximum Vessel Draught | 14.0m |
| UKC | 1.0m |
| **Declared Depth** | **-15.5 mCD** |
| Survey accuracy | 0.25m |
| Siltation Allowance | 0.3m |
| **Dredge Clearance Level** | **-16.05 mCD** |
| Over dredge Allowance | 0.5m |
| **Over Dredge Level** | **-16.55 mCD** |

1 0.3m has been adopted in the dredge volumes to account for average over dredge dimensions.

## 5.13 Engineering design criteria

### 5.13.1 Overview

The engineering design criteria adopted in the design are considered further in this section. These generally follow the recommendations agreed as part of the PoHDA studies and established in AGH-CEP0-DE-REP-0005 Basis of Design, unless otherwise noted.

### 5.13.2 Bathymetry & cadastral planning

Relevant navigation charts include:

AUS 150 – Western Port (Edition No. 2 dated 4 Jun 2010)

AUS 151 – Western Port – Entrance and North Arm (Edition No. 2 dated 4 Jun 2010)

AUS 152 – Western Port – Hastings Bight, Hanns Inlet, Rutherford Inlet and Crib Point

AUS 154 - Port of Melbourne Williamstown and River Yarra

AUS 155 - Approaches to Port of Melbourne

AUS 143 - Port Phillip

AUS 157 - Port of Geelong and Approaches

Planning zones, overlays and cadastral parcels are sourced from the Department of Environment and Primary Industry. The Planning Zones for both sites are shown in the respective sire sections of this report.

### 5.13.3 Tidal planes

Tides within Western Port are semi-diurnal with a strong lunar semi-diurnal component. The tidal range increases with distance from the entrance to the Western Channel, similarly to the tidal lag. The difference in tidal range between Flinders and Tooradin is approximately 0.8 m, with tidal lag about two hours between the same locations.

Table 22 summarises the tide levels for Stony Point, however it should be noted that the historical tide records at Stony Point have not accurately recorded the high tide levels.

**Table 22 Tide levels for Western Port (Stony Point) (PoMC Victorian tide tables, 2014)**

| Tidal level | Height (m AHD) | Height (m CD) |
|---|---|---|
| Highest recorded tide (06/06/88) | 2.09 | 3.78 |
| Highest astronomical tide (HAT) | 1.72 | 3.31 |
| Mean High Water Spring (MHWS) | 1.15 | 2.84 |
| Mean High Water Neap (MHWN) | 0.70 | 2.39 |
| Mean Sea Level (MSL) | 0.035 | 1.725 |
| Australian Height Datum | 0.00 | 1.69 |
| Mean Low Water Neap (MLWN) | -0.63 | 1.06 |
| Mean Low Water Spring (MLWS) | -1.08 | 0.61 |
| Lowest astronomical tide (LAT) | -1.69 | 0.00 |
| Lowest recorded tide (27/11/03) | -1.975 | -0.285 |

Tides in Port Phillip are semi-diurnal. The tidal range decreases with distance from the Heads. Table 23 summarises the tide levels for Pt Wilson.

**Table 23 Tide levels for Port Phillip (Geelong) (PoMC Victorian tide tables, 2014)**

| Tidal level | Height (m AHD) | Height (m CD) |
|---|---|---|
| Highest recorded tide (05/07/2011) | 1.13 | 1.71 |
| Highest astronomical tide (HAT) | 0.66 | 1.24 |
| Mean Higher High Water (MHHW) | 0.42 | 1 |
| Mean Lower High Water (MLHW) | 0.12 | 0.7 |
| Mean Sea Level (MSL) | | |
| Australian Height Datum | 0 | 0.58 |
| Mean Higher Low Water (MHLW) | -0.08 | 0.5 |
| Mean Lower Low Water (MLLW) | -0.48 | 0.1 |
| Lowest astronomical tide (LAT) | -0.58 | 0 |
| Lowest recorded tide (07/03/1972) | -0.81 | -0.23 |

### 5.13.4 Extreme water levels

The planning has included provisions for sea level rise and storm surge in accordance with Climate change scenario 2 - IPCC 2007 A1FI scenario in combination with 'high' wind speed scenario.

The resulting platform levels adopted for Hastings and Bay West are +5.5 mCD and + 5.0 mCD respectively.

### 5.13.5 Winds & waves

Extreme winds are based on AS1170 Part 2 for terrain category 1 or 2 as appropriate. These are reported in AGH-CEP0-DE-REP-0005 Basis of Design.

The wave climate at each port locations is driven by local wind waves, with similar resulting conditions, as summarised in Table 24.

The southern sections of the navigation channels at both sites are subject to both local wind waves and swell.

**Table 24 Estimated significant wave height and period at the terminal**

| | Return Period | | |
|---|---|---|---|
| | 1 Year | 100 Years | 500 Years |
| Significant Wave Height Hs (m) | 1.0 | 1.8 | 2.0 |
| Period T (s) | 3.5 | 4.3 | 4.4 |

### 5.13.6 Currents

The navigation chart for the Port of Hastings (Aus 150 "Western Port") indicates that tidal currents in excess of 2 knots are experienced in the shipping channels immediately to the south of the BlueScope jetty area, and tidal currents in excess of 3.5 knots are experienced in the Western Channel (off Phillip Island).

The navigation chart for the Port Phillip (Aus 154) does not identify any magnitude of tidal currents in the area. The VRCA Port Operating Handbook states that "the tidal stream in the Western Arm, ie Geelong Outer Harbour and Corio is not appreciable. The exception is where the stream crosses the bar between Point Henry and Point Lillias; the outgoing stream at this point is 1 knot during its second quarter". This suggests tidal currents are negligible.

Further hydrodynamic modelling undertaken as part of this study is available through Infrastructure Victoria.

### 5.13.7 Dredging

Dredged areas are to be designed to include allowance for maintenance dredging and where necessary provision is to be made for dredging extensions or deepening without destabilising adjacent slopes, scour protection or structures.

Specified dredging profiles are proposed as the minimum required for capital and maintenance dredging works.

Volume estimates for material arising from dredging of the berth pocket and navigation channels shall reflect the dredging equipment to be used and material to be dredged. The planning has adopted the following overdredging provisions:

- Vertical – 0.5 m (1.0m in very stiff clays) – (Backhoe or Grab dredger)
- Horizontal – 3.0 m outside toe lines (5.0 m in very stiff clays) – (CSD / BHD)

### 5.13.8 Ground improvement

Ground improvement options investigated as part of the PoHDA studies in 2014/15 have been adopted in the planning. The techniques assumed to apply are presented in Table 25.

**Table 25 Possible ground improvement techniques**

| Work component | Assumption / material | Recognised Technique |
|---|---|---|
| Containment bunds | Sand bunds.<br>Soft deposits removed before placement | - Vibro-compaction of sand fill |
| Main reclamation | Fine sand and clay, hydraulically placed below water, fill from BHD methods or land source spread and compacted using terrestrial earthworks equipment above water.<br>Very soft marine clays removed. | - Preload surcharge with vertical drains |
| Main reclamation | Sand material with soft deposits removed before placement | - Vibro-compaction of sand fill |

### 5.13.9 Revetment / sea walls

Permanent seawalls are assumed to comprise rock revetment & armour. They have been designed to comply with the requirements of the Rock Manual – The use of rock in hydraulic engineering (2nd edition) 2007 CIRIA/CUR.

Revetments are proposed at slopes of 1:2 or 1:3, such that they are consistent with the natural angle of repose of the material utilised at each stage of construction.

The arrangement of the seawall crest has considered sea level rise, potential wave overtopping and impact of landside operations as appropriate to the return period considered.

Concepts for sea walls are presented in Section 7.11.1 and Section 8.12.1 for Bay West and Hastings respectively. Temporary protection in the form of a grouted mattress has been adopted for areas of land reclamation left for periods of time before final development.

### 5.13.10 Loads

Notable criteria adopted as part of the concept planning is summarised in Table 26.

**Table 26 Load criteria adopted in the concept planning**

| Load | Value / provision |
|---|---|
| Uniform loads on berth structures | 10 kPa – forward of front crane rail<br>50 kPa – between crane rails<br>60 kPa – behind crane rails |
| Quay crane | 35 m gauge – 10 wheel Bogey |
| Mooring loads | 100 T bollards @ 15m centres assumed |
| Scour | Rock armour protection |
| Pavements | In line with the Structural Design of Heavy Duty Pavements for Ports and other Industries publication. |

### 5.13.11 Quay structures types

Various structural forms for wharf structures were considered as part of the studies for PoHDA in 2014/15. These options were based on the 'interpreted' ground conditions at Hastings.

Preliminary operating loads and structural assessment studies were undertaken for primary structures to approximate key member sizes, founding depths, dredging and backfill requirements for the purposes of comparing options.

The primary structure types considered included:

- Open piled quay deck over a sloping revetment;
- Bulkhead wall(s);
- Diaphragm wall
- Gravity Structures including caissons, concrete counterfort walls and concrete block wall
- Steel sheet piled circular, rectangular or linear steel cofferdam

The comparison of the options at Hastings identified a Bulkhead wall and suspended deck to be appropriate, with gravity walls considered unsuitable because of the soft ground conditions. Both options were recognised to have a good fit with the expected dredging and reclamation methods and underlying ground conditions.

The structure options have been revisited at Bay West. Section 7.11.3, subsequently sets out a rationale for the selection of a quay type considered in the concept. The proposals for Hastings are discussed further in Section 8.12.1.

### 5.13.12 Quay furniture

The planning has typically included provision for 100 T bollards and cellular fenders with low friction panels to be provided at 15 m centres along the quay structures. Safety ladders are assumed at 30 m centres.

The planning has recognised that other technologies exist in this space that can enhance terminal efficiency, and could be considered within any later stages of design. Typical examples include the use of 'vacuum' mooring systems instead of bollards and lines (e.g. Figure 24).

Such technology reportedly reduces the time it takes to get a vessel on and off a berth, and potentially allow vessels to be positioned closer together on the berth. Both aspects affect berth operating performance and potential capital cost.

**Figure 24 Example of vacuum system 'Moormaster 400' Source: Cavotec**

### 5.13.13 Pavements

With both concepts contemplating land reclamation, ground movement is considered to be an ongoing risk. Hence the planning has proposed that the pavement system employed must be flexible and able to be repaired easily. This eliminates the use of cast in situ concrete pavement.

The paving for the terminal can be divided into three zones.

The area under the ship to shore cranes and between the cranes and the seaward edge of the container stacks is subject to very heavy vehicle loads, containers and hatch covers being placed on the ground and loads from maintenance equipment. The vehicles that traverse the area are regularly making tight turns, tending to scuff the pavement. The area at the inshore end of the stacks is also subject to heavy vehicles turning. The preferred paving for both these areas is interlocked concrete blocks supported on lean mix concrete and crushed rock.

The container stacking area under the ASCs is often surfaced with very hard crushed rock ballast as this allows very easy correction for settlement. In Australia, AQIS have in the past opposed the use of crushed rock paving as they consider it allows the growth of alien plant species. This issue requires further discussion with AQIS.

At the rear of the terminal:

- the trucks are simply driving to and from their loading slots so the paving in this area can just be normal highway asphalt construction.
- The on dock rail facility will be block paved using a construction very similar to that under the ship to shore cranes.

### 5.13.14 Culverts & service/utility crossings

At each location the planning has identified the need for number of culverted or bridge structure crossings for the transport corridors to avoid obstructions and/or maintain the continuity of existing services and infrastructure at each location.

The planning has adopted a simplified approach to this. This considers the estimate of total number of crossing under two classes; 'Major' and 'Minor'. The estimate for each location is based on an interpretation of the relevant Services & Utility GIS data.

**Figure 25 Example 'minor' service crossing (left) and 'major' crossing (right)**

The 'minor' class is intended to reflect a simple culverted crossing (or similar), essentially comprising a single or multi-cell culvert that may be 5 to 8 m wide. The 'major' class is intended to reflect a single span bridge crossing (or similar) that may be 30-40 m wide. The two classes are indicatively illustrated in Figure 25.

The basis for their application is summarised in Table 27. The estimate of quantity at each location is defined in the respective feasibility section of this report.

**Table 27 Basis of application for service / utility crossings.**

| Class | Description | Application |
|---|---|---|
| Minor | Single or multi-cell culvert | Providing continuity to a minor surface water drain, agricultural irrigation channel or pipeline. |
| Major | Single span bridge crossing with earth embankments | Crossing a Creek, River or main surface water or sewage carrier. |

### 5.13.15 Road & rail bridges

The planning has estimated the number of road and rail bridge structures that may be required at each location to enable new transport linkages to 'connect with' or 'avoid' existing transport infrastructure. This includes estimates of grade separated junctions, overpasses and underpasses. The quantity estimates of each are defined in the respective sections of this report.

For the purposes of planning it is assumed that smaller span structures (up to 12 m) will consist of precast planks approximately 350 mm thick with an in-situ deck slab. These structures will be single span, simply supported bridges with reinforced concrete abutments supported on precast driven piles. Prestressed concrete Super T girders of up to 1800 mm depth with an in situ deck slab will be used for all spans up to 30 m.  Where a structure is required to span longer than 30 m, consideration shall be given to providing multiple spans or if provision of piers is either undesirable or impractical, alternative structural forms such as prestressed concrete box girders or steel structures can be considered to achieve greater spans.

## 5.14 Utilities and services

This section summarises the assumptions that have been made with respect to the planning for services & utilities at both sites. This has principally drawn on the findings of the studies completed for PoHDA.

### 5.14.1 Pipelines

**Hastings** - A full list of all pipeline licences in the area, including details of operators, pipe content, length, diameter and pressure is included in the Services & Utilities report.

Notable pipelines located within the port area (refer to Figure 27), include:

- Western Port-Altona-Geelong (WAG) Pipeline, used to transfer gas to refineries in Geelong and Altona that runs alongside the Western Port Highway
- ESSO Australia pipeline for the transfer of gas from Longford to Long Island (250 mm dia)
- Esso Australia, Elgas and Vic Gas pipelines for Liquid Petroleum Gas (LPG) for local use that also run alongside the Western Port Highway
- Crude Oil pipeline from Longford to Long Island Point owned by Esso Australia and BHP Billiton (700 mm dia.)
- United Petroleum Pty Ltd pipeline for unleaded petrol from Crib Point to storage facility at Long Island Point.

In addition to the gas and oil pipelines, there are also the following services easements in the area:

- Water Pipeline – Melbourne Water
- High Voltage Transmission Line – United Energy

**Bay West** - Notable pipelines located within the study area (refer to Figure 26), include:

- The Western Port-Altona-Geelong (WAG) Pipeline, used to transfer gas to refineries in Geelong and Altona that runs alongside the southern edge of the Princes Freeway
- A number of small diameter potable water pipelines running across the WTP site as part the irrigation network
- A Future ‘Brine’ pipeline that is proposed as part of a future salt reduction plant development on the site. This is intended to extract salt from recycled water destined to customers off-site and return briny water back to the lagoons on the WTP site. Diameter is not defined.

### 5.14.2 Drainage & irrigation networks

**Hastings** - There are four main catchments within SUZ1. Below is a summary of the catchment information provided by Melbourne Water:

- Watson’s Creek (Catchment Area 6,900 ha), is a permanent stream that forms in Frankston south and flows in a south easterly direction to Western Port (WBM Oceanic, 2002). The stream has been highly modified with much of the riparian vegetation cleared and extensive works carried out to realign the stream and increase hydraulic capacity.
- McKirdy’s Drain (Catchment Area 890 ha) is an ephemeral stream that forms north of Hastings and flows to Western Port. The stream has been highly modified with much of the riparian vegetation cleared and extensive works carried out to realign the stream and increase hydraulic capacity (refer to Figure 27).

- Oliver's Creek (Catchment Area 2,300 ha) is a major waterway forming upstream of Tyabb and discharging into Western Port at Hastings.  Agricultural activities and drainage works have resulted in modifications to the waterway including the realignment of the watercourse and the removal of riparian vegetation.
- King's Creek (Catchment Area N/A) is a stream that forms to the west of Hastings and flows through the township and discharges into Western Port at Hastings.

The BlueScope site which is approximately 800 ha can also be considered a catchment in its own right.  Whilst McKirdy's Drain discharges through the northern section of BlueScope's site, runoff from the rest of the site is managed by BlueScope. The majority of the BlueScope runoff is directed to a lake on the site. Overflow from the lake passes under Bayview Rd and discharges to Hastings Bite via a man-made drain. There is also a discharge point through the existing wetlands into Western Port Bay and another at the BlueScope Jetty.

Esso also have an EPA discharge license for stormwater from their plant, which is treated and discharged into Western Port Bay at Long Island Jetty. Stormwater from the rest of the site is discharged directly into the Bay.

A review of relevant data indicates that all of the major roads surrounding the site have swales or channels running alongside them, with culverts crossing under roads in appropriate locations.

Further details on surface water catchments and their management are documented in the Services & Utilities report.

**Bay West** - The Western Treatment Plant site is very flat and has existing extents of natural drainage and man-made irrigation infrastructure in place that is impacted by stormwater runoff.

The natural drainage includes:

- Werribee River originates in the Wombat State forest and flows though forested (headwaters) and agricultural land for over 100 km before it enters Port Phillip at Werribee South.  While the catchment has been significantly modified the river channel contains good quality remnant vegetation despite the lower reaches of the river being significantly flow stressed due to the extraction of water in the upper reaches for urban and irrigation use.  Water stored in Melton Reservoir is delivered to the irrigators at Werribee South via the river channel to the Werribee diversion weir in Werribee during the summer months
- Little River begins in the Brisbane Ranges and flows through the towns of Balliang, Little River before flowing through the Western Treatment Plant to Port Phillip.  Little River is ephemeral and flows through a largely modified landscape which includes native grassland, grassy woodlands including remnant river redgums (Melbourne Water 2013)
- Lollipop Creek is a small system with its headwaters near Balliang and flows through agricultural areas and Werribee before flowing into the Western Treatment Plant into the treatment lagoons.  Lollipop Creek is heavily modified with limited biodiversity values and lacks for the majority of its length any streamside vegetation

The main rivers and creeks are identified on Figure 26.

The man made infrastructure is understood to include:

- Shallow (1-2 m wide) drainage channels beside all local roads and typically to the perimeter of the agricultural paddocks. In the eastern portion of the site the paddock drains eventually connect to the '15E' main surface water carrier that outfalls to Port Phillip seaward of the primary treatment lagoons, as indicated on Figure 26.

- Shallow (1 - 2 m) wide irrigation channels that convey recycled water across the WTP site for agricultural uses. These also follow the local road alignments, and are identified in Figure 26.
- Two major irrigation channels. These are the main ‘eastern’ carrier and the main ‘western’ carrier. Essentially, as small creeks, these concrete lined channels are used to distribute recycled water across the WTP site to service the local irrigation channels that connect to the agricultural paddocks. The channels connect to the main incoming sewage channel close to Farm Rd and double as emergency sewage conveyance channels at times of high flow, or flooding. The eastern carrier runs to lagoon 115E and is indicated on Figure 26

The whole site is subject to flooding and inundation, flood risk mapping indicates existing land areas are at risk of complete inundation in 1:100 return period events. It is acknowledged that the development of a road / rail corridor will need to be built up from existing levels, and be designed such that it does not impact the flow of surface water away from the critical infrastructure in the NE catchment.

Further detail on the WTP land use is presented in Section 6.4.2 – Melbourne Water – Western Treatment Plant. Proposals to address flood risk are included in Section 7.3.1.

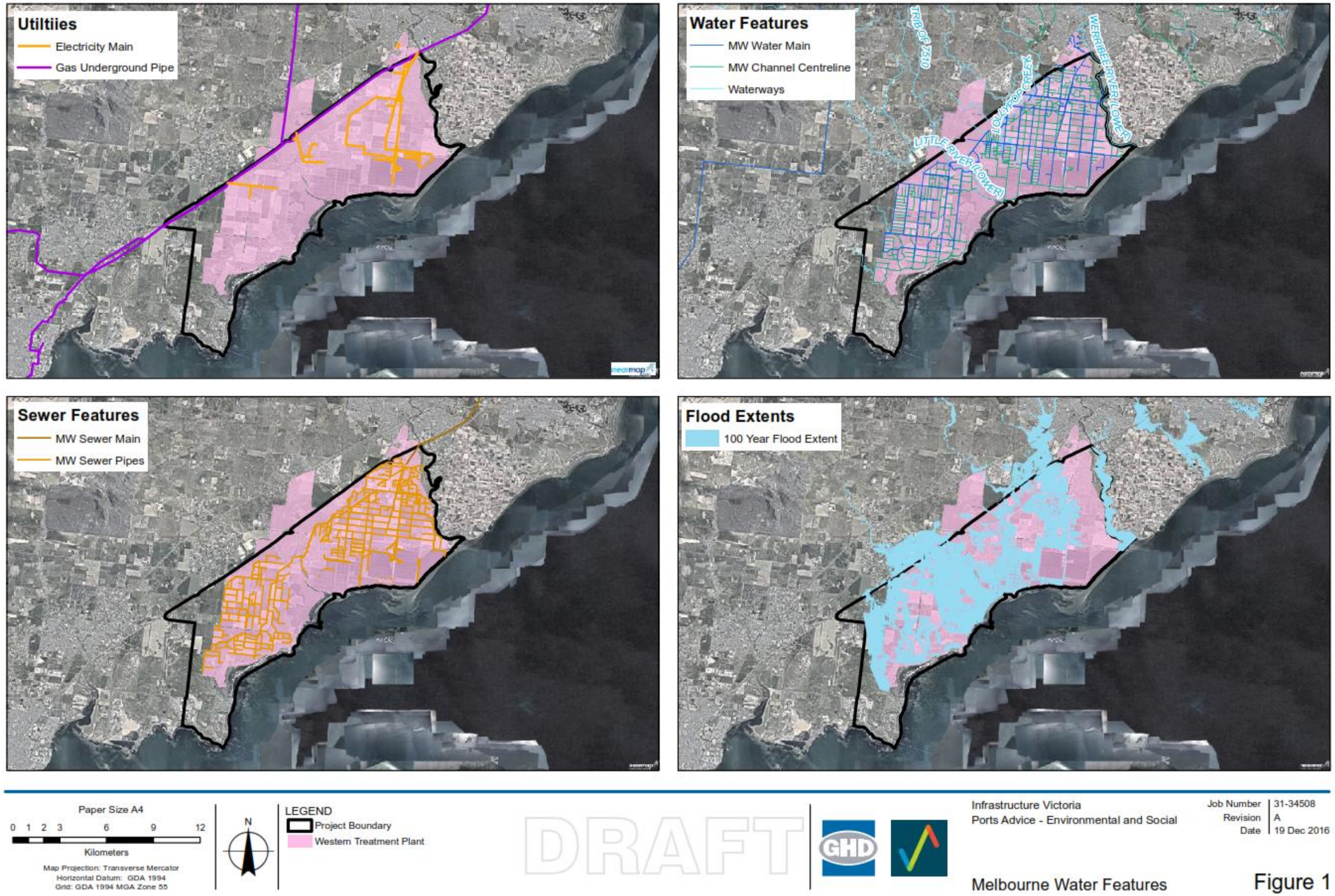



**Figure 26 - Plan of existing utilities around the Western Treatment Plant site area**

### 5.14.3 Utilities

**Hastings** - Details of all local Utilities & Services at Hastings are documented in the Services & Utilities report – AGH-CEP0-EG-REP-0017. This outlines the extent, ownership and capacity of existing services and utility infrastructure across the SUZ1 site and proposed transport corridor. This data was obtained through stakeholder engagement and site inspections.

**Bay West** – Details of local utilities & services made to known to GHD as part of this study are summarised below. This data has been sourced from Melbourne Water and publicly available records. The study has not involved any engagement with services and utility providers.

Power – a high voltage 220kV supply is available from the Werribee substation close to Farm Rd area. The site has 2 no. (separate) 22kV above ground supplies into the site running beside each on the eastern side of the main sewage carrier.

Network power capacity – the network capacity is not known, however the supply is adequate for WTP, which draws around 8-9 MW from the grid.

Renewable electricity – AGL operate on the site and extract methane to generate electricity. The estimated current capacity is estimated at 10 MW (MW Source), the future capacity is estimated at 14MW. The renewable energy is supplied back to the grid, essentially making the WTP operations electricity neutral.

Water - Potable water supply exists. A 300 dia main comes in from the boundary at the Princes Freeway to the west of the future OMRR location. There is a distribution network of 150 diameter pipes across agricultural areas below ground. The potable supply is used to support the agricultural operations.

Recycled water – this is produced by MW as a by-product of the treatment process, and moved around site via two main concrete lined channels (eastern and western) with further local distribution in open channels around each paddock. The eastern carrier dog legs alongside the Werribee River and is likely to interact with proposed transport corridor. The main carriers are estimated to be around 5 m wide.

Sewerage – other than the main lagoons and main sewerage carrier channel and pipe coming into the site from the NE corner, there is a sewer rising main running across the Werribee River in the SE corner into the WTP site. This comes from Werribee South and is managed by City-West Water.

Gas - No supply network exists on site. Methane from sewage is captured and processed by AGL for energy production.

Telecommunications – no details – but fixed and mobile services are confirmed to exist on site.

Other - A chlorine storage facility exists to NE of Cocoroc township.

**Utility & services demand**

The study has relied on utility and service demand estimates that were produced for PoHDA as part of the 2014/15 studies and are presented in Section 5.14. Associated assumptions are enclosed in Appendix C.

It is assumed that development at both Bay West and Hastings will generate similar demands from the container terminal but differ on the landside to reflect the actual footprint of port precinct that coexists with the terminal. This is reflected in the tabulated demand estimates.

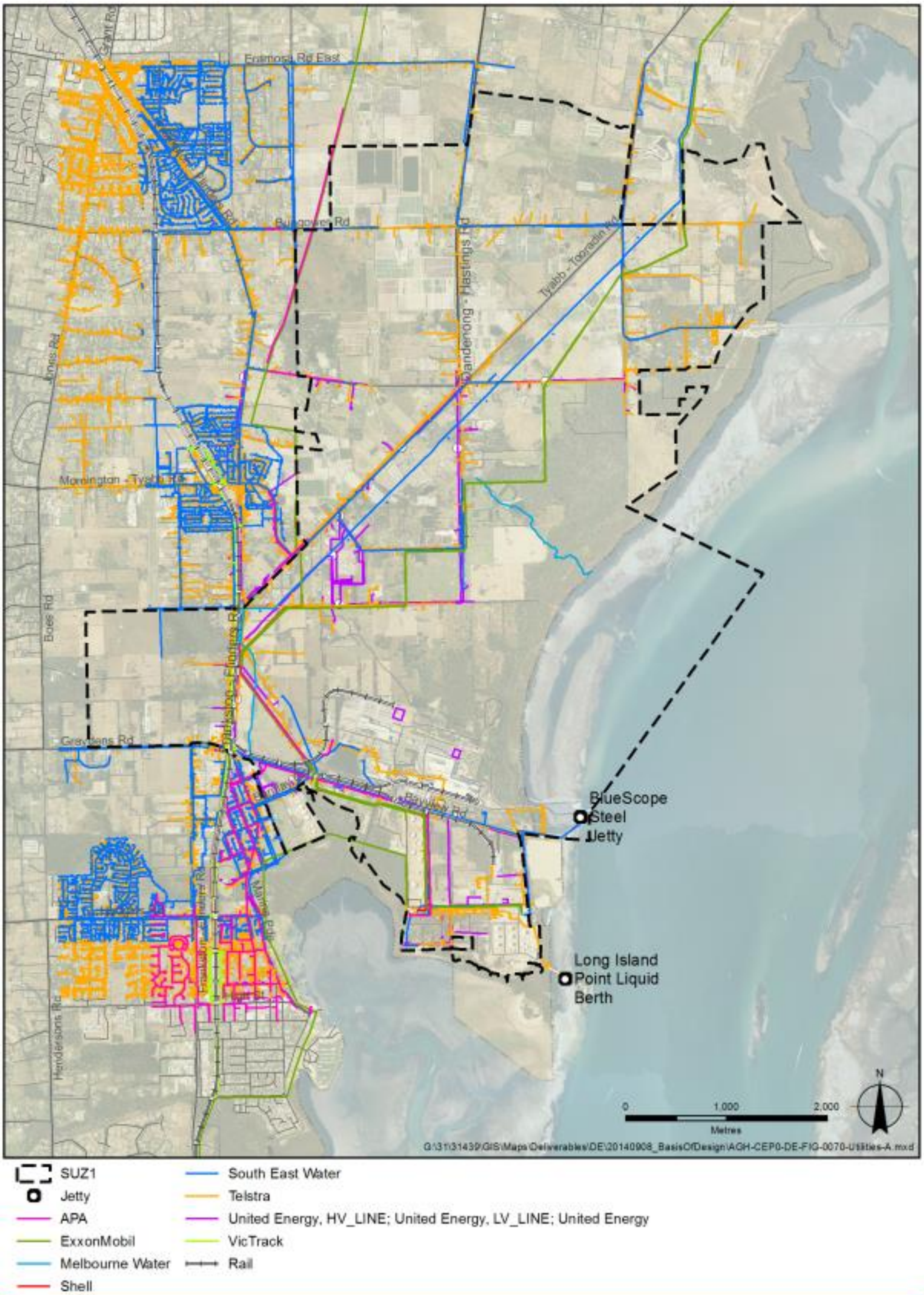



**Figure 27 - Plan of existing utilities around the Port of Hastings**

# 6. Siting Bay West

## 6.1 General

This section summarises the findings of the review of opportunities, constraints and future land uses to identify a site location and terminal configuration within Port Phillip for representation of the Bay West option.

## 6.2 Site assessment process

The selection of a location and configuration for a container port to represent 'Bay West' has comprised several stages which are summarised in the following sections and described in Figure 28.

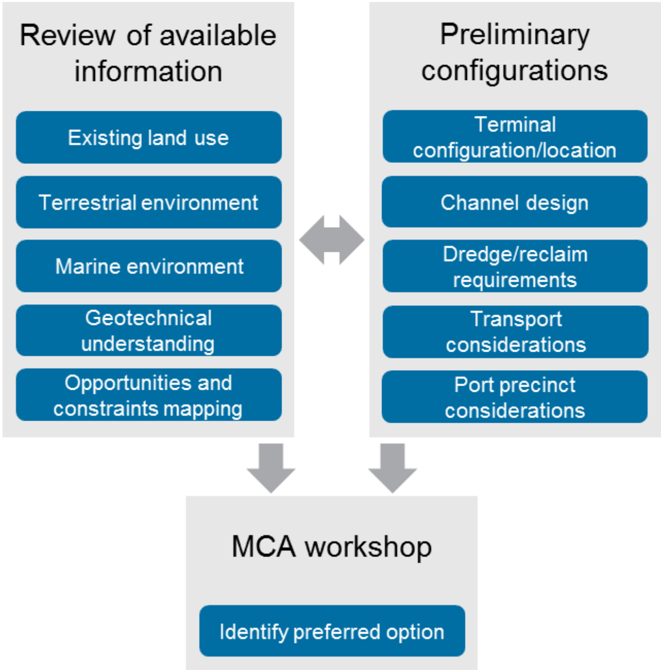



**Figure 28 Site assessment methodology**

## 6.3 Study area extents

The extents of the study area were Point Cook in the east, Point Lillias to the west, Princes Freeway to the north and Port Phillip to the south. The study area is shown in Figure 29.

An initial screening exercise reduced the extents of the assessment. The eastern extents were deemed to be unsuitable as a consequence of rail linkage challenges and the potential impacts to amenity and recreational values around Werribee South, Wyndham Cove, Point Cook Park and the presence of the Point Cook RAAF Base.

The western extents were deemed to be impacted by:

- Shallower water and shallow basalt along the coast line west of Point Wilson which would increase dredge volumes and costs significantly over other sites; and
- The buffer requirements of the Refinery at Geelong, rural residential, educational and open space uses were expected to constrain the use of land west of Point Lillias.

Section 6.4 of this report presents further information on the key land use areas contemplated. Section 6.8 outlines the site locations that have been considered.

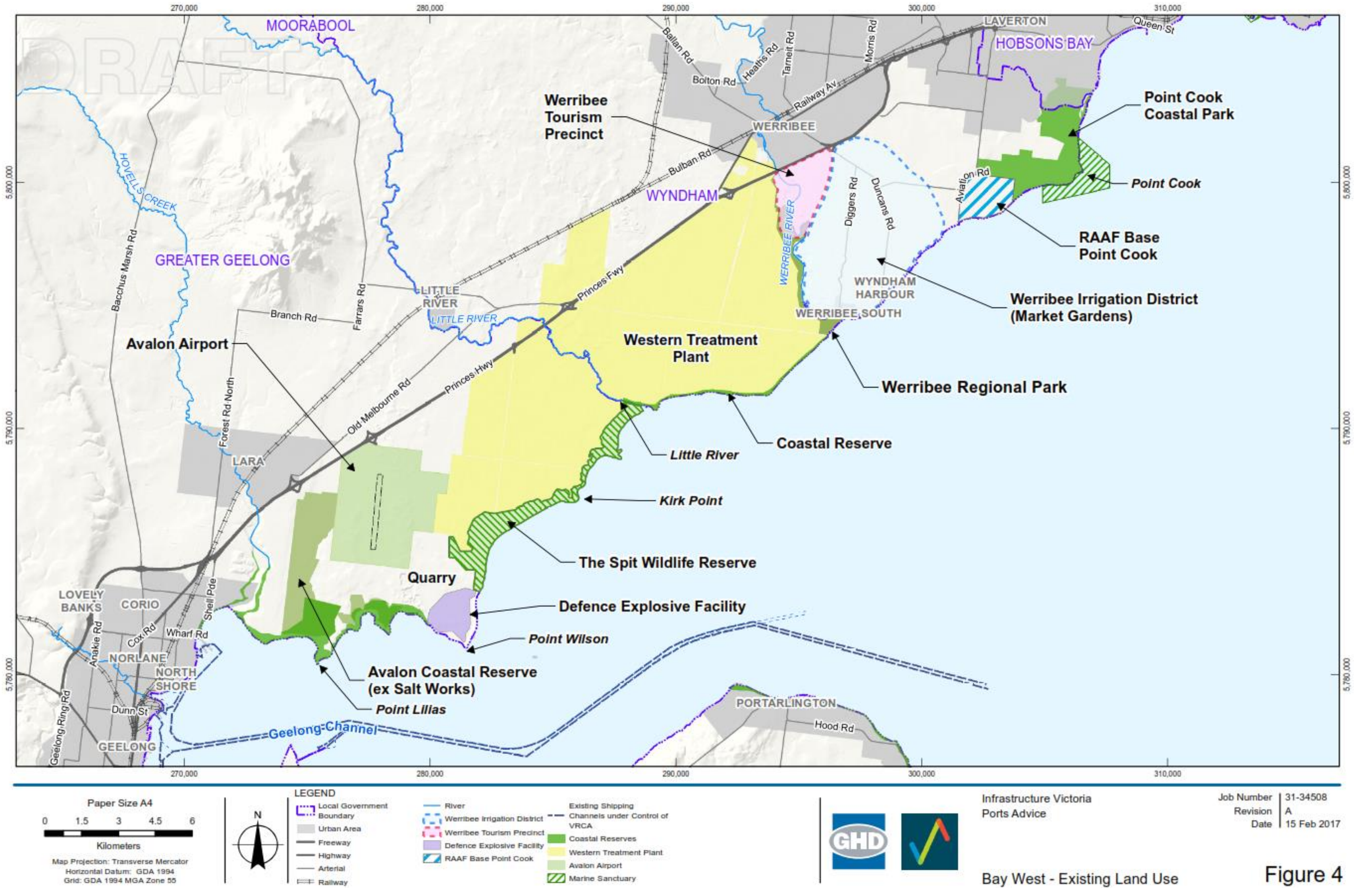



**Figure 29 Bay West study area**

## 6.4 Key land uses

There are a number of existing land uses within the study area that may impact the location of a potential port. The following provides an overview of these major land uses. Figure 29 identified their location.

### 6.4.1 Werribee Irrigation District - (Market Gardens, Tourism Precinct & Boat Ramp)

The Werribee Irrigation District (WID) which is located in the estuarine flood plain of the Werribee River. It is bounded by Werribee River and the Western Treatment Plant to the west, the Princes Freeway to the north, Port Phillip to the south and the D1 Drain to the east.

The WID commenced as a settlement in the early 1900s and today comprises approximately 3,000 hectares (Ha) of land that is largely populated by '**market garden**' growers, as well as land that is used for tourism. The Tourism area includes the Werribee Park Mansion, Werribee Open Range Zoo, Werribee Park Golf Club, State Rose Garden, National Equestrian Centre, Sofitel Mansion and Spa, and Shadowfax winery complex). In addition, the WID includes the Wyndham Harbour Development, a future 1000 berth marina and coastal residential village on which construction began in late May 2011.

In 2009, data indicated that the total area being used for agriculture is approximately 2,350 Ha, with an average farm area of approximately 30 Ha. In 2009, there was an estimated 90 farm management holdings. Land ownership appears to be very stable, with farms being consolidated through leasing arrangements rather than land sales.

The market gardens are major producers of lettuce, broccoli and cauliflower. The value of production per hectare is high, with highly intensive agriculture practices typically producing three crops annually. In recent years, WID farmers have faced significant water shortages, prompting the use of Class C recycled water for irrigation from 2004 to supplement water supply. Irrigation water is supplied by Southern Rural Water (SRW), whilst the Class C recycled water is supplied by the Melbourne Water Western Treatment Plant. This recycled water is highly saline, as a result a greater amount of irrigation water must be used to assist in reducing this salinity than would otherwise be required.

Use and development within the WID is regulated by the Wyndham Planning Scheme. The WID is sited within the Werribee South Green Wedge, to which the Werribee South Green Wedge Policy and Management Plan applies. The Wyndham Planning Scheme Municipal Strategic Statement recognises the WID as a vegetable growing area of State significance. An objective of the Werribee South Green Wedge Policy and Management Plan includes the separation of agricultural land uses and activities from residential, commercial and industrial development and facilities.

*Adjacent Residential areas*: Within or adjacent to the WID are the town of Werribee and suburb of Point Cook, and the smaller communities of Werribee South and Wyndham Cove, all located east of the Werribee River.

*Werribee River Boat Ramp*: a large, multi-lane facility for recreational fishing and boating on the Werribee River at Werribee South.

### 6.4.2 Melbourne Water – Western Treatment Plant

The Western Treatment Plant (WTP) is located to the west of the Werribee River, adjacent to the Werribee Regional Park (which is managed by Parks Victoria). The WTP treats around 60% of Melbourne's sewage (approximately 500 mega litres at Average Dry Weather Flow) and produces high quality recycled water for use in the WID and for City West Water (CWW)

customers. Treated effluent that is not recycled is discharged to Port Phillip to the south via a number of lagoon outfalls located centrally along their Bay frontage. The general area is indicated in Figure 30.

In addition to the main sewage treatment plant, recycled water treatment plant and distribution pipework, the WTP site also has an AGL-operated cogeneration power facility, which is almost sufficient to provide for the WTP's power requirements. The WTP site has significant Ramsar listed wetlands and agricultural areas and is home to the historic township of Cocoroc.

The WTP is situated on a total landholding of around 10,568 Ha, with approximately 5,000 Ha of this land dedicated to agribusiness, and the remainder to the sewage treatment facility and associated works and biodiversity conservation areas. The management of the agricultural business has recently been outsourced by Melbourne Water, with the associated land on a 20-year lease to the agricultural operator. Agricultural uses include cropping, cattle and sheep. Irrigation of the farm with recycled water provides low cost nitrogen reduction that would otherwise need to be achieved through more expensive treatment options.

The WTP facility is continually being upgraded to support Melbourne's population growth and meet environmental obligations.

Recent major upgrade works include:

- Primary treatment lagoon cover replacement and extension works to expand biogas collection and construction of a recycled water pipeline to service City West Water customers.
- Upgrade works to the lagoon pipeline and bay foreshore areas to enable more efficient delivery of nutrients to intertidal areas where high numbers of shorebirds feed,
- Construction of a pipeline from the 'Old Lagoons' area to Lake Borrie to provide increased nutrients to Lake Borrie and low cost sewage treatment.
- A new Activated Sludge Plant is now in construction and renewal of an existing Activated Sludge Plant is also proposed.
- Closure of the Farm Rd access to vehicles from land to the north of Princes Freeway.

Future land use at WTP has also been considered with land required for expansion of the treatment process and resource recovery opportunities identified. The impacts of climate change (e.g. foreshore erosion and sea level rise) are also being investigated for WTP with an adaptive management plan to be developed. The land use understanding is presented in Figure 30, this highlights:

- Transfer of land use to some areas that exist to the north of the Princes Freeway
- Future expansion of the lagoon treatment system to the northeast of 160 South Rd and to the west of the current lagoon extents to the south of 160 South Rd (mid-green shading). This being planned to address future sewage demand but also as a mitigation to the risk associated with the increasing amount of coastal erosion occurring along the foreshore that bounds this lagoon.
- Upgrade of 160 South Rd as one of the main freight route for MW activities at WTP.

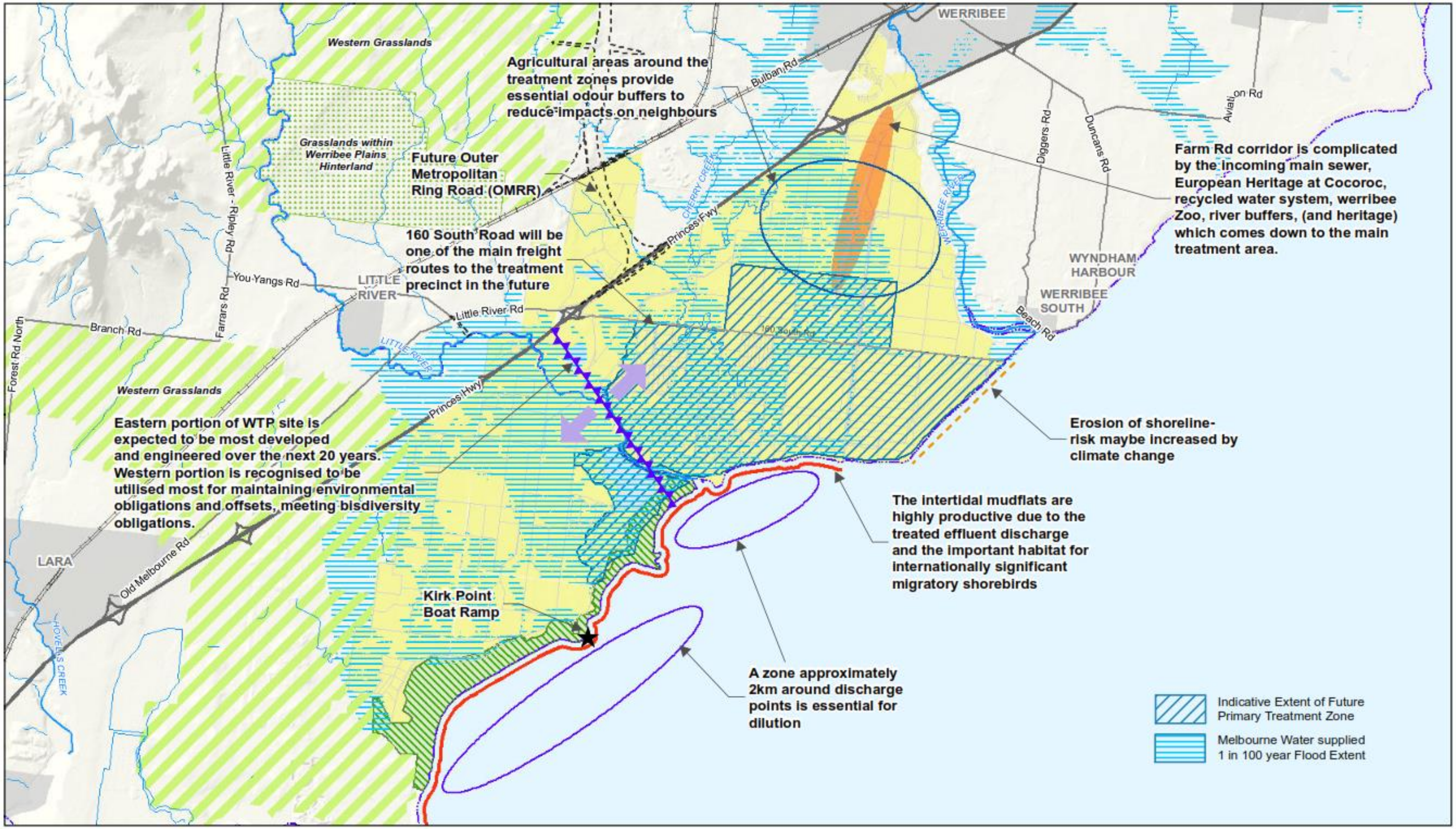



**Figure 30 Understanding of key issues relevant to the future land use at the Western Treatment Plant**

### 6.4.3 Australian Department of Defence site at Point Wilson

Point Wilson comprises an Australian Department of Defence site, that has been used as an explosives facility since the early 1960s and covers 325 hectares. The site contains four explosive handling and storage buildings, and a 2.7 kilometre jetty constructed in the late 1950s and used to load and unload explosive ordinance. The jetty is not in use after the Victorian Regional Channels Authority Harbourmaster deemed the jetty unsafe

### 6.4.4 The Spit Wildlife Reserve

The Spit Wildlife Reserve located on the coast between Point Wilson and Kirk Point, the reserve has high environmental value intertidal sand spits, saltmarsh and mudflats. It is used by migratory birds and is part of the Port Phillip Bay (western shoreline) and Bellarine Peninsula Ramsar Site.

### 6.4.5 Point Lillias

Point Lillias is a thin peninsula at the very south of the site that abuts the former Cheetham Saltworks. Point Lillias is listed as a wetland of international importance under the Ramsar convention as part of the Port Phillip Bay (western shoreline) and Bellarine Peninsula Ramsar Site

### 6.4.6 Mountain View quarry

The Mountain View Quarry at Point Wilson is operated by the Barro Group and is bounded by Corio Bay to the south and Port Phillip to the east. The site is also adjacent the Spit Wildlife Conservation Nature Reserve, an expansive area of saltmarsh habitats which overlap marginally into the north-east corner of the site.

The site is shown in Figure 31, and is bordered by Avalon Airport to the north-west, and the Commonwealth Government Munitions Storage area to the south-east. The site is accessed from Dandos Road.

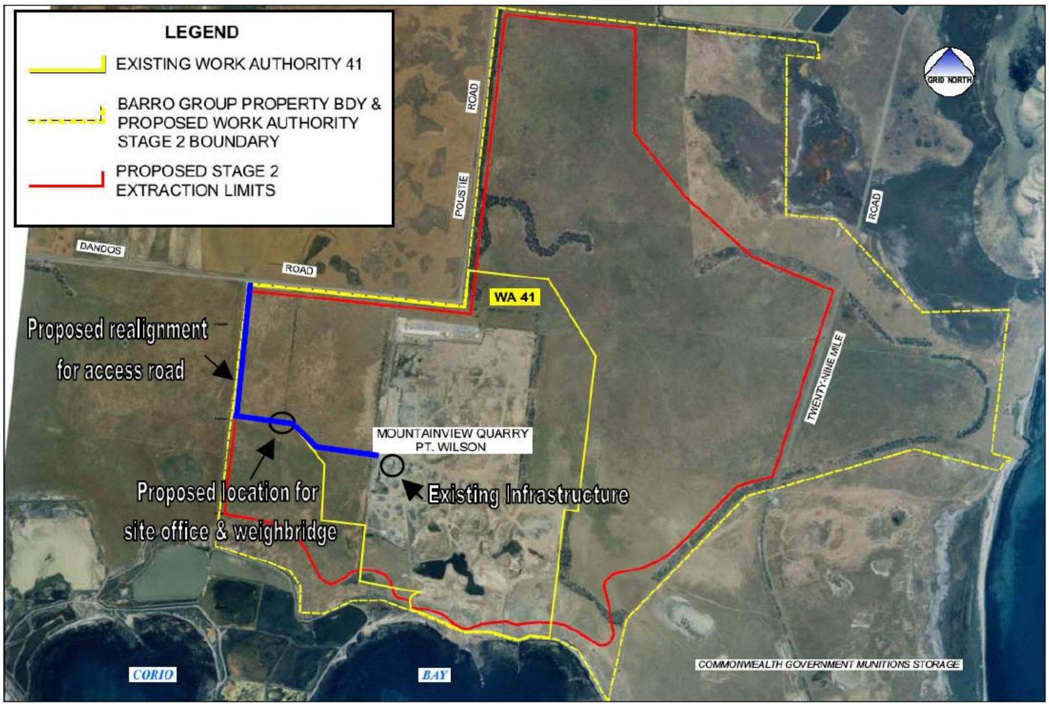



**Figure 31 Mountain View quarry site area**

The surrounding land uses provide buffers between the site and the nearest residential dwellings, which are approximately 5 kilometres away.

Quarrying activities on site began in the early 1970s, with 2012 production rates varying between 1 and 1.4 million tonnes of basalt per year. The existing Stage 1 quarry involves the extraction of basalt over an area of 324 Ha to a depth of approximately RL 0 m. The Stage 2 extension would increase the extraction area to 562 Ha and includes the extraction of quality basalt in some deep areas below the water table. The Stage 2 extension would extend operations on site by 40 to 50 years at current production rates and would essentially be a continuation of current activities, expanding the operation boundary to the north, east and west, with a small proportion of deep extraction below 0 mAHD.

### 6.4.7 Avalon airport

Avalon Airport is located south west of Melbourne along the Princes Highway. The land which immediately surrounds the Avalon Airport to the north east predominately consists of large parcels of either farming or grazing land. Avalon Airport is also bounded by the Cheetham Salt works, the Mountain View Quarry, the Commonwealth Government Ammunitions Storage Facility and the Melbourne Water Western Treatment Plant.

Avalon Airport Corporation is in the process of considering its long term future and building on the existing Avalon Airport Future Directions plan. An Airport Masterplan is publicly available and presented in Figure 32.

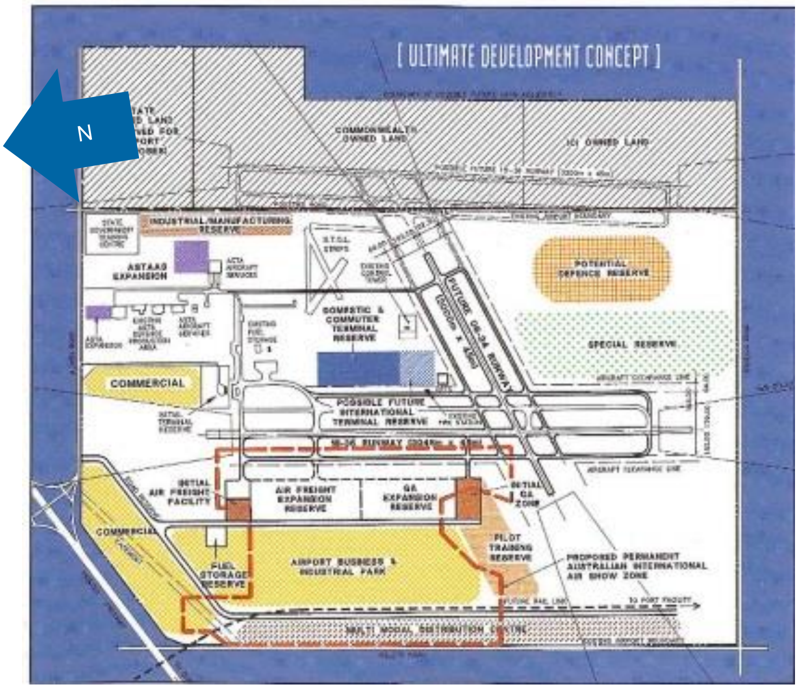



**Figure 32 Avalon airport future masterplan**

Avalon Airport currently has one main runway which is orientated north south. The masterplan suggests a future 2nd and 3rd runway arrangement running north-south and east-west. The resulting configuration is indicated in Figure 30. Terminal zones for all options are expected to be outside the height restricted zones.

The airport is protected by the Council of Australian Governments (COAG) Airport Environs Overlay control, which exists to discourage unsuitable development over areas around the Avalon Airport that require protection to future proof the airport for the purposes of expanded flight path operations and a potential second runway.

### 6.4.8 Point Cook RAAF base

The Royal Australian Air Force (RAAF) Base at Point Cook is part of RAAF Base Williams and occupies approximately 250 Ha on the shoreline of Port Phillip.

This base was the first RAAF Base in Australia and currently provides facilities for the Air Force element of the Australian Defence Force Gap Year Program and the RAAF Museum. The airfield is operational and used for general aviation uses and aerobatic uses. The aerobatic uses of the airfield restrict the height of infrastructure on land surrounding the base, extending to the Western Treatment Plant in the south and Altona South in the north.

## 6.5 Local environment

This area of Port Phillip is recognised as being rich and diverse. It is a Ramsar listed area encompassing terrestrial, intertidal, and marine areas. A full description of environmental values is contained in the supporting Environmental & Social work package study work for IV.

## 6.6 Physical attributes

### 6.6.1 Bathymetry

Figure 33 highlights the bathymetry in the area (mCD). The bathymetry along the north-western coast is characterised by a gently sloping seabed profile of around 1 to 500 profile out to around the -10 m CD contour, after which the seabed is generally flat.

The -10 m CD contour is typically 5 km from shore. The maximum water depth offshore in the Bay is around 30 m.

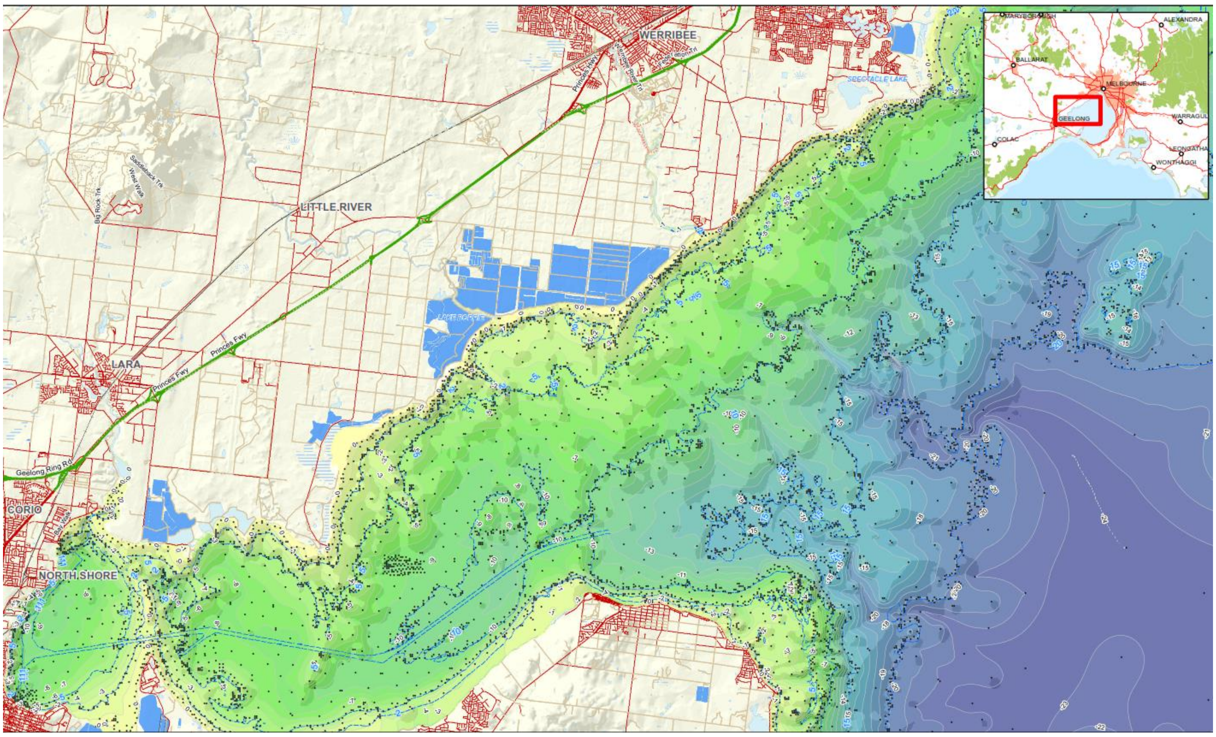



**Figure 33 Bathymetry in the study area**

## 6.7 Geotechnical understanding

The understanding of geotechnical conditions has been gained through a desktop review of published information and targeted geophysical investigation. This section identifies the information sources, the scope of the geophysical survey and general conclusions on the geotechnical situation.

### 6.7.1 Geophysical investigation

GHD have undertaken a marine geophysical investigation for IV for the purpose of investigating the 'Bay West' site, which covers the area between Point Cook and Point Lillias on the north-western shore of Port Phillip Bay.

The investigation was to assist in determining risks to port development including dredging of access channels, swinging basins and berths as well as a significant area of reclamation for quays and container terminals.

The marine geophysical survey focussed on the identification of the rock horizon extending out from the shoreline. The aim was to highlight areas potentially impacted by future dredging levels.

The main survey area was covered by longitudinal and tie lines with a coverage of 147 lineal km using following geophysical investigation techniques:

- Sub bottom Profiling (SBP)
- Marine Magnetics (MM)
- Side Scan Sonar (SSS)

The findings are summarised in Figure 34.

### 6.7.2 Sources of information

The following sources of information have been reviewed and considered in the geological desk top assessment


Bird E.C.F, 1993. *The Coast of Victoria.* Melbourne University Press, Melbourne.

Bird E. 2011. *Changes on the Coastline of Port Phillip.* Victorian Government Department of Sustainability and Environment, Melbourne.

Coffey Geosciences, 2005. *Port of Geelong Timber Beacon Replacement Project, Geelong Channels, Victoria.* Victorian Regional Channels Authority.

Cupper M.L., White S. & Neilson J.L. 2003 Quaternary *In:* Birch W.D. ed. *Geology of Victoria,* pp. 337-359. Geological Society of Australia Special Publication 23. Geological Society of Australia (Victoria Division).

Department of Primary Industries *Sites of Geological and Geomorphological Significance.* Victorian Resources Online, Port Phillip and Westernport, accessed 06 July 2012.

GEDIS – Geological Exploration and Development Information System. Geoscience Victoria borehole database.

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Geological Survey of Victoria, 1974. *Melbourne* 1:63 360 Map Sheet. SJ-55-1 Part 7822 Zone 55

Geological Survey of Victoria, 1977. *Portarlington* 1:63 360 Map Sheet.

GHD internal borehole database.

GHD, 1993. *Specification 91/8 Report on Phase 1 Assessment Part A – Engineering Soil Tests Shipping Channels.*Port of Geelong Authority.

GHD. October 2016. Port Philip Bay Geophysics Survey. For Infrastructure Victoria. Rep No. 3134451-72036.

GHD. September 2016. Wilson Spit Rock Study, Geophysics Survey Report. For Victorian Regional Channels Authority. Rep No. 34246-254267

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Holdgate G.R., Wagstaff B. & Gallagher S.J., 2011. Did Port Phillip nearly dry up between ~2800 and 1000 cal. yr BP? Bay floor channelling evidence, seismic and core dating. *Australian Journal of Earth Sciences 58:2,* pp. 157-175.

Hydrographic Service, Royal Australian Navy, 1986. *Approaches to Melbourne* 1:37 500 Map Sheet Aus 155.

Hydrographic Service, Royal Australian Navy, 1981. *Geelong Harbour and Approaches* 1:37 500 Map Sheet Aus 157.

### 6.7.3 Regional marine geology

The seabed stratigraphy within the project area is characterised by recent Holocene-age deposits of silty sands, clayey silts and silty clay overlying Tertiary-age soils and rocks of the Brighton Group and Fyansford Formation. Over parts of the study area, the tertiary deposits are overlain by Quaternary Pleistocene Newer Volcanics basalt. The general sequence of strata is summarised in Table 28 below.

**Table 28 Sequence of strata at Bay West**

| Unit Name | Age | Distribution and Description |
| --- | --- | --- |
| Holocene and Pliestocene Sediments (Recent deposits) | Quaternary Holocene and Pleistocene | Expected to occur over much of the project area to a variable thickness. Typically unconsolidated silty sand, sandy silt and sandy clay of low strength. |
| Newer Volcanic Basalt | Quaternary Pleistocene | Laterally discontinuous over project area. Generally dark grey, fine grained variably vesicular high strength rock. Fracture patterns are variable, and weathered, interbasalt soil zones may be present. |
| Brighton Group (Moorabool Viaduct Sands) | Tertiary Pliocene | Expected to be present over much of project area. Comprises silts, sand and clay. |
| Fyansford Formation (includes Batesfordian Limestone members) | Tertiary Miocene-Oligocene | Expected to be present, at depth, beneath much of project area. Typically comprises dark grey calcareous clay with interbedded ferruginous and calcareous layers.<br>At depth, sandy limestone may be present. |

#### Holocene and Pleistocene sediments

The recent sediments are expected to be of very soft to firm consistency and may contain shell fragments and organic material including sea weed. The depth of the sediments is expected to be variable.

With reference to a marine geophysical survey of the project area undertaken by GHD in 2016 (refer Figure 34), the thickness of sediment above the basalt across the project area varies between less than one metre and greater than 26 metres. The thinnest cover of sediment principally occurs to the western extent of the project area, being thickest in the central portion of the project area. The geophysical study split this material into two units (Units 1 and 2).

- Unit 1 is expected to comprise recently deposited fine sands and silt.

- Unit 2 is expected to comprise fine silts and clayey deposits

In general, these materials are expected to be of low strength and relatively loose consistency.

As part of the geophysical survey undertaken in the Wilson Spit area for the Victoria Regional Channels Authority, GHD was provided with borehole logs for holes drilled south of the existing shipping channel by URS in 2014. These logs record the recent deposits overlying the basalts to comprise sandy clays, clays and sands. The clays are generally stiff to very stiff, with some soft and firm layers, in places. The sands were generally medium dense, but with some loose zones present.

Within the deposits, buried channel features resulting from the formation of sub-aerial river systems during periods of marine regression, are known to be present in Port Philip Bay. The geophysical survey identified two such features in a survey line conducted approximately 2km offshore from Kirk Point. These features are approximately 15m to 20m deep and between 0.8 km and 1.0 km wide and infilled with Unit 1 and Unit 2 materials.

### Newer volcanics basalt

With reference to the available geophysical survey data presented in Figure 34, Newer Volcanics basalt is inferred to be present beneath the Holocene sediments over much of the western end and the of the project area, and beneath the survey line conducted closest to shore.

Where present, the depth to basalt has been found to vary between 1 m and greater than 26 m below seabed level, corresponding to elevations between -3 m to -30 m CD. The findings from the geophysical survey align well with expected locations based on LIDAR and magnetics surveys as reported by Holdgate (et al) and presented on Figure 35. The data show that the seaward extent of the basalt varies along the coast of the project area, being up to 10 km in the west (at the entrance to Corio Bay), and varying between 7 km and 2 km (approx.) over the remaining area. As a general rule, the elevation of the top of basalt decreases with distance from the northern shoreline.

With reference to the URS boreholes drilled at Wilsons Spit, coring of the basalt, undertaken in three boreholes, reveals the basalt to comprise distinctly weathered to fresh, high to very high strength rock, with rock quality designation (RQD) values between 0% and 67%.

The extent of near-surface basalt at Point Wilson (some 10 km west of the site) was verified during the original dredging of the Geelong Port Channel (conducted circa 1965), most notably at the junction of the Point Richards Channel and that of Wilson Spit Channel, where the rock required removal by grab and blasting.

### Brighton Group (Moorabool Viaduct Sands)

Tertiary-age Brighton Group soils are inferred to be present beneath the project are based upon a review of the 1:65,000 scale geological maps of Geelong, Portarlington and Melbourne. The Brighton Group, and its contemporaneous equivalent in the Geelong and Portarlington regions – the Moorabool Viaduct Sands, are described in the Geology of Victoria to comprise ferruginous sandstones, often fossiliferous, and up to 21 m thick.

Studies of the Brighton Group rocks beneath Melbourne describe clay, sandy clay, clayey and silty sand and occasional silt materials. Fine grained soils are generally of firm to hard consistency, while the sand-rich soils are generally medium dense to very dense.

### Fyansford Formation

The Fyansford Formation is expected to be present beneath Brighton Group/Moorabool Viaduct soils across the project area.  In the Corio Bay area, Fyansford Formation soils are present beneath the Holocene sediments and exposed in low cliff sections along the coast line.

The Fyansford Formation comprises dark grey clay, often calcareous, which contains interbeds of relatively hard ferruginous and calcareous material.

With reference to Haberfield (1992), the Fyansford Formation comprises over-consolidated sandy silts, clays, silty sands and clayey sands.  The clays are generally very stiff to hard with reported undrained shear strengths being as high as 300 kPa and 500 kPa.  SPT N values are reported to range between 21 and 40, with refusal being possible on the calcareous or ferrigunous bands which tend to be consistent with weak rock.  As such, the Fyansford Formation is relatively incompressible.

### Regional onshore geology

The geological sequence recorded onshore in the project area is broadly consistent with that encountered offshore, except for the type, extent and thickness of Holocene-age deposits.

The 1:63,360 scale geological map for Portarlington indicates the onshore geology to comprise a surface covering of Quaternary Pleistocene clay and sandy clay, with some beach sand and localised swamp deposits overlying the Tertiary Moorabool Viaduct sands.

Along the coast towards Melbourne, the surface geology comprises Deutgam Silt, described as brown to grey-brown silt with abundant carbonate nodules; gravel, sand and silty sand; coastal swamp deposits comprising fine sand and silty clay, and localised raised beach ridges comprising sand, shelly sand with minor silty or clayey sand.

The Deutgam Silt deposits were laid down in a depression in the basalt surface (Bird, 1993). Historical borehole data suggests that these alluvial deposits exceed 20 m thick in some areas. In recent times the Werribee River has incised these deposits forming its current channel.

The alluvial deposits are likely to be compressible, requiring consideration for onshore construction. These deposits are likely to be thickest in the vicinity of the current Werribee River, however there is a risk of buried former channels and accompanying thick deposits across the delta area.

The recent Holocene and Pleistocene deposits are expected to overlie Newer Volcanics basalt along much of the project area between point Wilson and Point Cook.

Weathered basalt outcrops at surface in large sections of the southern part of the study area. Residual basalt soils generally consist of stiff, sensitive high plasticity clay that are known to be highly reactive.

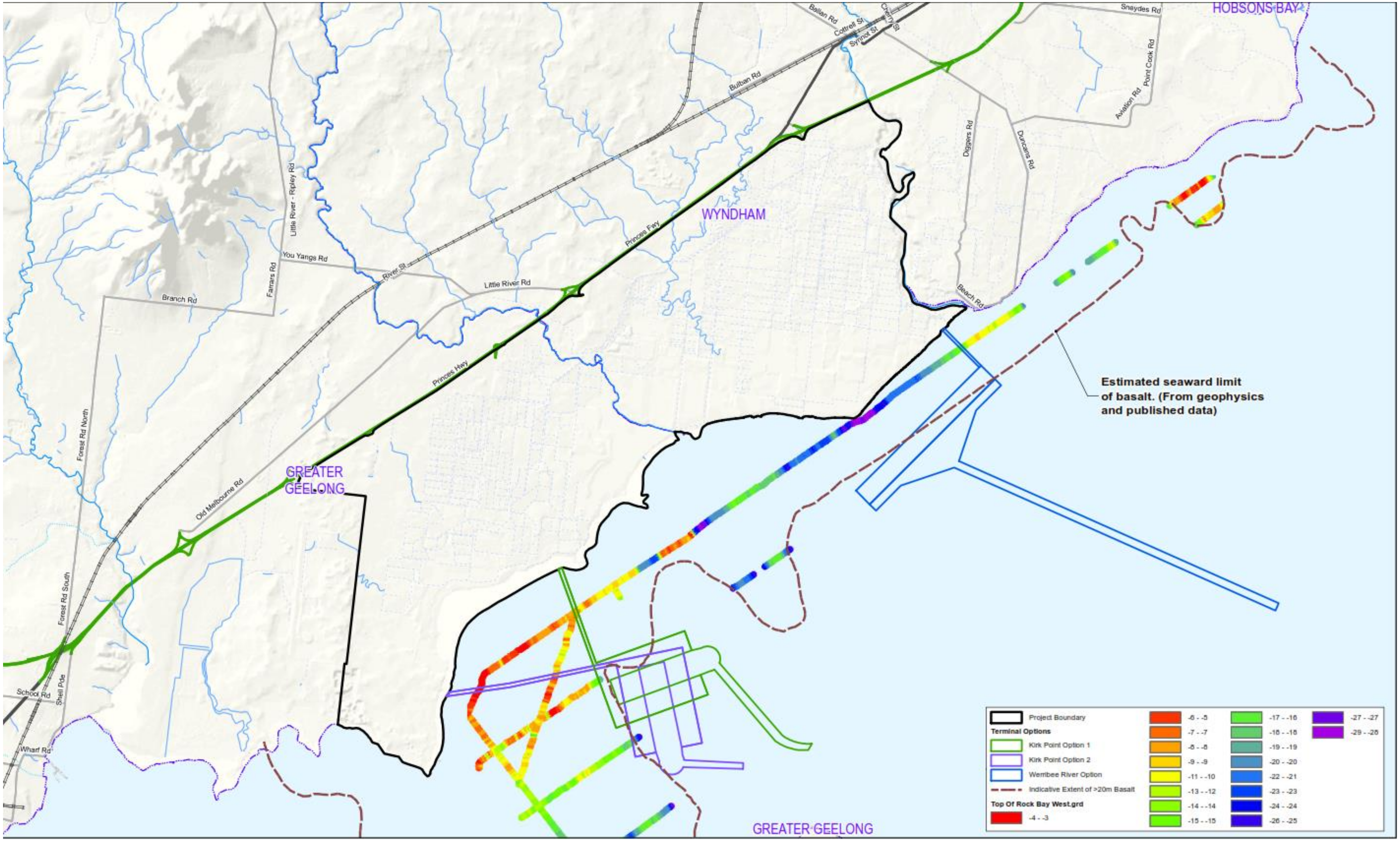



**Figure 34 Geophysical investigation findings (extents and depth of sub surface basalt)**

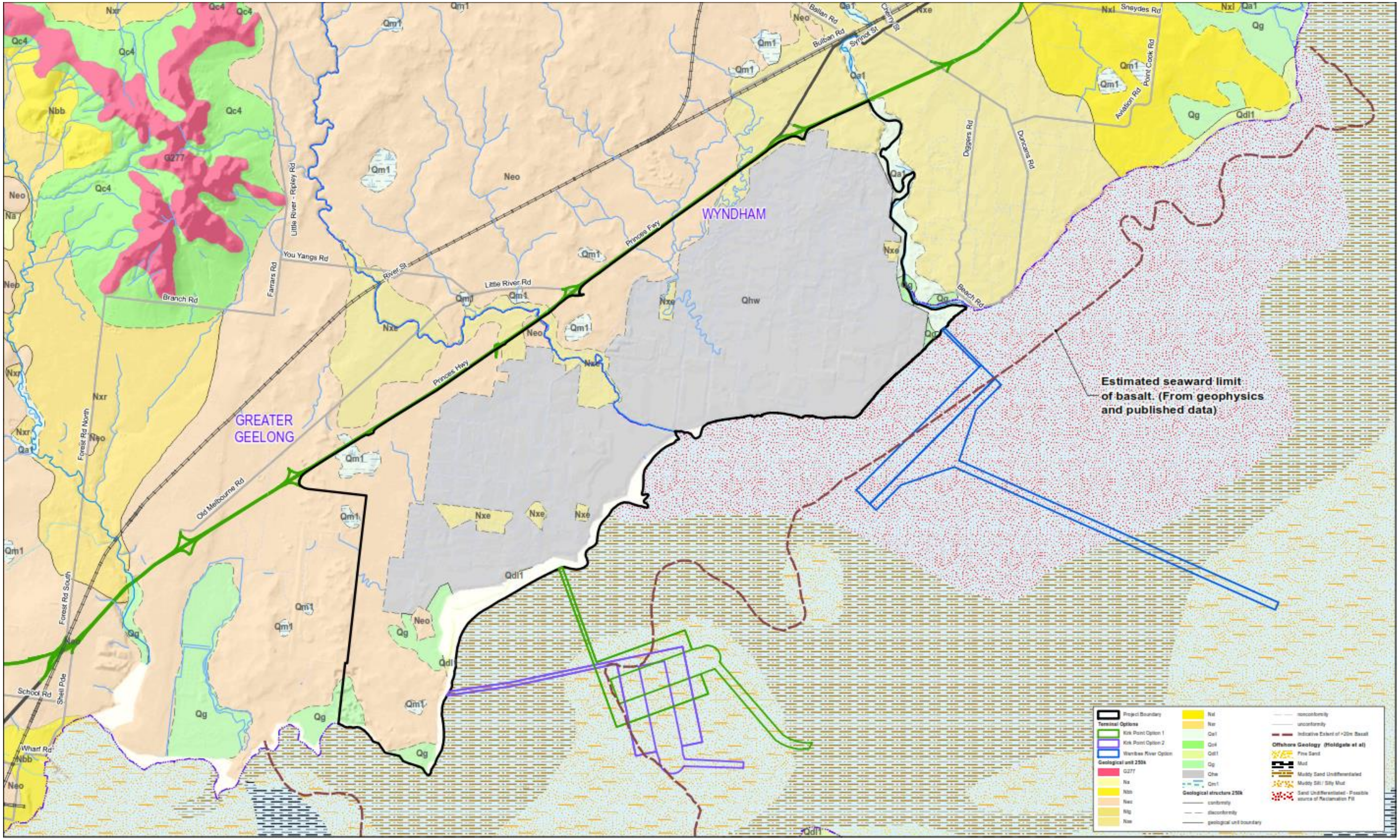



**Figure 35 Geotechnical summary of Bay West surface sediment (with configuration options)**

## 6.8 Preliminary location options

After screening the site envelope and geotechnical data, three locations were proposed. These are identified together on Figure 36 and are (from west to east) defined as:

- Point Wilson
- Kirk Point; and
- Werribee River

All concepts contemplate offshore development comprising land reclamation. This approach minimises dredging and allows material to be beneficially re-used. The offshore location mitigates against the need to dredge rock which is estimated to have a 14:1 cost ratio with clay[2].

For the purposes of assessment and to satisfy the broad functional needs, each configuration comprised 5 km total quay line, a 600 m wide land footprint, 700 m dia turning basin, 230 m wide channel, -16.5 mCD dredged depth, a +5 mCD fill height, 100 m wide road corridor and a 5km x 250 m rail marshalling yard.

The locations are described below.

### 6.8.1 Kirk Point

The Kirk Point location is identified in green in Figure 36 This contemplates:

Terminal and quay

- An offshore island development in a similar location to that considered for Pt Wilson
- A port footprint with berth located at least 4 km from the E-W shoreline to keep the envisaged extents of potential dredging outside the critical zone of Basalt flows

Transport corridors

- Road and rail transport linkages running north-south from the terminal to the shore and then north- south across the landside areas of the WTP to connect to the Princes Freeway and the existing rail corridor to the North.
- The transport linkage is envisaged to align with the future OMRR junction. Rail marshalling on WTP land or potentially west of the future OMRR alignment.

Channels

- A new navigation channel running partly along the alignment of the existing Pt Richards channel serving Geelong Port and into the port area

### 6.8.2 Point Wilson

This location is identified in purple in Figure 36, and contemplates:

Terminal and quay

- An offshore island development
- A port footprint with berth located at least 5 km from the Point Wilson shoreline to keep the envisaged extents of potential dredging outside the critical zone of Basalt flows

2 Source: Baggerman study for GHD

Transport corridors

- Transport linkages running east-west from the terminal to the shore and then north-south outside the WTP western boundary (close to Avalon Airport) to connect to the Princes Freeway west of future OMRR junction and the existing rail corridor to the North
- Rail marshalling close to Avalon Airport

Channels:

- A new navigation channel running partly along the alignment of the existing Pt Richards channel serving Geelong Port and into the port area

### 6.8.3 Werribee River

The Werribee River location is identified in red in Figure 36. This contemplates:

Terminal and quay

- An offshore island development further to the east of the other options, westward and clear of the outlet of the Werribee River
- A port footprint with berth located at least 1.5 km from the adjacent shoreline to keep the envisaged extents of potential dredging outside the critical zone of Basalt flows.

Transport corridors

- Road and rail transport linkages running north-south from the terminal to the shore and then northwards and westward across the landside areas of the WTP to connect to the Princes Freeway and the existing rail corridor to the North. The route runs around the sewage treatment lagoons.
- The transport linkage is envisaged to align with the future OMRR junction and potential operational freight routes on the WTP site (Mw designations).
- Rail marshalling west of the future OMRR alignment.

Channels

- A new navigation channel running directly from deep water into the port area.

## 6.9 Preliminary port configurations

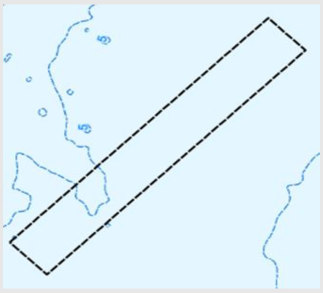
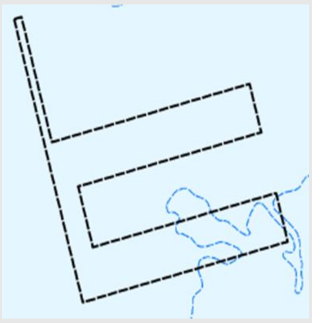
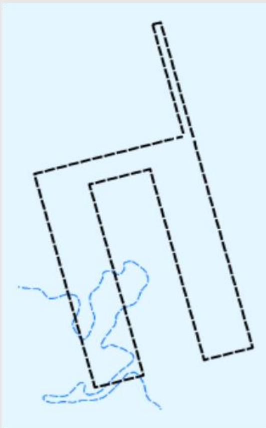
The assessment considered alternative configurations and locations of the port facility.

Potential configurations included:

1. Single linear piers and terminals
2. Multiple piers / terminals, to form a terminal basin.

The features of the configurations are described further in Table 29 to highlight specific attributes that are relevant to sustainable design, capital cost, environmental impact and fit with the proposed future land use around WTP.

**Table 29 Terminal configurations considered**

| Scenario | Description | Preferred configuration |
|---|---|---|
| 1 | Single island berth constructed from dredged material arising from the new channel and turning basin dredging together with other dredging works (as appropriate). The arrangement would be optimised to minimise disposal of dredged material. |  |
| 2 | Multiple piers orientated east-west to form a single basin. This is assumed to be constructed from dredged material arising from the new channel and turning basin dredging together with other dredging works (as appropriate). The arrangement would be optimised to minimise disposal of dredged material<br><br>Out of the two options under this arrangement scenario, this configuration was found to have a higher dredge volume but lower in-situ reclamation volume (need) for similar distances from shore. |  |
| | Multiple piers orientated north-south to form a single basin. This is assumed to be constructed from dredged material arising from the new channel and turning basin dredging together with other dredging works (as appropriate). The arrangement would be optimised to minimise disposal of dredged material<br><br>Out of the two options considered under arrangement scenario, this option was found to have a lower dredge volume but higher reclamation volume for similar distances from shore. |  |

Assumptions: 5 km total quay line, 600 m wide footprint, 700m dia turning basin, 230 m wide channel, -16.5 mCD dredged depth, +5 mCD fill height, 500m wide basin, 250m wide berth pocket.

### 6.9.1 Proposed configuration for Kirk Point & Point Wilson

The terminal configuration at Kirk Point and Point Wilson is a terminal consisting of two piers running either parallel, or perpendicular to shore. With the choice being influenced by the associated route of the road and rail connections and navigation channel alignment. Reasons for this are as follows:

- A single pier option running perpendicular to shore set outside the assumed rock extents would encroach on the existing shipping channel serving the Port of Geelong.
- Single pier options running parallel to shore could create a larger wave shadow which has potential to affect the primary water mixing zone of the WTP outfalls.

### 6.9.2 Proposed configuration for Werribee River

The terminal configuration proposed for Werribee River is a terminal consisting of a single island pier running parallel to the shoreline. This was selected for the following reasons:

- There is greater opportunity to balance dredge volumes with reclamation needs using material arising from the works close to WTP. This is due to a lower amount of reclamation material being required to construct the island compared to options comprising pairs of piers.
- Predominant winds are from the south-west which will be running parallel to ships which are moored at the terminal. This is favoured as it reduces the chances of wind causing difficulties during mooring/berthing.
- It aligns well with the assumed rock contour profile, mitigating rock dredging risks.
- There is good opportunity to phase subsequent dredging tasks such they minimise impacts on any early phase operations.
- One pier is similar in concept to that being adopted at Hastings.

### 6.9.3 Implications of distance from shore

The distance of each proposed terminal from the shore is impacted by:

- the risk of needing to dredge basalt,
- the extended travel distance over water and
- the bathymetric profile at each location, as deeper water reduces dredging, but increases reclamation needs.

The presumed extent of basalt is indicated in Figure 34 and the each of the option layout figures (over the page) by the dashed brown line.

The implications for dredge and reclamation volumes is discussed in Section 6.10.

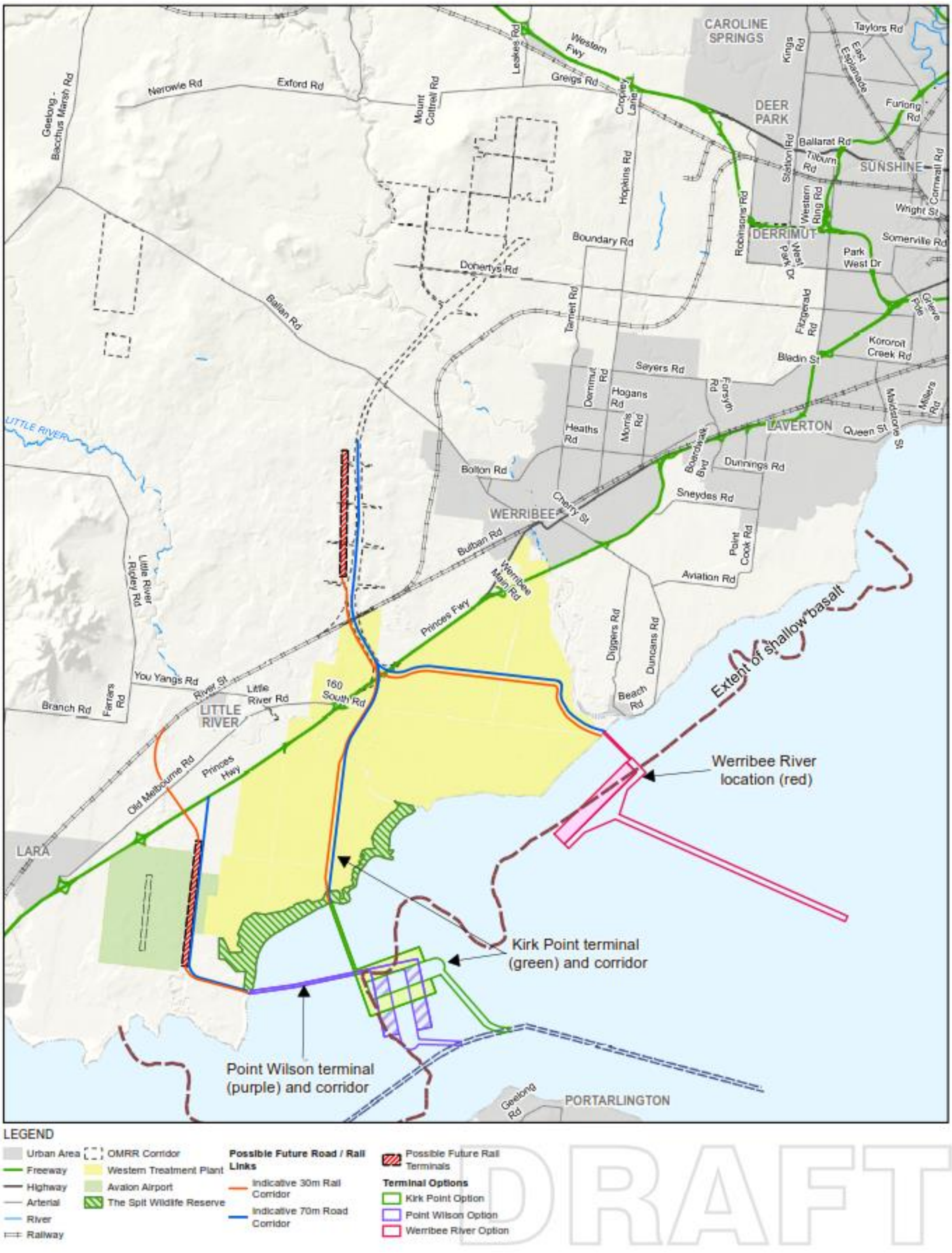



**Figure 36 Kirk Point proposed terminal location**

## 6.11 Dredge volume comparison

### 6.11.1 Channel dredge volumes

Channel dredge volume estimates were used as a proxy for the dredge task, as vessel turning and berth pocket needs were expected to be similar (with the basin area broadly matching island berth pocket area).

The highest dredge volumes came from channels leading to the Kirk Point and Point Wilson options. It was also found that the use of the existing Geelong Port channel, enabled dredge volumes to be minimised for this location. This is due to the deeper water and the reduction of material needing to be dredged due to the existing channel.

The Werribee River site had the smallest dredge volume. It was found that the dredge volumes were typically 30% to 50% higher when dredging to the Kirk Point and Point Wilson site.

Figure 37, shows a comparison of the three possible shipping channels from deep water to Bay West terminal locations. (assumptions are stated on page 84.)

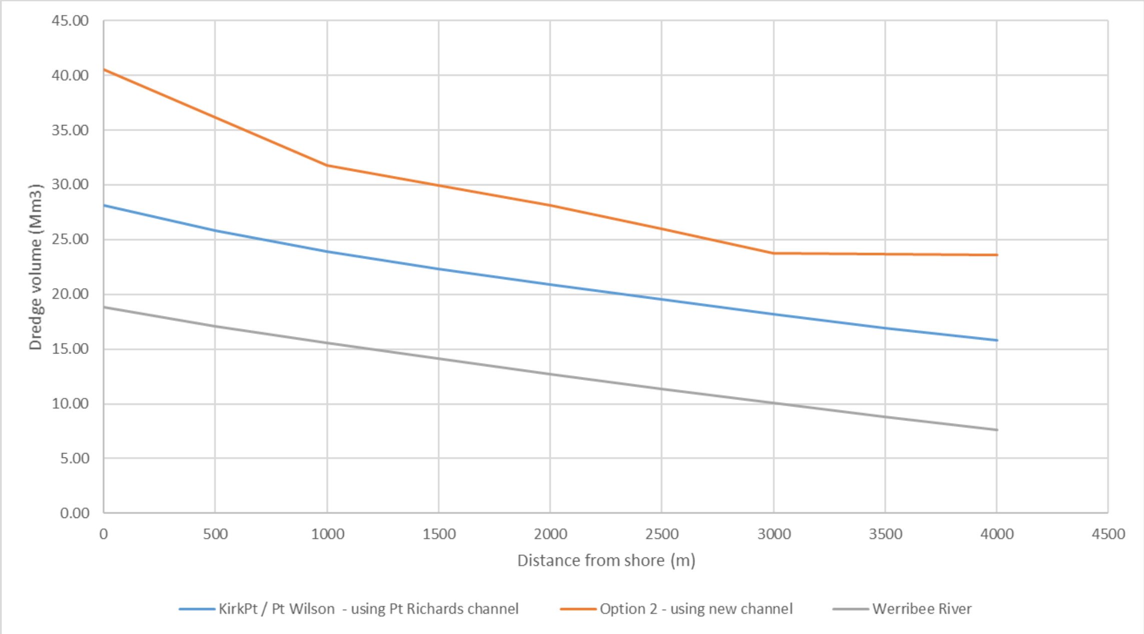



**Figure 37 Differences in channel dredge volumes**

### 6.11.2 Balance of dredging and reclamation

With sustainability in mind, a further assessment was undertaken to consider the opportunity to balance total dredge and reclamation volumes for the adopted configurations at each site location.

This considered the implications for the balance of material at different distances from shore. This tested scenarios for the percentage reuse of the capital dredged material arising from only the new channel, turning basin and berth pocket.

#### Point Wilson

Figure 38 illustrates that the 'optimal' location at Point Wilson would be around 750 m from shore (if 100% of the dredged material is able to be used for reclamation) and 0 m from shore (if 80% of the dredged material is able to be used for reclamation).

It is noted that this would put the development in the shallow basalt  zone, increasing the risk of dredging rock and likley result in an heaviliy imbalanced (dredge volume: reclaim) solution.

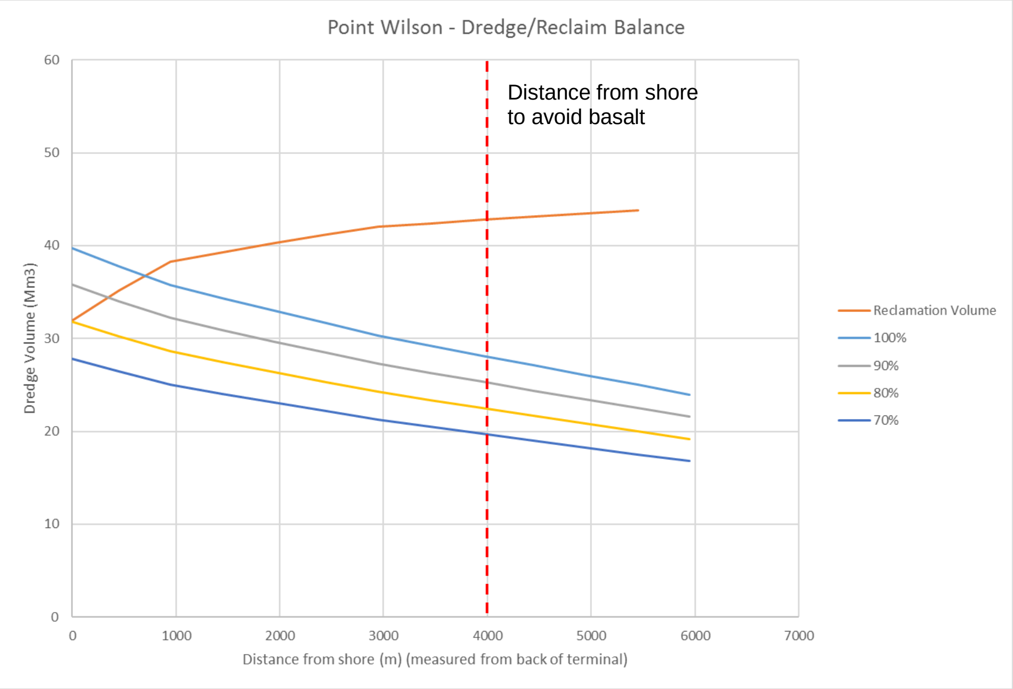



**Figure 38 Point Wilson dredge/reclaim volume estimate**

### Kirk Point

Figure 39 illustrates that the ‘optimal’ location at Kirk Point would exist between 1200 m from shore (if 100% of the dredged material is able to be used for reclamation) and 250 m from shore (if 60% of the dredged material is able to be used for reclamation).

As per Pt Wilson, this would put the development in the rock risk zone, and likley result in an heaviliy imbalanced solution.

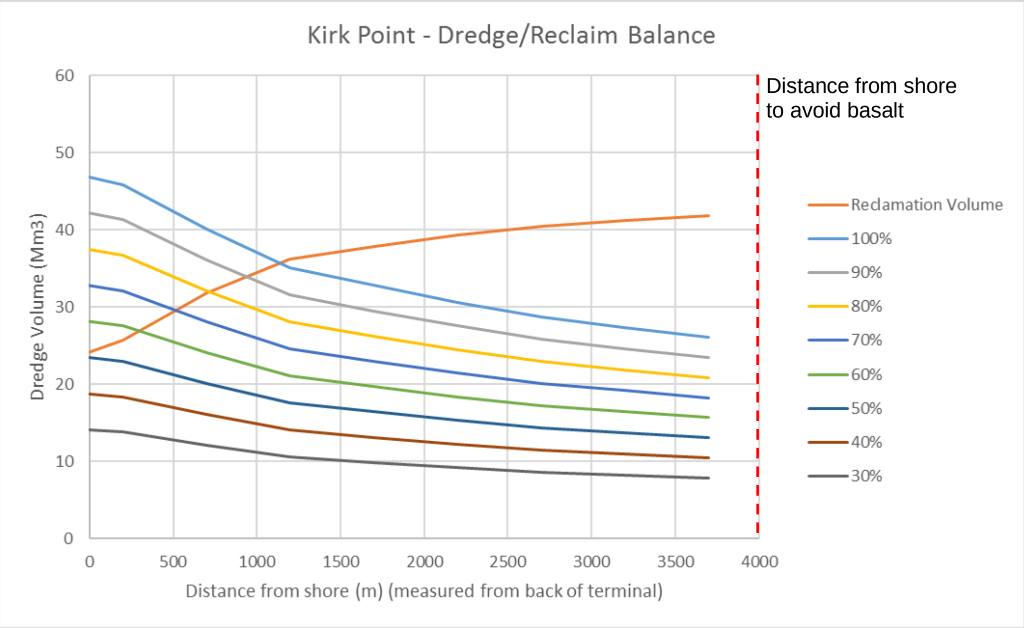



**Figure 39 Kirk Point dredge/reclaim volume estimate**

### Werribee River

Figure 40 illustrates that the 'optimal' location at Werribee River would be between 250 m from shore (if 50% of the dredged material is able to be used for reclamation) and 2 km from shore (if 100% of the dredged material is able to be used for reclamation).

It was noted that this provides good opportunity to site the terminal outisde the shallow basalt zone (expected out to 1.5 km), and allow a more favourably balanced dredge-reclaim solution to be pursued.

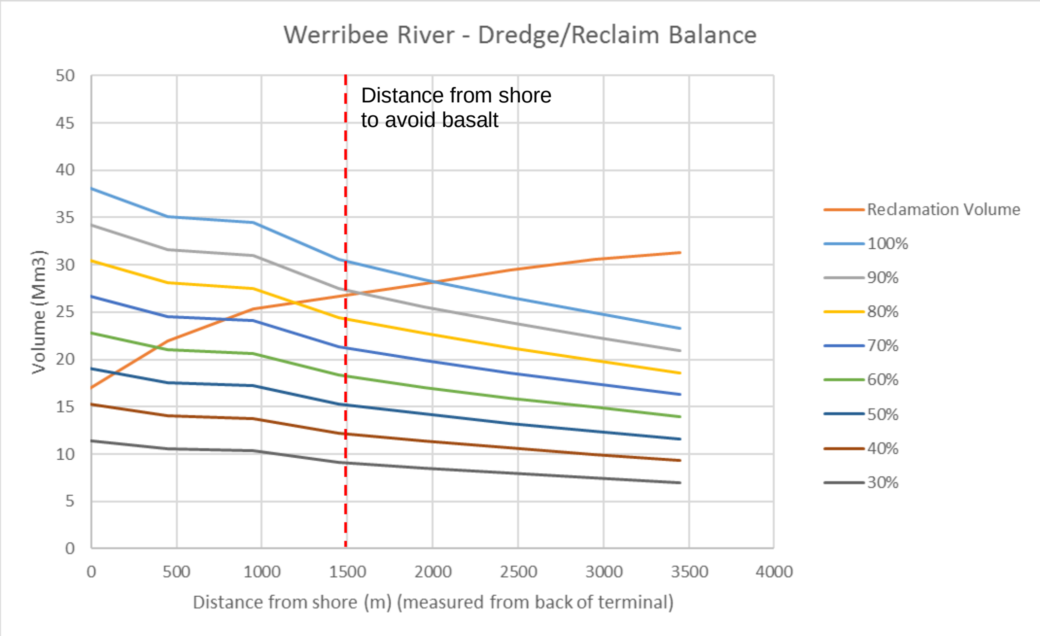



**Figure 40 Werribee River dredge/reclaim volume estimate**

### 6.11.3 Total dredge volume estimates

Total dredge and reclaim estimates for the three sites, avoiding rock dredging and stated assumptions are shown in Table 30 for comparison.

If the configurations were located outside their respective basalt flow extents, the reclamation needs at Kirk Point and Point Wilson would in excess of 40 Mm$^3$, with a corresponding dredge task of 25 to 30 Mm$^3$ to provide vessel access. This would necessitate additional dredging to balance reclamation needs. The volume would be dependent on the re-usability factor.

At Werribee River, both the dredge and reclamation task at the site area are expected to be in the order of 25 to 30 Mm$^3$ providing some opportunity to balance needs and/or reduce additional dredging.

**Table 30 Potential range of dredge and reclamation volumes (Mm$^3$)**

| | Dredge (Mm3) | Reclamation (Mm3) |
|---|---|---|
| Point Wilson | 30+ | 40+ |
| Kirk Point | 30+ | 40+ |
| Werribee River | 27 - 30 | 25-30 |

## 6.12 Options assessment

The three options were assessed in a workshop comprising representatives of Infrastructure Victoria, The Environmental Assessment team and the Hydrodynamic modelling specialist.

The options were assessed comparatively against criteria aligned to the following topics with the results being recorded in a table simply indicating which option performs best.

The representative option was selected based on the resulting performance picture, i.e. the one that was indicated to be favourable on the most occasions.

The assessment criteria themes included:

i) Risk of impact to existing environmental & social values

ii) Heritage

iii) Impacts to flood risk

iv) Land use, zoning and key infrastructure (roads / rail / pipelines)

v) Geotechnical factors

vi) Implications based on the WTP future land use understanding

vii) Dredging and reclamation considerations – volume, optimisation opportunity etc.

The outcome of the assessment for each criteria is provided in Appendix D along with the supporting assessment maps. The summary findings are reported in Section 6.13.

## 6.13 Assessment findings

The comparison workshop process identified that the Werribee River Site is the most appropriate site for representation of the Bay West option. The basis being as follows:

- Highest value environmental areas such as saltmarsh communities exist to in the western portion of the WTP site. These can (largely) be avoided if the terminal is configured around the Werribee River site.
- Future (engineered) development on the WTP site will occur mainly in the north and east. This future land use is expected to have 'better' compatibility with the minimum landside development needs of the future port. i.e. transport corridor.
- The preservation of the natural values of the western shoreline and 'areas of coastal retreat' are recognised as fundamental components of the MW's future land use strategy. The maintenance of the environmental values, are key to their ongoing obligations to maintain the Ramsar status of the site. Development to the east, is perceived to be least likely to impact these values.
- A transport connection between the terminal island and the main land may have a significant impact to the feeding and nesting areas of shorebirds, which could be divided by the proposed transport connection. As shorebirds do not fly at significant heights and prefer not to fly under structures, the placement of transport connections is an important factor. High valued bird habitats such as mudflats and saltmarsh communities exist in the western part of the WTP. These can (largely) be avoided by locating the terminal at the Werribee River site.
- There is reduced risk of having to dredge Basalt at the eastern end of the WTP site. Additionally, the Basalt risk appears to allow the terminal to be located closer to the shoreline for the Werribee River Site, providing increased opportunity balance reclamation needs from dredge materials and reduce bridge connection lengths out from land.

- Kirk Point has shallow basalt extending further from the shoreline, which pushes the potential terminal land forms further from shore. This means that at the Kirk Point Site, the reclamation volume is typically higher, reducing flexibility of balancing those volumes with minimum dredge volume solutions.
- Werribee River is closest to established road and rail links providing opportunity to reduce the cost of freight movements to and from the north and east compared to the Kirk Point or Point Wilson site. The eastern site also appears to have a number of alternative road route alignment options associated with it, all of which can be navigated around the future lagoons. The road and rail alignment contemplated for the Werribee River site can be arranged to connect with the future OMRR junction.
- An offshore development in front of the shoreline bounding the 115E lagoon would reduce the effects of coastal erosion along this section of shoreline. This would reduce the risk of lagoon rupture resulting from climate change / storm events. This is currently a significant concern for Melbourne Water, and one of the principal drivers for retaining options to be able to expand the lagoon network inland in the future.
- It is likely that a terminal at the Werribee River site would have a lower risk of impacting outfall mixing when compared to the other two locations.
- There was a view that flooding risk would be marginally greater towards the west of the WTP, hence indicating that the Werribee River option was preferred.
- Kirk Point that is subject of a future boat ramp upgrade would more likely be impacted if a container terminal was developed nearby.

A summary of the comparison results is provided in Appendix D.

### 6.13.1 Representative option for Bay West

The representative option for Bay West is shown in Figure 41 and comprises:

- A linear terminal on a reclaimed island parallel to, but offset from the shoreline by at least 1.5 km
- Road bridge or causeway connection to land from the eastern end of the proposed terminal.
- Dredged access channel straight in from deep water to a central turning basin and berthing pocket in front of the quay.
- A transport corridor through the WTP site to the north and west connecting with the Princes Freeway and future OMRR junction.
- Options for a rail marshalling yard next to OMRR with additional sidings close to the port.

The development concept is discussed further in Section 7.

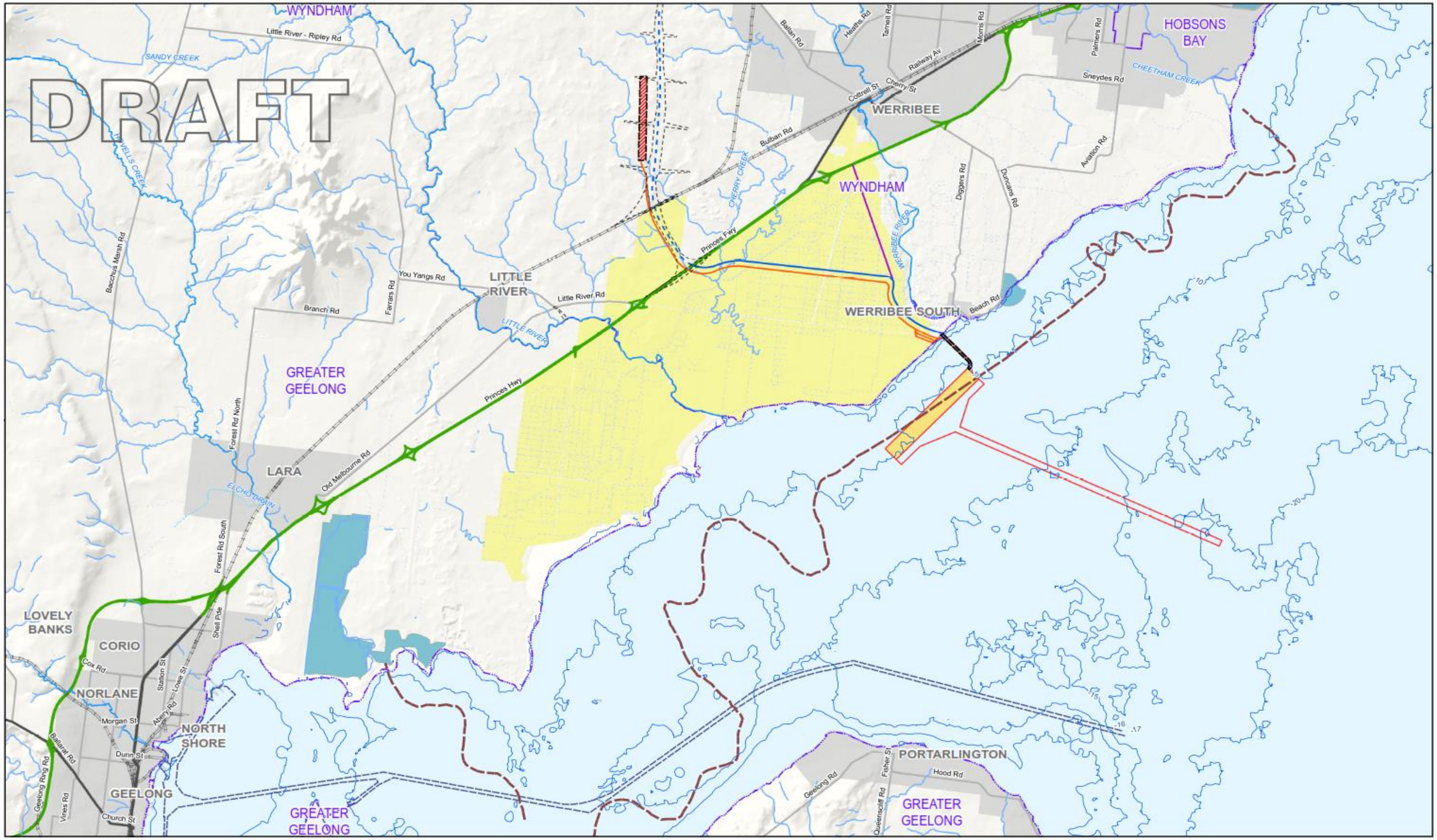



Figure 41 Representative option for Bay West

# 7. Bay West Concept

## 7.1 General

This section summarises the conceptual arrangement of the Bay West arising from the technical study. This considers the factors set out in Section 5 and describes:

- The proposed arrangement, channel concept and phasing of the development
- The proposed transport infrastructure
- The proposed landside development.
- A preferred form of quay structure
- How the choice of construction method impacts the choice of location and cost. Analysis is undertaken to identify an optimal arrangement considering dredging variables.

## 7.2 Terminal layout

The terminal layout contemplated for Bay West is presented in Figure 42. This comprises a 600 m wide land footprint built as a reclaimed island in Port Phillip. The island incorporates a wharf structure and apron at the front, central container stacking areas, truck exchange zone and rail handling facilities at the rear of the terminal. The cross section is indicated in Figure 43.

The general arrangement in Port Phillip however, features a single quay line of 4.1 km length to provide 9 M TEU capacity. A single quay line provides greater flexibility in the longer term for the allocation of cranes to vessels and the ability to accommodate different vessel sizes.

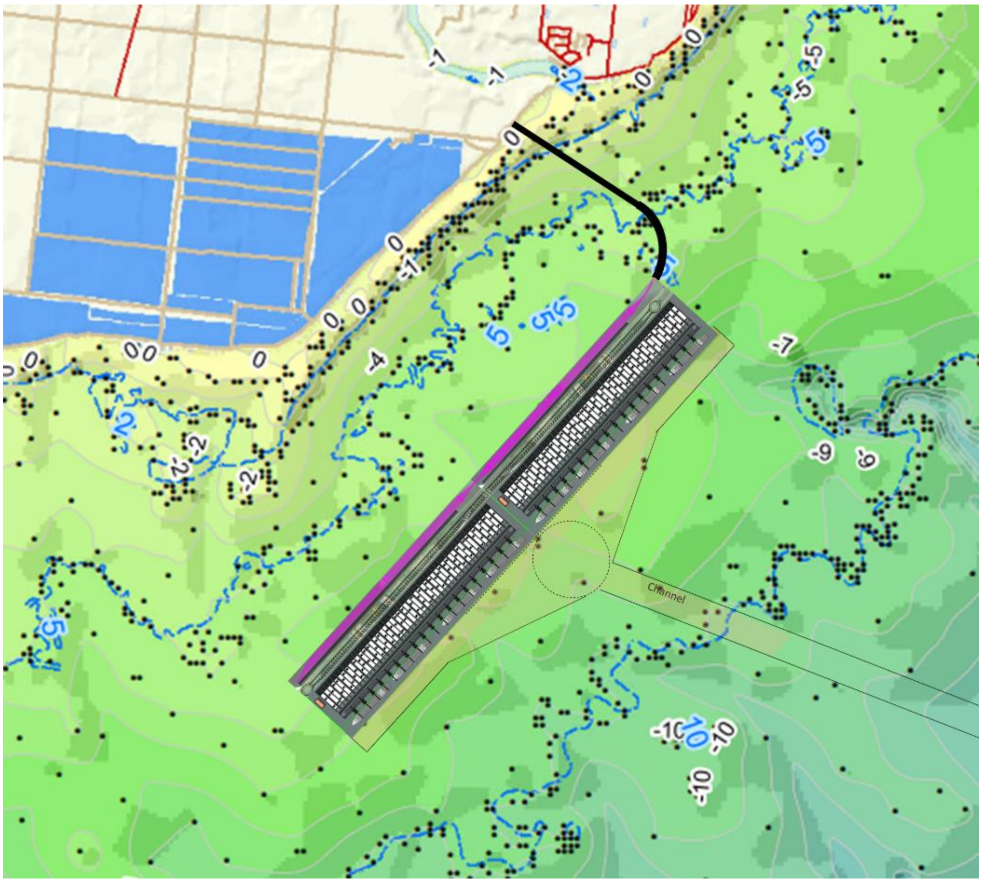



**Figure 42 Proposed layout for Bay West**

### 7.2.1 Terminal alignment

The berth is aligned parallel to the shore. This follows the bathymetric contours, and presumed profile of basalt rock that runs at depth to reduce the risk of encountering rock in the dredging works. This alignment has been proposed to minimise impacts on coastal processes whilst allowing vessels to be moored in the direction of predominant summer winds.

The distance from shore to rear of the land footprint is proposed at no more than 2 km. This is dimension is however critically related to the selected dredge method and design vessel size (dredge volumes) as it influences the degree of 'optimisation' that is achieved through the beneficial re-use of the dredged material. These aspects are discussed further in Section 7.8.

The terminal is proposed to be connected to shore via a highway and rail connection located at the eastern end. This arrangement allows for road and rail to be easily connected to a preferred transport corridor alignment across the WTP site. This alignment avoids the existing and proposed sewage treatment lagoon areas. The arrangement for the transport corridor is discussed further in Section 7.3.

The transport connection over water could comprise a piled trestle or solid causeway. For the purposes of the study it is assumed that an open piled trestle structure would be provided for distances up to 1.5 km, and a causeway form thereafter. The link would provide multiple truck lanes, twin train tracks, lighting and services. An open piled structure is proposed so as to minimise the loss of seabed in the near-shore area and to minimise the 'blocking' effects on coastal processes and water movement. The proposed arrangement is discussed further in Section 7.11.3


**Figure 43 Indicative cross sectional profile of the terminal**

### 7.2.2 Stage 1 arrangement

With the transport linkage proposed at the eastern end, the terminal is expected to be staged from east to west to allow future stages of development to occur without disruption to the stage 1 operations.

A stage 1 (3M TEU) development of 1450 m is expected to comprise all terminal components, and is expected to have rail infrastructure be installed as part of the initial development if demand exists.

The arrangement assumes trucks would enter from the eastern end of the island using the bridge and circulate behind the stacks. The truck marshalling and entrance gate can be located either on the Island or close to the landside entrance of the marine access bridge.

Trains would enter the terminal from the same location. Trains would run between the landside rail marshalling facility and into designated sidings and facilities to the rear of the truck circulation areas. Further detail on rail infrastructure connecting to the terminal are discussed in Section 7.3.2.

Figure 44 presents an indicative staging sequence for Bay West.

### 7.2.3 Ultimate development

Ultimate development contemplates two further extensions of quay and terminal area. The second stage would comprise 1350 m of quay length, and the third around 1300 m of quay length with a final compliment of around 36 ship to shore cranes.

The phased development at Bay West, is expected to be different to that at Hastings, as the wharf and terminal development will likely be undertaken on land that is already in place. This is discussed in Section 7.8, but is proposed in response to the size of the phase 1 capital dredge volume and proposed dredging strategy.

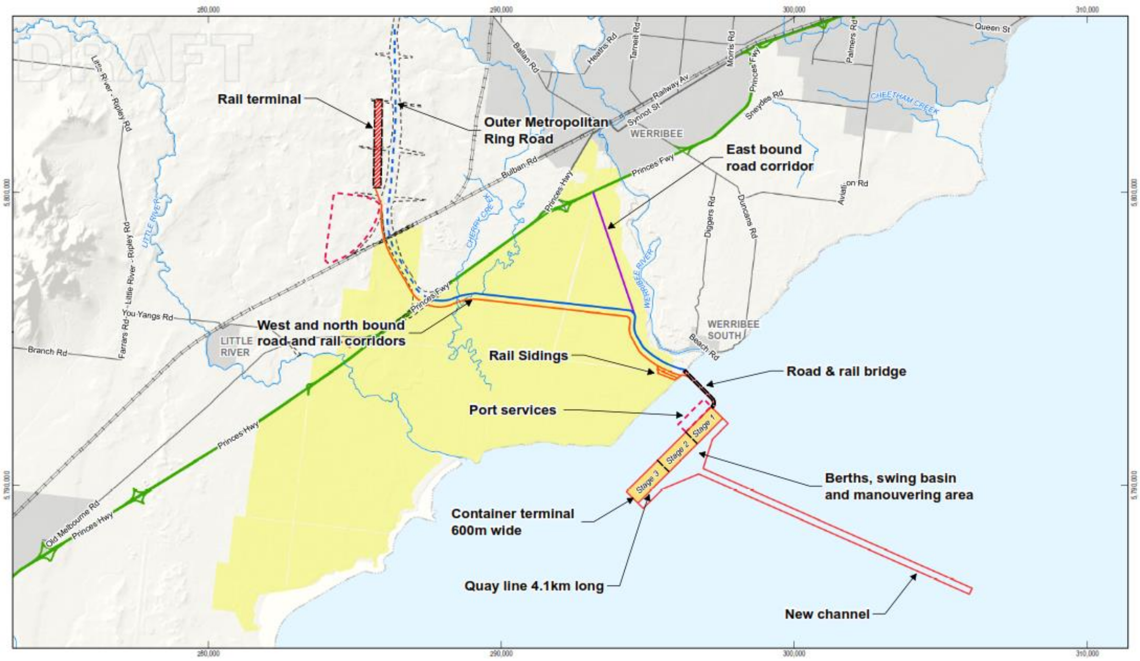



**Figure 44 Indicative staging plan for Bay West**

## 7.3 Transport connections

The Bay West port location south of the Werribee River is approximately 7-10 kilometres from the Princes Freeway and Maltby Bypass of Werribee, which would provide direct freeway access to the North of Melbourne via the Western Ring Road and to the east via the West Gate and Monash Freeways.

Improved access to the east and north of Melbourne is also expected through the Western Distributor Project increasing capacity on the West Gate Freeway and links to the north of Melbourne. The Princes Highway also provides direct access to Geelong and the south west of Victoria.

The Outer Metropolitan Ring Road (OMRR) is planned to provide a major additional road network link close to the Bay West location. The OMRR will provide a circular connection from the Princes Highway between Little River and Werribee around the western and northern development areas of Melbourne to the Hume Highway at Beveridge (and beyond).

The OMRR is likely to be in place at the timing of the second port development link increasing overall road network options and capacity for Bay West. Planning also includes a rail corridor along the OMRR alignment.

### 7.3.1 Main highway network connections

The existing and proposed road linkages define two key corridor alignments to the port:

- A corridor that serves the west and north, along a general east west alignment connecting to the intersection of the Princes Highway and the OMRR, providing efficient movements to the north, west and south; and
- A corridor running north through WTP that is removed from the Werribee river but connecting to the Princes Highway on the Maltby Bypass to provide efficient access to the east/south east and inner northern suburbs.

These corridors would connect to the Princes Highway at:

- Farm road
- At the junction of the Princes Highway and the proposed Outer Metropolitan Ring Road

#### Farm Road connection

The connection to Farm road will cross 23 canal/drains of varying size between 3 and 8 meters in width requiring culverts and one wide open drain 35-40 metres in width which is likely to require a larger structure

It will also cross eight minor internal roadways associated with Melbourne Water's current operations and one pubic road linking Farm Road with the Werribee River Park.

At the connection with the Princes Highway a major highway interchange will be required with on and off ramps with access in both east and west directions.

#### OMRR connection

The road connection to the OMR will cross approximately 13 additional canal and drain points across the Melbourne Water land varying in size from 3 – 8 meters with two large open drain crossing of approximately 35- 40 metres in width. This connection will also need to cross Lollypop Creek just before connection to the Princes Highway to the west.

It will also cross eight minor internal Melbourne Water roadways and one major roadway at Metropolitan Farm Road

It is anticipated that the OMRR roadway will be implemented and a grade separated roadway connection to the Princes Highway from the west will be in place. Construction of a connection from the east with on and off ramps to facilitate movements not covered in the original structure. (half a diamond connection) will be required.

The general arrangement of the proposed connections is shown in Figure 44.

### 7.3.2 Proposed rail connection

The proposed rail connection to Bay West will comprise a single rail corridor between the Port (on-dock facility) and the Geelong Melbourne mainline rail corridor and future rail links along the OMRR. The alignment will run alongside the proposed 'east-west' road corridor linking with the future OMRR junction.

The planning assumes that rail connections will exist in the OMRR alignment connecting to the Melbourne Geelong rail corridor at the time of Bay West development, and connections from the port will need to be developed to link to this interchange.

The connection will consist of a dual gauge two track rail corridor with additional sidings in close proximity to (but back from) the bay shoreline. The railway corridor will require a grade separation at the Princes Highway, which is most likely to be under the highway to allow for relevant road on and off ramps above.

After crossing the Princes Highway, the rail corridor will connect to the Melbourne Geelong Railway in both directions and continue onwards to join the OMRR rail corridor. The grade

separation for port connection rail is likely to be under the Geelong Melbourne Railway with direct connection to the OMRR rail corridor. Connections to the Geelong Melbourne Corridor will ramp up in either direction to provide north-east and south west access along this rail corridor.

A Rail Interface Terminal for the port will be required to provide for trains to be staged and longer regional trains (up to the maximum length of 1800 m standard gauge) to be adjusted in size to fit on-port rail sidings. A location was considered within the WTP site parallel to South Rd as indicated on the representative option for Bay West - Figure 41. However, it is not considered suitable due to incompatibility with Melbourne Water's current and future waste treatment operations in this area.

An alternative option is to position the terminal (marshalling yard) further away from the port close to the OMRR corridor, as indicated in Figure 42. This site is some 12 km from the proposed port and would influence the efficiency of rail movements into the port, adding cost and additional travel time. Future planning for OMRR road crossings may also require further alignment in this area.

To improve the efficiency of the rail, the following is proposed:

- a smaller holding yard closer to the port (eg: four 600 – 900 metre sidings at or adjacent to the wharf) to reduce the inefficiencies of waiting time or transfer capacity to the rail shunting yard,
- Improved interface arrangements for some trains to combine the shunting yard within with the WIFT site in Truganina and cater for holding points closer to the port

The proposed terminal at Bay West (of 3km in length) is shorter than a similar terminal proposed for Hastings based on a level of integration with the WIFT terminal and flexibility for Rail Port Shuttles to utilise sidings adjacent to the port.

### 7.3.3 Rail network impacts

The Bay West rail connection to the existing standard gauge and broad gauge networks on the Melbourne to Geelong rail corridor provides a core link to the network, however demand expectations of the new port will need to also provide for rail capacity on network links to the port.

The connection at the junction of the Melbourne Geelong railway and the future OMRR rail corridor will provide some additional options for links to the northern suburbs and regional areas. However, the majority of demand over time is likely to be with metro rail shuttles linking back to suburban locations along the Melbourne Geelong corridor through Werribee to planned terminals at Altona, Somerton in the north and Lyndhurst in the east. In addition to the existing regional requirements of up to an indicative 18 trips (one way) daily at the port of Melbourne, a 20 % share of Metropolitan demand would add 19 trips at 3.0M TEU, 37 trips at 6.0M TEU and 56 trips daily at the port at 9.0 M TEU.

The area is served by the broad gauge rail network between Geelong and Melbourne with Werribee to Melbourne metropolitan services just north of the proposed port site. Residential development in the Werribee area is now the fastest growing area in Australia and additional passenger rail capacity will be required, impacting the current broad gauge lines from Werribee to Melbourne. The standard gauge network also operates along this corridor and currently consists of a single rail line with passing loops. Although capacity could be developed on both gauges this is considered the best network for development for freight traffic.

The development of a new dual gauge line from the OMRR/Melbourne to Geelong Junction through Werribee and Laverton to Newport and Tottenham over a distance of approximately 34 km would allow best use of existing infrastructure and allow increased capacity for both broad

and standard gauge to provide network capacity for the port. The existing standard gauge line will also need to be converted to dual gauge to provide for overall capacity as the port develops. Alignment of this development with potential network changes on the standard gauge network will need to consider impacts of:

- Other demand changes on the standard gauge network for freight and passenger trains
- The relocation of interstate terminals from Dynon to a potential WIFT location in Truganina.
- Inland rail implementation
- OMRR rail developments
- Other corridor development for broad gauge (using the same land corridors)

Additional capacity development over time is also likely to be required on the standard gauge network between Tottenham and Somerton, dependent on other demand factors and on broad gauge on the Dandenong Rail Corridor aligned to passenger demand factors and other developments.

### 7.3.4 Local transport corridor(s)

Road alignments and the rail track will run from the Highway to the port across land utilised by Melbourne Water. The infrastructure is likely to require some bridging and culverts to cross drainage channels in the area however this is not significantly more than in other major highway development

The corridor across the WTP site is expected to be 120-150 m width, but be wider where a rail terminal or sidings were provided. Services and utilities connecting to the island port will also be located along this corridor alignment.

The transport corridors will provide parallel road and rail network connections from the island connection.

The northern road linkage will run parallel with the Werribee River, some 400 m from its river banks following the alignment of the river and at a constant distance away to avoid environmental interfaces.

Both corridors will also avoid the Melbourne Water proposed lagoon expansion area to the north of the existing lagoons.

## 7.4 Surrounding land use (Bay West)

### 7.4.1 Planning zones and overlays

Figure 45 and Figure 46 show the Planning Zones and Overlays.

The study area currently contains a diverse range of land uses, including recreation; nature conservation; sewage treatment; aquaculture; fishing; grazing; industry including oil refining; quarrying; salt production; port facilities; and other urban development.

A large proportion of the study area is zoned Public Use Zone, (mainly the Western Treatment Plant), while much of the northern parts of the study area west of the Little River are within a Farming Zone.

The area to the west of Little River is prone to flooding, and is covered by a Land Subject to Inundation Overlay.

Land around the Werribee River corridor and to the west of Little River is covered by Environmental Significance Overlays to reflect and protect the environmental values surrounding these waterways.

A large area of land to the north of the Princes Freeway (west of the Outer Metropolitan Ring Road reserve) identified as the future Western Grassland Reserve is also protected by an Environmental Significance Overlay and is subject to a Public Acquisition Overlay (PAO). This reserve would protect the largest remaining concentration of volcanic plains grasslands in Australia and a range of other habitat types, including ephemeral wetlands, waterways, Red Gum swamps, rocky knolls and open grassy woodlands.

DELWP is the acquiring authority for land in the reserve and will seek to negotiate voluntary sale agreements with landowners affected by the PAO.

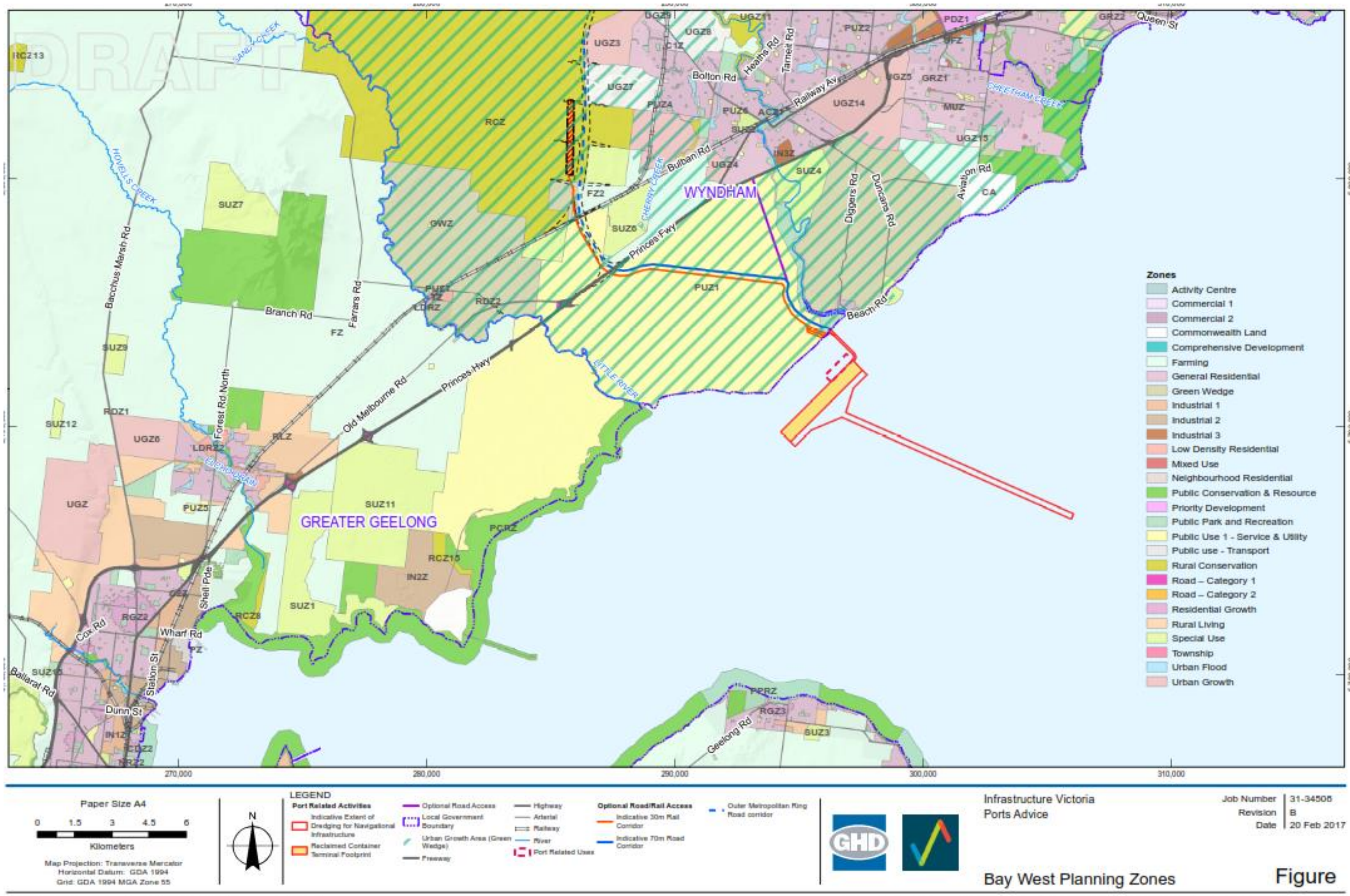



**Figure 45 Bay West planning zones**

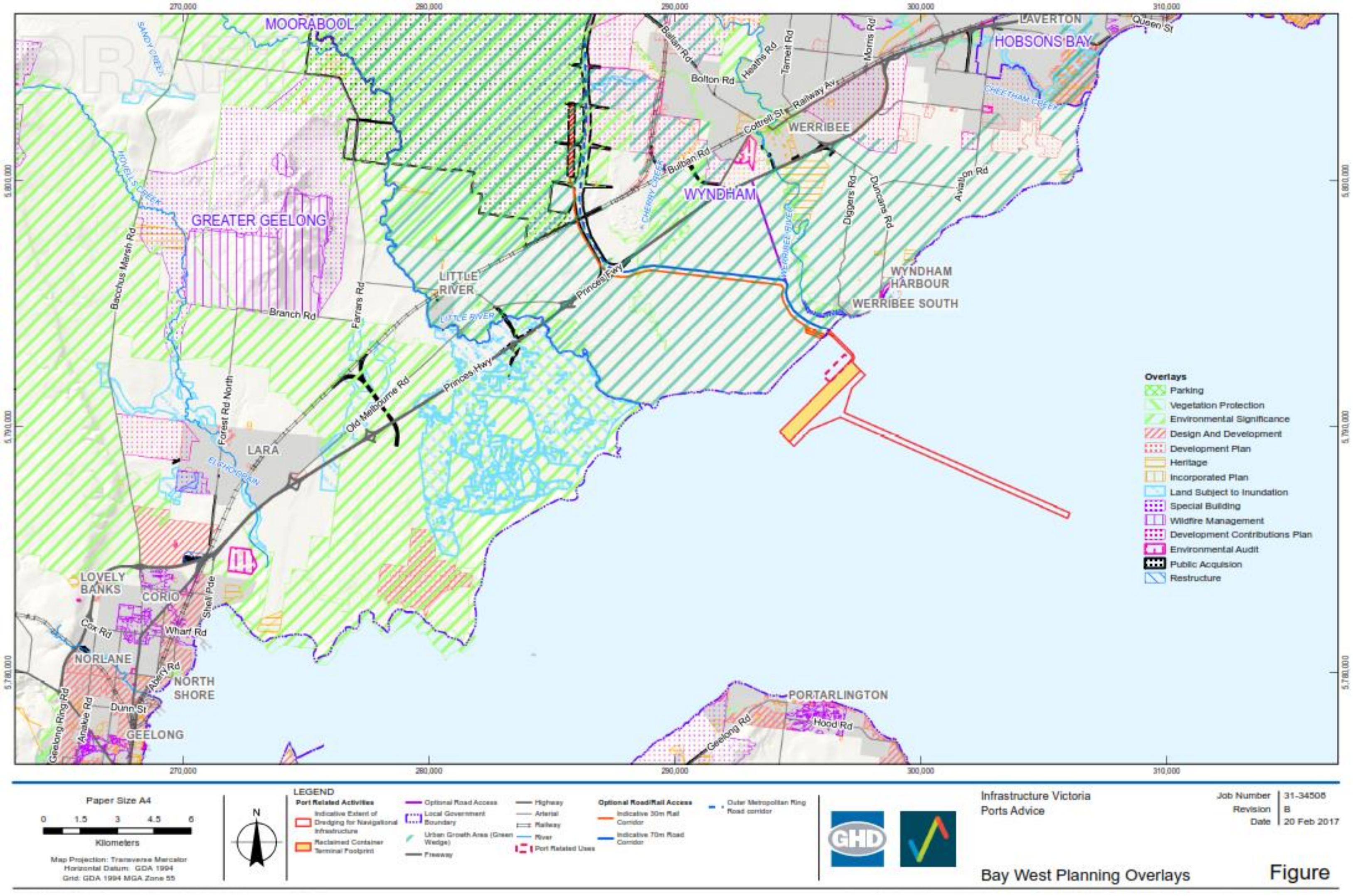



**Figure 46 Planning overlay at Bay West**

### 7.4.2 Land use 'fit' and potential impacts of port development

#### Transport networks

The road and rail transport corridors connecting to existing transport networks are largely within land that is currently used as part of the WTP operations, and is within close proximity to Melbourne Water's planned recycled water plant expansion on the eastern side of Farm Road.

The desirable location for the rail terminal and zones of interest for port-related uses would also be close to Melbourne Water operations, including the planned increased treatment area. There is potential for these port-related uses and transport corridors to impact upon existing and planned Melbourne Water operations.

The proposed Outer Metropolitan Ring Road (OMRR) Corridor has been reserved in a Public Acquisition Overlay. The OMRR is intended to enhance connectivity between key international transport hubs including the Port of Melbourne and Melbourne Airport, and provide high speed road and rail transport links for freight and passengers across the west and north metropolitan area. The OMRR provides an opportunity to link a port development at Bay West with freight and logistics precincts further to the north.

In addition, funding for the Western Interstate Freight Terminal (WIFT) pre-feasibility study is being provided by the Federal and Victorian Governments. If given the final go-ahead, the project would include the construction of an interstate terminal and freight precinct at Truganina in Melbourne's west, as well as a rail link to the Interstate Rail Freight Network serving markets to the west (via Geelong, Ararat and Adelaide) and north of Victoria (via Albury). The concept design for this facility incorporates an option for a port related terminal, potential future connection to a container port and connection to the rail corridor within the OMRR.

#### Other land use interests

The most significant public landholdings within the study area include:

- Western Treatment Plant – freehold land vested in Melbourne Water
- Avalon Airport – Commonwealth Department of Defence
- Point Wilson Ammunitions Complex – Commonwealth defence land
- Werribee River Park – Crown land managed by DELWP/ Parks Victoria
- The Spit Wildlife Reserve – Crown land managed by DELWP/ Parks Victoria

Private land can generally be described as either larger rural allotments of between 30 to 180 hectares, or residential or rural-residential allotments of between 500 square metres to 2 hectares. The residential and rural-residential allotments are clustered in and around the township of Little River and the outskirts of the suburbs of Werribee and Werribee South.

The Green Wedge areas limit the potential for residential development encroaching into land vested in Melbourne Water that is used for the WTP, where most landside elements of the port development concept are proposed to be located.

The port development is proposed to largely avoid key areas of environmental value, however the potential rail terminal location and area identified for port-related uses to the west of the OMRR corridor is recognised as having unique biodiversity values and it is designated as the future Western Grassland Reserve. Discussion with DELWP as the acquiring authority of this land would be required to determine the suitability of this area for port-related development.

Overall, the study area provides opportunities for port development to leverage against key existing and proposed infrastructure (airport, rail, road) for compatible and complementary uses.

Land occupied by the WTP contains areas subject to noise and/or odour, and these areas are not being considered for industrial or logistics type uses, other than transport corridors.

### 7.4.3 Protection of land for future port-related uses

The following planning scheme mechanisms might be considered in order to protect and / or reserve land for future port related use and development and land based transport connections:

- Planning Scheme Amendment:
  - Rezone required land to a more appropriate zone (consider use of existing VPP *Port Zone*, or the *Special Use Zone* with a tailored schedule to Bay West Port operations
  - Apply a Pubic Acquisition Overlay for transport purposes to reserve land for road and rail connections (i.e. PAO5 – Port Services and access corridor).

## 7.5 Port precinct

### 7.5.1 Port precinct options and issues

Typically, the development of a port will drive a level of local development for port related activities, particularly:

- Port administration and security facilities
- Customs and AQIS services (Border Security)
- Empty Container Parks together with transport and warehousing facilities that are ideally close to the Stevedore terminals.
- Access to bonded warehouses within a direct non- public road link to the terminals is a key element considered in recent port design.
- Consolidation depots operated by logistics companies are also common which allow for the consolidation of loads from a local port precinct location can provide for substantial cost savings with elimination of trips and travel distance in the supply chain.
- Broader warehousing and Distribution Centres also benefit from a location close to the port although many of these facilities source goods from a broad scope of supply chains across both import/export and domestic supply chains.
- Support industries and facilities which provide food, fuel and other services to the port workforce are typically in close proximity.

The need for efficient container movement and consolidation points is a key aspect of the landside port supply chains and the current identified options for a port precinct are:

- a constrained precinct in the north-eastern corner of the WTP site clear of the future lagoon expansion areas; and/or
- A broader precinct to the west of the Princes Highway and OMRR alignment.
- On reclaimed land as part of the terminal development project.

#### WTP land precinct option

The development of a port precinct within the Melbourne Water land would be beneficial; however, the current use of the land may not allow a substantial development and reuse of the land in this area, without having a significant impact on WTP operations. Such development is not currently proposed.

### Port precinct north of the Princes Highway

An alternative option is to locate this precinct (in part or full) to the west of the Princes Highway and the OMRR alignment (or similar) where broader access and options are available.

This site does raise a number of supply chain efficiency issues, in that travel distance to the precinct would be 12 km from the port island. This reduces the advantage of this site as a direct port related precinct and direct service facilities for employees may not succeed (eg Lunchtime food).

It may be appropriate for warehousing, logistics depots and Distribution Centres, however transport movements would now have travelled almost half way to the current Truganina and Tarneit logistics centres, hence the attractiveness may be reduced. This location would also be unfavourable for eastbound traffic, as trucks would have to travel an additional 12 km in the opposite direction (ie an additional 24 km for the return trip) to stage freight in this area.

Table 31 highlights the port components that could be considered in a precinct at or beyond the Princes Highway. This area would allow a larger development and a wider scope of precinct activities.

**Table 31 Princes highway port precinct components**

| Land use | General purpose | Potential scope |
|---|---|---|
| Warehousing | Import/export storage | Up to 200 – 250 Ha |
| Bonded warehousing | Import/export value add | 30-40 Ha |
| Distribution Centres | Store and distribute imports | 150 Ha |
| Trucking depots | Load consolidation and distribution locations | 75 Ha |
| Empty Container parks | IMEX supplies | 150-170 Ha |
| Retail and service areas | Include car parking /truck parking support local services | 5 Ha |
| Other Industrial | | Demand led |
| **Total** | | **up to 690 Ha** |

### On reclaimed land as part of the port development

The findings of the dredging and reclamation needs assessment reported in Section 7.9.1 and Table 38 identifies an opportunity for additional land to be created from the optimisation of the dredged material.

This analysis highlights an opportunity to extend the island by around 600 – 700 m depending on the design vessel scenario and final location. Such an extension would add around 30 to 40 hectares of land to the port footprint.

This land could be considered for some of the more critical port precinct operations such as AQIS, customs and retail services, as indicated in Table 32 that summarises the estimated footprint of the various port precinct components.

**Table 32 Port precinct components desirable on the WTP site**

| Land use | General purpose | Potential scope |
|---|---|---|
| Bonded warehousing | Import/export value add | 25 Ha |
| Trucking depots | Load consolidation and distribution locations | 30-40 Ha |
| Customs and AQIS | Border security | 15-20 Ha |
| Empty Container parks | IMEX supplies ( some only) | 40 Ha |
| Retail and service areas | Include car parking /truck parking | 8-10- Ha |
| **Total** | | **125 Ha** |

### 7.5.2 Drainage channel Interfaces

The current Melbourne Water activities comprise a large number of drains and sewer flows in the area. This includes two major alignments from the Farm Road area with infrastructure up to 35-40 metres wide traversing alignments south to the major ponds areas and south west towards Lollypop Creek. Other drainage or channel crossings between major northern land parcels appear to vary up from 5-8 metres in width.

The proposed transport corridors indicate the channel locations will need to be crossed approximately 23 times on the northward alignment with one large open drain 35-40 metres to be crossed. The east west alignments for rail and road will require up to 13 channel crossings and another two larger drain interfaces.

Smaller channels are proposed to be crossed using smaller span structures (up to 12 m) consisting of precast planks approximately 350 mm thick with an in situ deck slab. These structures will be single span, simply supported bridges with reinforced concrete abutments supported on precast driven piles.

Prestressed concrete Super T girders of up to 1800 mm depth with an in situ deck slab are proposed for all crossings up to 30 m. Where a structure is required for distances longer than 30 m, consideration shall be given to providing multiple spans or if provision of piers is either undesirable or impractical, alternative structural forms such as prestressed concrete box girders or steel structures can be considered to achieve greater spans. The abutments of each bridge will consist of reinforced earth walls with a reinforced concrete abutment beam supported by driven concrete piles.

### 7.5.3 Road connections to the Princes Highway

The roadway connection to the Princes Highway at Farm Road contemplates development at the location of existing Farm Road bridge crossing, but assumes the existing bridge will be demolished and replaced due to the significant cost of widening and strengthening the existing structure.

The replacement bridge would be a two span structure with 1800 mm depth Super T girders and an in situ deck slab for the superstructure. The substructure will consist of a reinforced concrete pier column supported on either bored or driven concrete piles and with reinforced earth walls and a reinforced concrete abutment beam supported by driven concrete piles at the abutments.

The road and rail connections proposed for the OMRR junction alignment will comprise grade separated structures. The railway line will sink into a cutting and travel beneath the freeway,

while the roads will go over the freeway with a multiple span bridge provided for the north bound and south bound road alignments.

The rail cutting will be formed through a battered slope embankment where space and geotechnical conditions allow and through a reinforced concrete diaphragm wall in other locations.

The road bridges will consist of prestressed concrete girders capable of spanning up to 38 m. The road will then continue at this elevation until it crosses the railway line to the north, the elevation can be achieved through either a mix of part elevated structure (i.e. a viaduct) and part embankment or with an elevated structure only. Maintaining this elevation allows for the port railway lines to connect to the existing railway beneath the elevated structures. An underpass is then to be provided for the railway which crosses the existing Melbourne – Geelong line. This structure will be a steel through girder bridge.

As it is to be expected that the OMRR will constructed prior to the Port and the connecting transport infrastructure, at the road and rail Interchanges consideration needs to be given during its planning and design to achieve the most efficient ultimate configuration that provides grade separated crossings for the Port road and railway and connections to the existing network.

The scope of the potential design interface issues in and around the intersecting road and rail corridors at the OMRR connections will make it essential for early engagement to ensure planning for both the development of a Bay West port and the OMRR are well coordinated with inputs from all parties.

## 7.6 Navigational infrastructure

As set out in section 55.11.6, the port facility requires a new access channel, turning basin and dredge pocket. It is assumed that these will be dredged.

Table 33 summarises the depths that are proposed for the identified navigable areas for the 14,000 TEU vessel and 18,000 TEU vessel being considered. These include the depth adjustment provisions set out in Table 18.

**Table 33 Proposed dredged depths for constrained and unconstrained vessel**

| | Parameter | Depth (mCD) | | |
|---|---|---|---|---|
| | | Berth pocket | Swing basin | Channel |
| 14,000 TEU | Declared depth | -14.50 mCD | -14.60 mCD | -15.00 mCD |
| | Over Dredge Level | -15.35 mCD | -15.45 mCD | -15.85 mCD |
| 18,000 TEU | Declared depth | -15.00 mCD | -15.10 mCD | -15.50 mCD |
| | Over Dredge Level | -15.85 mCD | -15.95 mCD | -16.35 mCD |

### 7.6.1 New channel access & turning basin

Table 34 presents the proposed dimensions for the channel and turning basin for the same vessels. These reflect both 1-way and 2-way configurations and arise from the criteria set out in Table 17 Criteria used in the channel concept design.

**Table 34 Proposed channel width for constrained and unconstrained vessel**

| Vessel | 1 way width (m) | 2 way width (m) | Turning basin (m) |
|---|---|---|---|
| **14,000 TEU** | 178 | 307 | 650 |
| **18,000 TEU** | 218 | 378 | 700 |

### 7.6.2 Aids to navigation

The planning has not addressed Aids to Navigation. The number of navigational aids would be subject to simulation study and final channel and berth design. A provisional allowance has however been made for twelve channel beacons, one set of port entry lights (PEL) and four berth mounted navigational lights.

### 7.6.3 Existing channels in Port Phillip

The requirements for modification of the existing channels in Port Phillip has been addressed separately by AECOM in navigation works package. No modifications are required for the 14,000 TEU vessel, and local widening of the Port Phillip channel Heads is required for the 18,000 TEU vessel.

### 7.6.4 Proposed arrangement

The proposed arrangement for the channel, turning basin and berth pocket is illustrated in Figure 47.

The arrangement of the berth pocket and drag back zone has been configured to accommodate two berths before it widens out to join the turning basin.

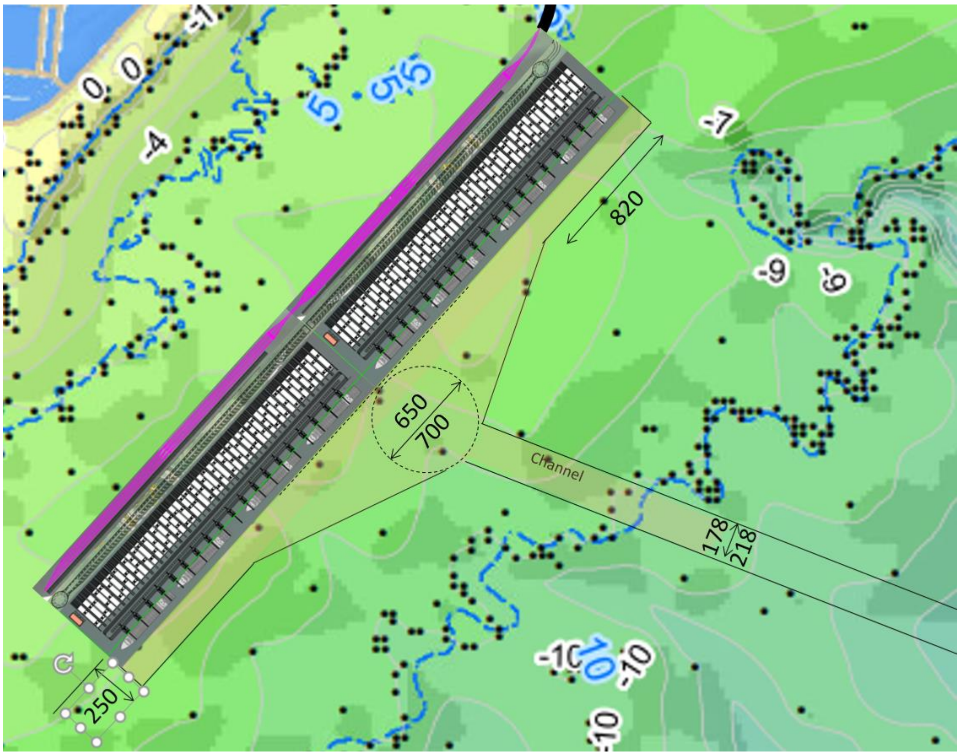



**Figure 47 Proposed arrangement for the channel, turning basin and berth pocket**

## 7.7 Dredge volumes

### 7.7.1 New channel, basin and berth pockets

Dredging volume estimates for the channel, swing basin and berth pocket for the two design vessels described are presented in Figure 48. The results are presented for different distances from shore to the landside edge of the reclaimed island.

The results indicate a dredge volume range of 14 Mm$^3$ to 26 Mm$^3$. The lowest volumes occur furthest from shore. There is typically a 3 M Mm$^3$ difference between vessel size.

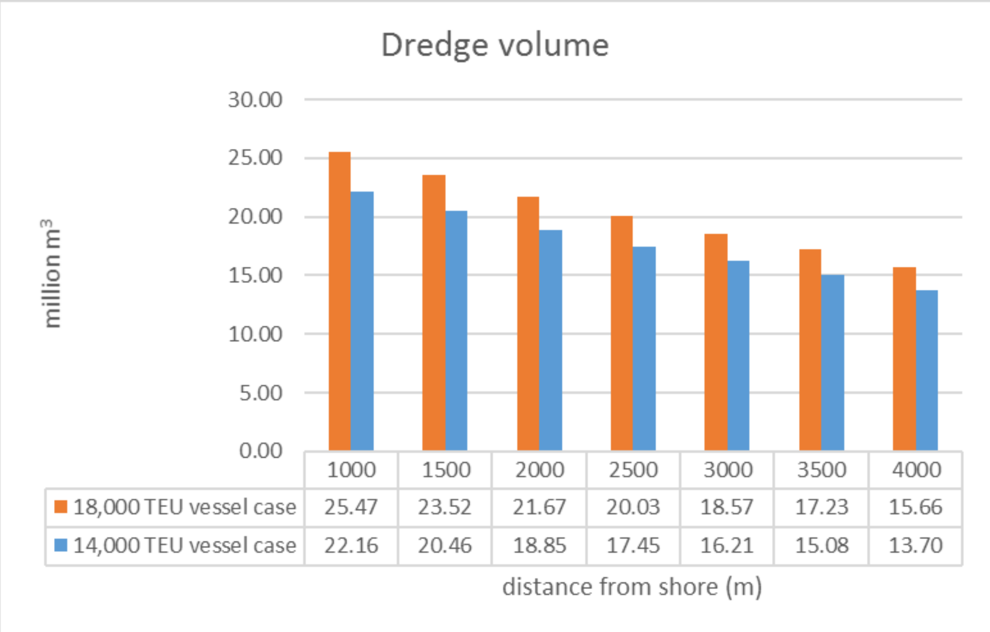



**Figure 48 Estimated volume of dredging based on vessel size and distance of the terminal from shore**

### 7.7.2 Existing channels

The estimated volume that will arise from dredging the existing channels into Port Phillip has been provided by AECOM. This is presented in Table 35.

The material is expected to be sand with some 10% to 20% being rock.

**Table 35 Dredge volume estimates (m$^3$) for the existing PoM channels**

| Zone | Volume (m$^3$) |
|---|---|
| Great Ship Channel | 100,000 |
| Nepean Bank | - |
| South Channel West | - |
| South Channel East | - |
| Sub-Total Rock | - |
| Sub-Total Sand | - |
| **Total** | **100,000** |

## 7.8 Dredging & reclamation feasibility

Baggerman Associates have prepared the feasibility of the dredging and reclamation task at Bay West.

This section summarises the findings of that study. dredging of the Great Ship Channel is covered in Section 7.8.8.

### 7.8.1 Materials to be dredged (excluding existing channels)

Excluding existing channels, the materials to be dredged include:

- Soft surface sediments in the proposed development footprint (assumed at <1m)
- Underlying stiff to hard clay materials in the navigable areas; and
- Sand arising from the need to modify the existing channels in Port Phillip and/or source additional reclamation material.

The volume of material is broadly expected to comprise:

- Up to 1 $Mm^3$ of soft surface sediments
- 18 to 20 $Mm^3$ of clay materials
- Up to 8 $Mm^3$ of sand material where this used to construct bunds and capping (a preferred construction scenario).

If the in-situ clay material was dredged and disposed of separately, with only sand used to form the land reclamation, the sand volume would be

### 7.8.2 Work method scenarios

With the Bay West terminal being located in water of insufficient natural depth, the requirements of dredging and reclamation have been considered together, under the following scenarios:

1. To form the reclamation from the capital dredging
2. To reclaim the land using material sourced from offshore
3. To reclaim the using a mix of the above methods.

The relationship for each of the above scenarios is summarised in Figure 49, Figure 50 and Figure 51 respectively.

With consideration of the volumes, and preference for granular material for surcharge, capping and pavement construction, scenario one is least preferred and scenario three is the most sustainable.

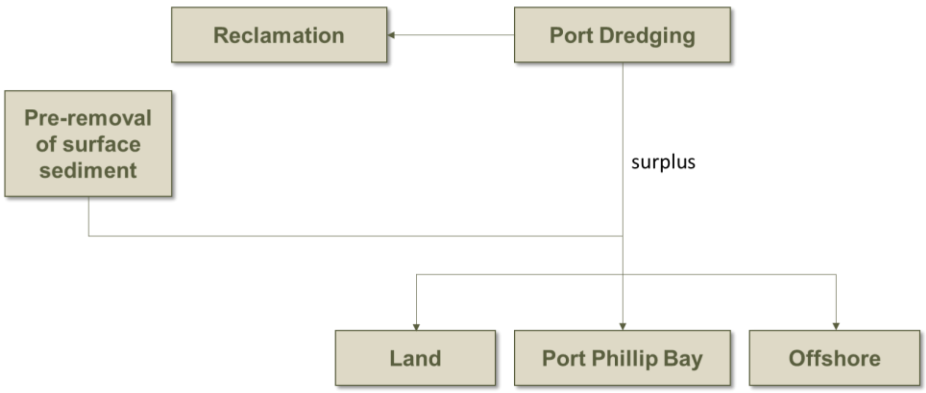



**Figure 49 Scenario 1 – Reclamation sourced only from port capital dredging**

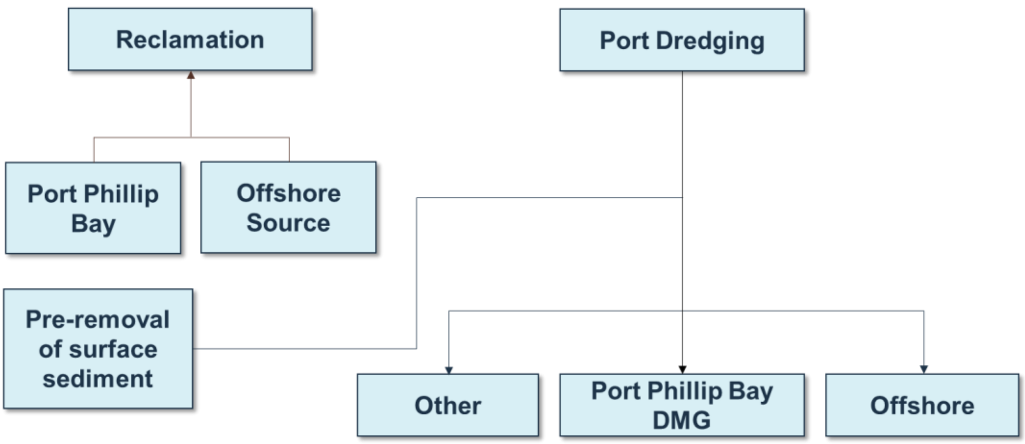



**Figure 50 Scenario 2 – Reclamation sourced from dredging other material**

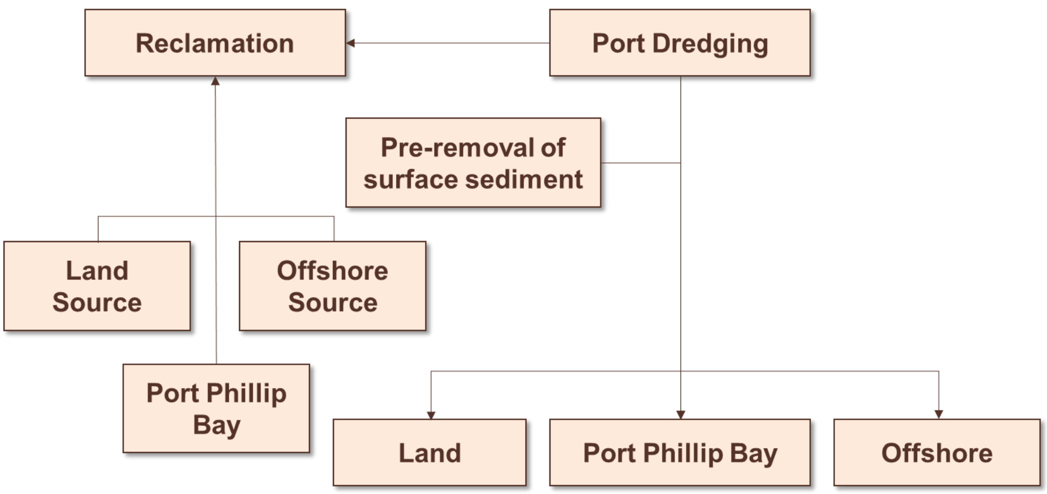



**Figure 51 Scenario 3 – Reclamation sourced from port capital dredging and other sources**

### 7.8.3 Dredge methods

Three applicable dredge methods have been identified and are described in Table 36 to provide an overview of method but also define the implications for the different material types. These include:

- Backhoe Dredging (BHD)
- Cutter Suction Dredging (CSD)
- Trailer Suction Hopper Dredging (TSHD)

### 7.8.4 Reclamation methods

Being mindful of the dredging options and beneficial re-use considerations, two applicable reclamation work methods are recognised. These include:

1. Forming the land entirely from sand material sourced away from the capital dredging site by pumping dredged sand material through a spreader or diffuser at the end of a discharge pipeline from a TSHD; and
2. Forming the land using material arising from the capital dredging in conjunction with a sand capping layer – this involves the placement of the clay material within protective bunds or another retention structure.

**Table 36 Dredge methods considered for Bay West**

| Method | Description & Implications | Suitability |
|---|---|---|
| (Mega) Backhoe Dredging (BHD) | Dredging by backhoe dredger involves the use of a very large marine excavator mounted on a purpose built spudded pontoon.<br>Materials may also be selectively excavated provided a good soil model is available for the dredging area. Dredged material can be visually observed to assess its suitability for reuse.<br>Excavated soils can also retain much of their in-situ soil structure and are not fluidised as is the case for cutter suction or trailing suction dredging, resulting in a more compact material at the placement site.<br>Dredge productivity is much lower than for other methods. | All materials can be dredged ranging from soft to hard clays, very dense sand and weak rock.<br>Shallow water.<br>Scenario 1 & 3 |
| Cutter Suction Dredge (CSD) | The cutter dredger operates as a fixed vessel. The stern is held in position with a working spud, mounted in a movable carriage. The working spud is dropped, or lowered, into the seabed, thereby holding the stern in a fixed position. At the forward end of the dredger there are two powerful side anchor winches from which are connected two side anchors. The side anchors are positioned either side of the dredge cut. The side anchors winches reeve in and pay out in concert, thereby swinging the dredger from side to side across the full width of the dredge cut. Dredged material is discharged to reclamation via floating and shore pipeline, or may be loaded into barges moored alongside | Soft to Hard Clays / medium rock / sands – destined for a DMG<br>Scenario 2 |
| Trailer Suction Hopper Dredge (TSHD) | TSHD deploy suction pipes fitted with dragheads. The suction pipes are lowered over the side and the dredger traverses over the dredging area at slow speed. The seabed material is drawn into the suction pipes by the dredge pumps in the form of slurry, which it then is discharged into the vessel's hopper. Water used in the dredging process is discharged back into the sea through an adjustable hopper overflow system. TSHD can discharge the loaded hopper at a DMG through bottom doors in the hopper, or alternatively re-fluidise the hopper material (sand) and pump it out through a floating pipeline, or jet it out over the bow through a nozzle. | Sands destined for reclamation<br>Soft to stiff clays destined for DMG.<br>Jumbo TSHD can dredge to 100m+ water depths.<br>Scenario 2 & 3 |

Both reclamation methods are indicated respectively in Figure 83 on page 163 and Figure 52 over the page. Method 1, is proposed at Hastings which is discussed in Section 8.11

Figure 52 illustrates how sand bunds would be used to contain the clay and act as a core for protective rock armoured sea walls. In this sequence, the bunds need to be placed ahead of the clay filling works.

As an alternative to bunds, sheet piles could be considered in either a temporary or permanent arrangement. A sheet piled wall solution would allow more clay to be utilised in the reclamation.

These two construction methods are considered further in Section 7.9, as it affects the outturn cost and decision on terminal location.

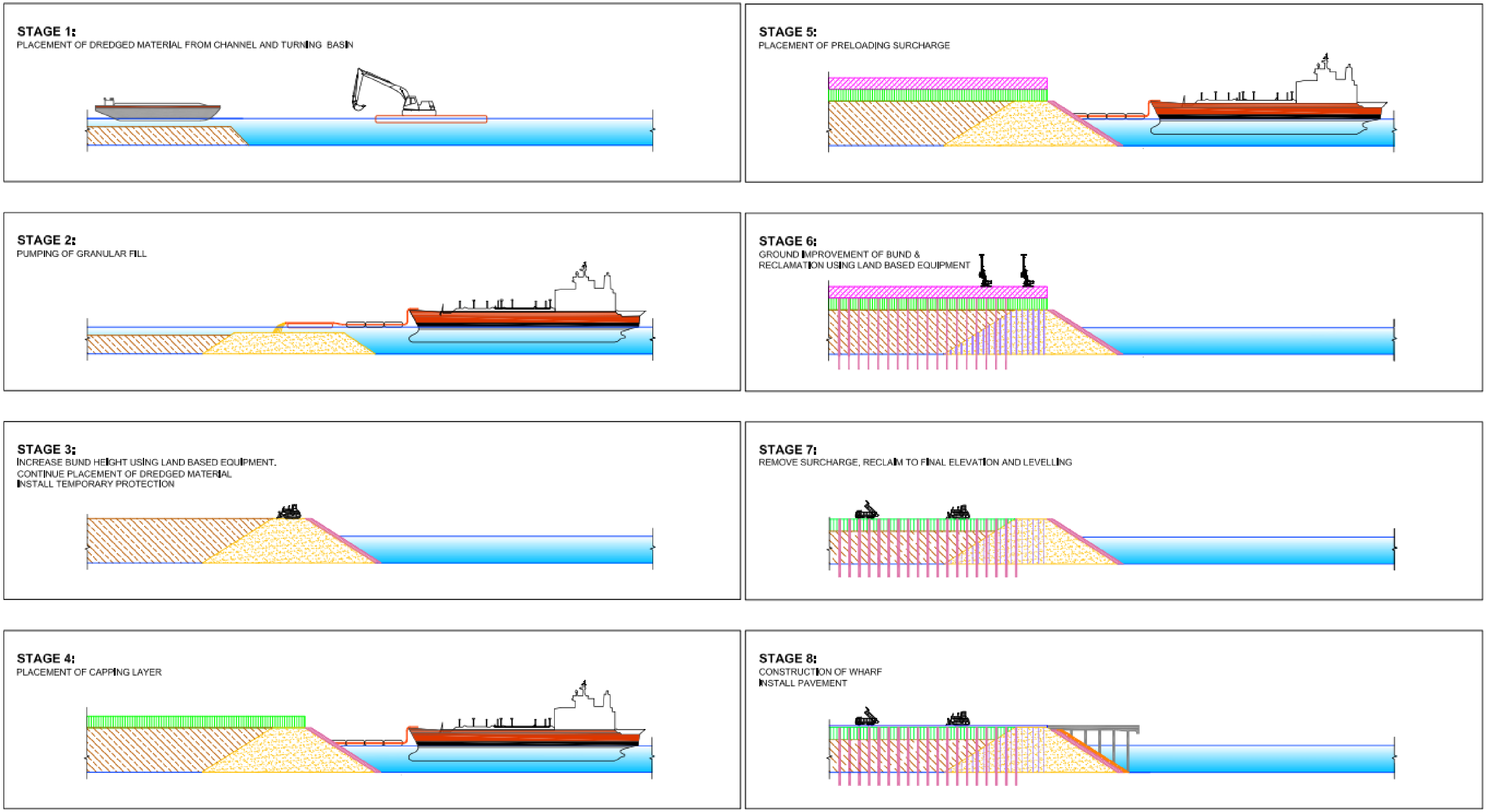



**Figure 52 Indicative construction sequencing at Bay West using capital dredge materials with sand bunds**

### 7.8.5 Other sources of sand material

The dredging and reclamation study has identified potential sources of sand material. These include:

- Maintenance dredged material from Port Phillip – estimated at around 200,000 $m^3$ per annum. Potentially 4 M $m^3$ available in 20 years.
- Capital dredging of existing channels in Port Phillip, potentially as a requirement to provide access for larger vessels to Port of Melbourne in the future.
- Dredging of sand deposits offshore or elsewhere in Port Phillip.

### 7.8.6 Dredge material disposal grounds (DMG's)

The dredging and reclamation study has identified potential options for the disposal of surplus material. These include:

- Use of the existing DMG's located with Port Phillip that are used by the Port of Melbourne or Geelong. In the case of Melbourne, it recognised that the clays could be used to further develop under water containment bunds used as part of the routine maintenance dredging undertaken in the Yarra River.
- A zone identified to provide environmental benefit, i.e. to create an intertidal area or mudflat.
- An offshore DMG in the event the materials to be dredged, prove to be of little or no value in providing suitable engineering quality fill for the port land, or have a low environmental benefit or high environmental demand outcome. It is assumed that a DMG can be developed for use in deep water Bass Straight.

### 7.8.7 Dredging cost estimates & production rates

Unit cost estimates and production rates for the selected work methods are provided in the accompany report from Baggerman Associates – titled Ports Planning Advice, Dredging & Reclamation, 15 February 2017.

### 7.8.8 Dredging the Great Ship Channel

This Section provides a summary of the proposed dredge method and cost estimate for the widening of the Heads, and is based upon the experienced gained during the Channel Deepening Project (CDP).

#### Material to be dredged

The compressive strength of materials dredged during the CDP ranged from 1 to 27 MPa. This required the powerful dredger "Queen of the Netherlands", fitted with especially designed dragheads and associated safety systems the approximate maximum hardness possible.

#### Environmental risk management

A deep canyon runs diagonally across The Rip. Dredging required an EMP that mitigated dredged material spill into the canyon. Consequently, dredging was always positioned at locations such that the tidal currents were running are away from the canyon. This placed critical limitations on the dredging work method.

#### Safety

The Rip is one of the most dangerous stretches of water in the world, and is notorious for currents and swell. This means it is very difficult for a TSHD to dredge consistently into the

current. Given all of this any TSHD planned to be deployed in The Rip needs to be large and powerful.

### Work method

It is assumed that a powerful TSHD such as the “Queen of the Netherlands” will be deployed to dredge in The Rip. This will be fitted with a purposely designed “ripper” draghead and associated safety systems.  Other dredger types, namely jumbo and mega cutter dredgers and mega backhoe dredgers can dredge this strength materials, however their safe sea state workability in The Rip can be considered to be approaching Nil.

Dredging will be undertaken by shunting.  That is dredging in one direction, then backing up to commence the next dredging run. Production rates are expected to be extremely low, but this is the only type of dredger that may be safely deployed in The Rip.

Based on the expected strength of material to be dredged, and the extreme hydrodynamic forces to be contended with by the dredger in The Rip only one suction pipe is expected to be deployed.

### Dredge volume

Given that the dredging in The Rip is widening, it is expected that it will consist of mainly removing high spots and pinnacles, that is continual “high spot hunting”.  Therefore, as with the CDP dredging undertaken in The Rip, the over dredging ratio will be very high.

### Cost estimate

Given the environmental risk management considerations noted above the base cost estimate is based upon dredging only taking place on the ebb tide (Item 1), and therefore at other times the dredger is gainfully engaged upon other capital dredging for the project.

Spoil disposal is assumed to be into the existing spoil ground(s) in Capel Sound.  Note that draught limitations may now apply for jumbo trailer dredgers in this area.

Given the nature of the work method in dredging in The Rip, and the environmental and safety risk management requirements the cost estimated are based upon lump sums, not unit rates.

The cost estimates are based upon a net volume of 100,000 $m^3$, and a swept area of 110,000 $m^2$.

The cost adopted in these estimates are based upon a greatly reduced cost for developing and trialling the ripper dragheads that will be required, given that it has been proven during the CDP that this work method is effective.

### Base cost estimate

For this cost estimate the mobilisation, site installation and demobilisation cost are picked up by other capital dredging components. The cost of developing, constructing and trialling ripper dragheads for the dredging in The Great Ship Channel are included.

| | |
|---|---|
| Execution Cost: | $150,000,000 |
| Mobilisation: | $ 9,300,000 |
| Total | $159,300,000 |

### 7.8.10 Opportunities / observations

The following opportunities arise from the dredging and reclamation study:

- There is good opportunity to beneficially re-use a substantial portion of the capital dredged clay material in the land reclamation. Potentially requiring keeping volumes for disposal to Port Phillip to an absolute minimum. This is considered further in Section 7.9.
- There is opportunity to beneficially re-use material dredged from maintenance dredging from existing Port Phillip channels from an early date to offset capital dredging costs at a later date. This strategy may alleviate future (maintenance dredged) material disposal challenges for these works. (Capel Sound DMG is understood to be restricted in depth for the TSHD that is usually employed for these works; an alternative DMG will be required in the near future).
- The adoption of a work method that considers the use of capital dredged clay and sand provides improves design flexibility significantly. The method provides significant opportunity to optimise the materials arising through choice of location and configuration in Port Phillip. This provides opportunity to identify the lowest cost and most sustainable port option.

### 7.8.11 Ground improvement

The reclamation methods set out in the previous section will require ground improvement treatment to be applied to consolidate the material and ensure long term performance.

For sand filling, a vibro-compaction treatment is proposed, which involves the use of a vibrating probe that can penetrate granular soil to depths of over 30 metres. The vibrations of the probe cause the grain structure to collapse thereby densifying the soil surrounding the probe. In order to effectively treat and densify a loose soil, the probe is raised and lowered in a grid pattern. Vibro-compaction performs well in medium and coarse sand and fine and medium gravel deposits. This method was used for the high performance areas (around quay structures) of the 60 hectare reclamation completed as part of the Port Botany expansion.

For clay filled areas, a pre-load surcharge system is proposed in conjunction with vertical drainage. The surcharge will be applied to the extent that it exceeds the final operating loads on the area and the fill is allowed to settle progressively. The rate of settlement is monitored and, when it slows up to a predetermined rate, the surcharge is removed and construction can start on the reclamation.

This pre-load process is typically very slow. The application of the treatment is assumed to comprise vertical drains installed on a 1-2 m grid to beyond the depth of the reclamation, with the application of around 3-4 m of sand fill surcharge. A sand stabilisation system (such as grass) is placed on top. This would be left in place for up to 2 years.

The application areas for the two methods is indicatively indicated in Figure 53.

With the dredging at Bay West being likely undertaken as part of a single campaign, the surcharging strategy is proposed in a way that material can be reused in the permanent works.

The sequence which is indicatively described in Figure 53, sees the phase 1 surcharge material being used for subsequent capping layers and surcharge accordingly.

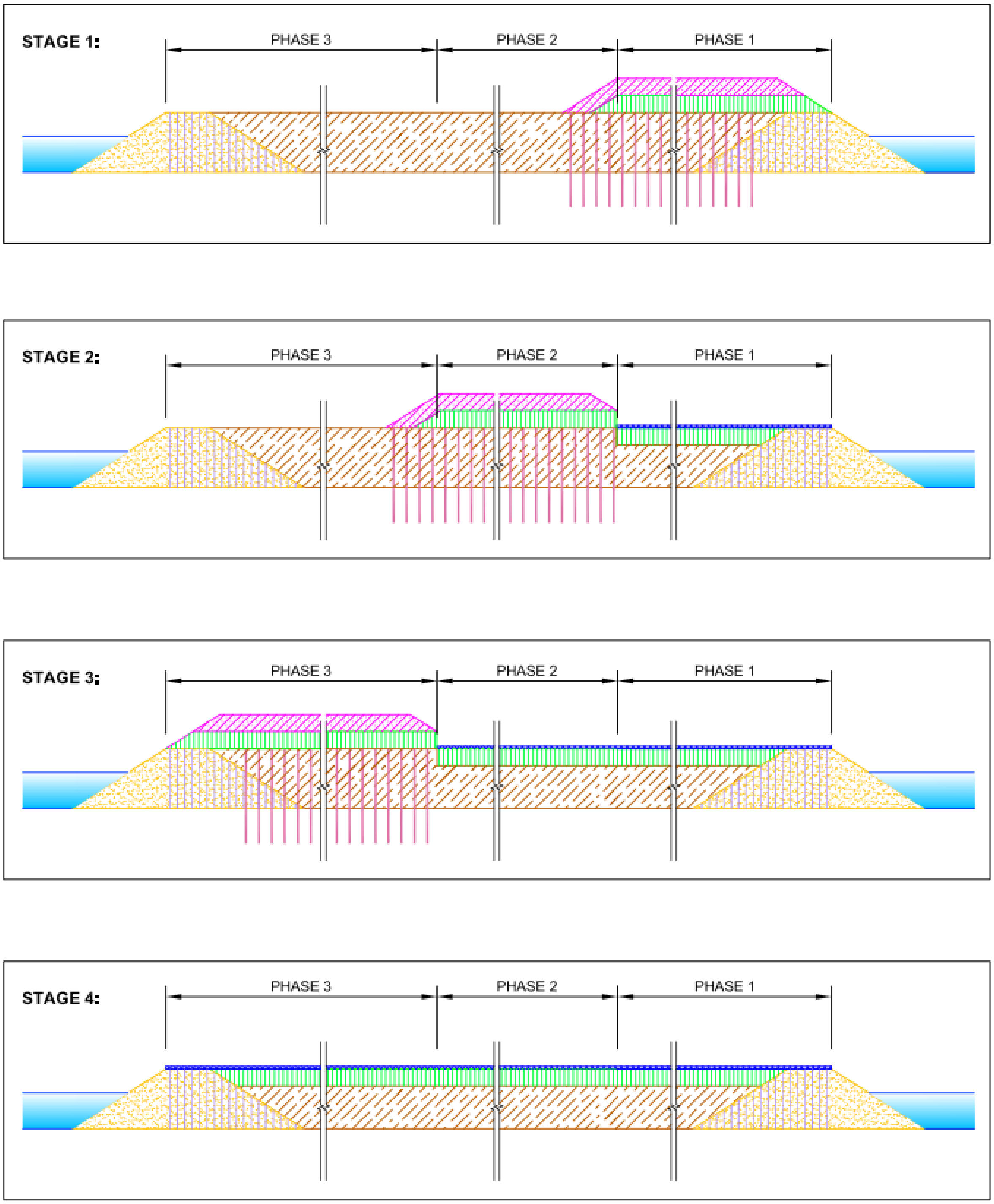



**Figure 53 Indicative sequencing of surcharge material**

## 7.9 Port optimisation

Further assessment has been undertaken to revisit the choice of location to reflect the two recognised work method scenarios. This section summarises the findings.

The assessment considers how the balance of dredged sand and volumes of clay for disposal impact cost and the beneficial re-use outcome for the respective capital dredging volumes.

### 7.9.1 Scenario 2 – Clay and sand materials combined

The assessment of this work method considers two simplified clay retention scenarios:

1. The use of sand bunds.
2. The use of a sheet piled wall retention system.

For each it estimates the total dredge and reclamation task to identify an approximate location from shore up to which clay material arising can be used beneficially and disposal volumes are minimised.

The testing considers the optimum locations for a high case (18,000 TEU) and medium case (14,000 TEU vessel), as these each drive different dredge volumes under each offset location.

The assumptions that define the volume of sand material required for the bunds and capping layers is presented in Figure 54. The analysis assumes the island is 4.1 km long.

The graphical outputs for the sand bund method are presented in Figure 56 and Figure 56 for the sheet pile method.

The findings are summarised in Table 37. This indicates that for a 4.1 km long island built from capital dredge material with sand used for control bunds and capping:

- An optimal location (resulting in minimum clay volumes for disposal) for the 14,000 TEU vessel could feasibly be found between 1.5 and 2.0 km from shore; and
- An optimal location for the 18,000 TEU vessel would exist between 2.5 and 3.0 km from shore depending on the interface between clay and sand layers.

**Table 37 Island offset for optimal use of dredged clay under different reclamation scenarios and vessel size**

| | 14,000 TEU vessel case | 18,000 TEU vessel case |
|---|---|---|
| Sand bunds / clay to +1.0 mCD | 2 km | 3 km |
| Sand bunds / clay to +1.5 mCD | 1.75 km | 2.75 km |
| Sand bunds / clay to +2.0 mCD | 1.5 km | 2.5 km |
| Sheet Piles (No sand bunds) | 1.5 km | 2.5 km |

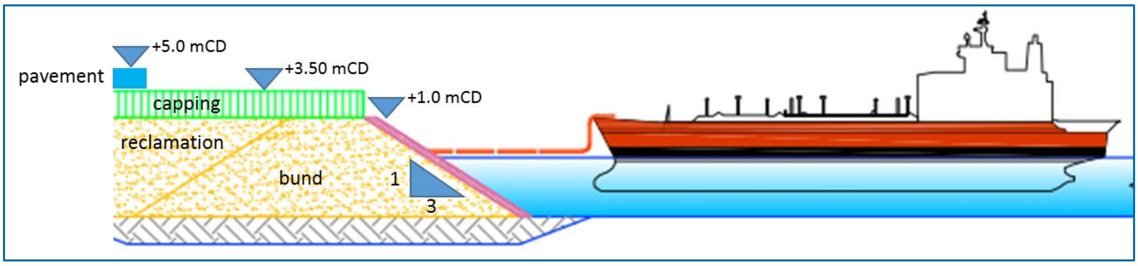



**Figure 54 Assumed arrangement for bunds and capping used in analysis**

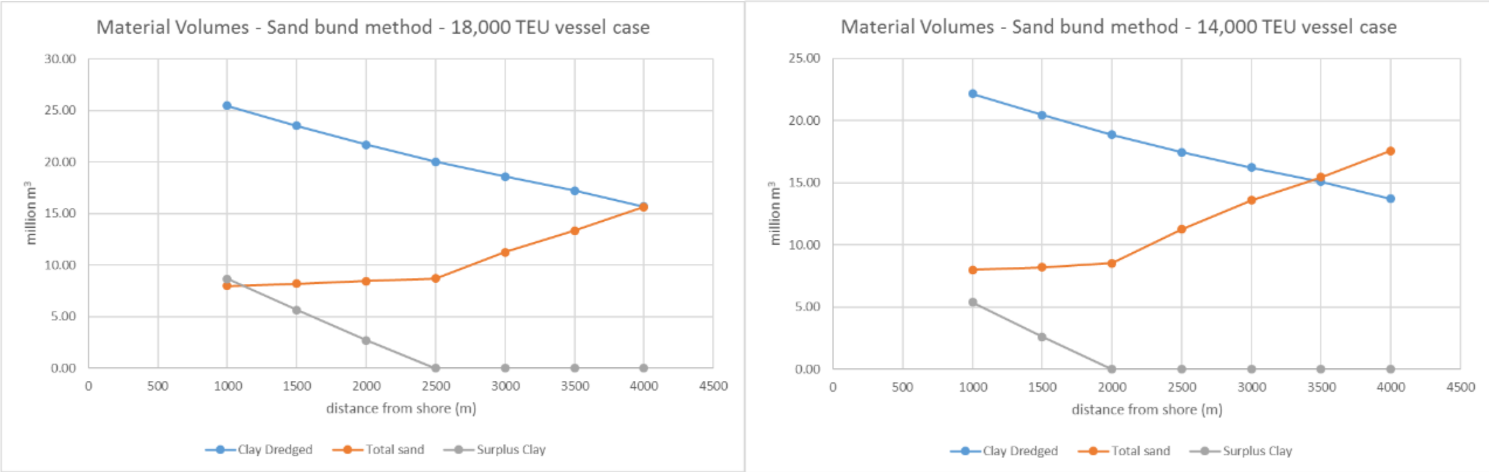



**Figure 55 Comparison of clay volumes for disposal and total sand material requirements for 18,000 TEU and 14,000 TEU vessel scenarios at varying island offsets using sand bunds**

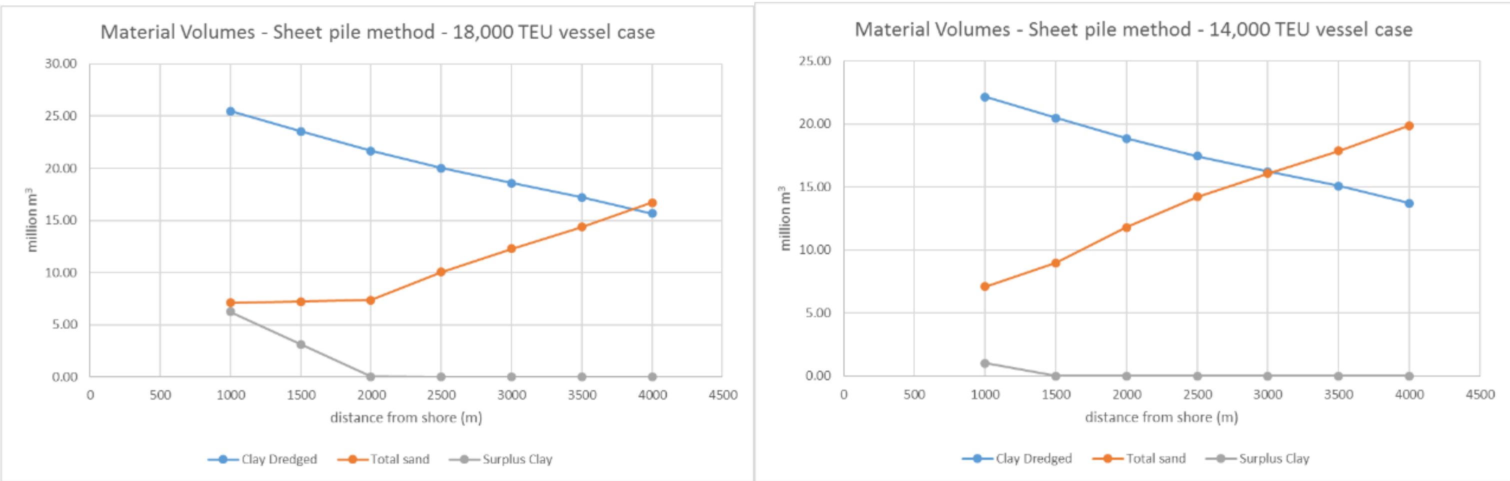



**Figure 56 Comparison of clay volumes for disposal and total sand material requirements for 18,000 TEU and 14,000 TEU vessel scenarios at varying island offsets using sheet pile retention structures**

### Impact on dredging cost

The testing of the balance of reclamation and disposal volumes has been combined with unit costs for the applicable work methods to provide an indication of impact on cost.

Figure 57 and Figure 58 highlight the findings, and demonstrate:

- the volume of clay for disposal, has a significant impact on total cost, and on a unitary basis, it is preferable to place the material in the island rather than dispose of it.
- Once the clay has been used in the island, the costs savings of moving further out from shore become less significant, although the cost sensitivity testing does not consider increased bridge length cost.

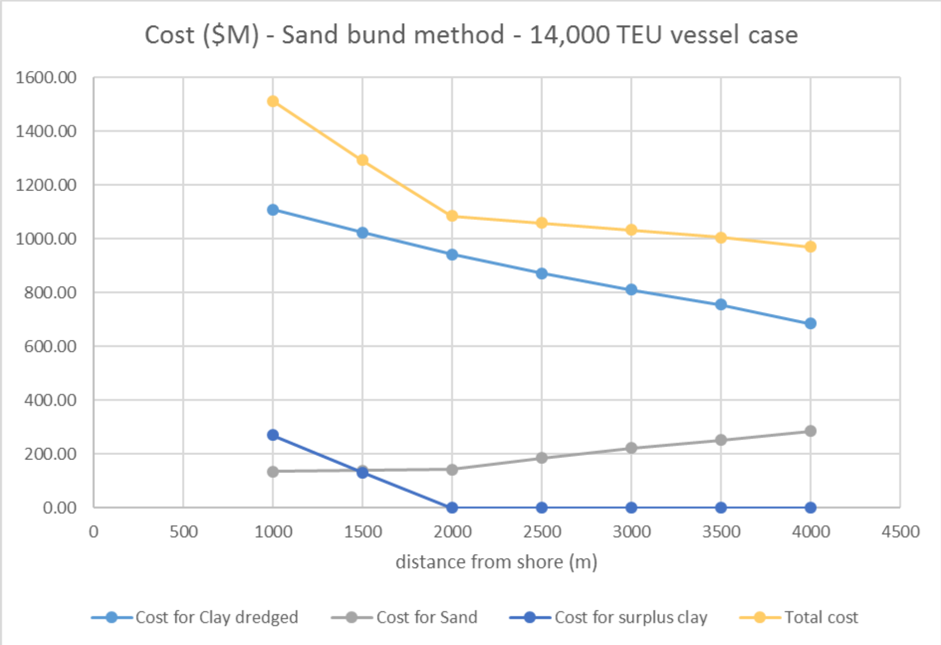



**Figure 57 Impact of clay disposal on dredge cost for the 14,000 TEU vessel**

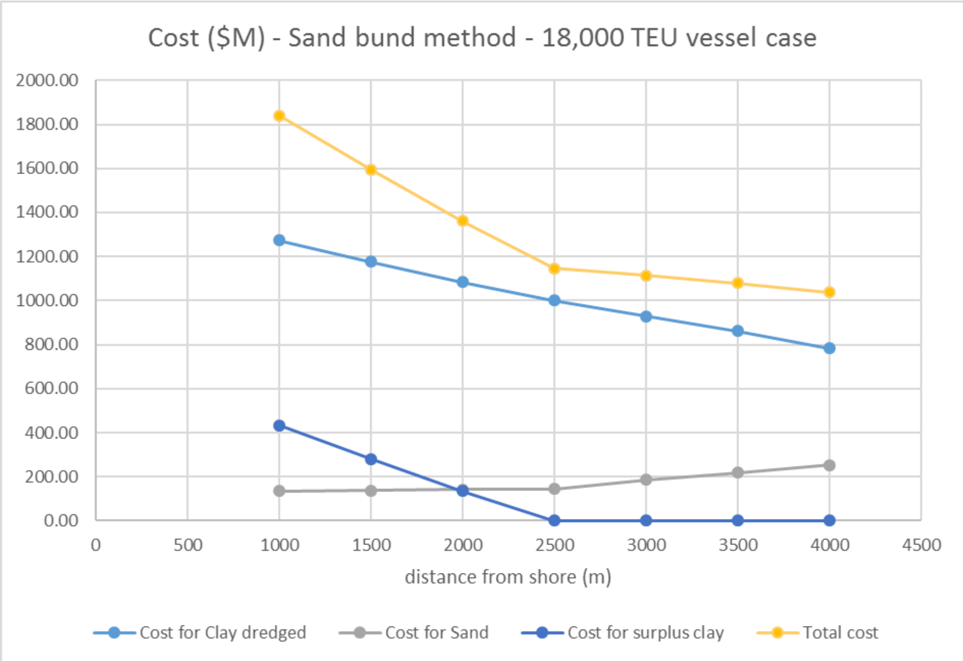



**Figure 58 Impact of clay disposal on dredge cost for the 18,000 TEU vessel**

### Additional land creation opportunity

Ignoring additional ground treatment costs, the assessment highlights that the disposal of clay, adds disproportionate cost to the project.

Table 38 illustrates how the surplus dredged clay material could be used to create a longer island for each offset distance from shore. A longer island (without associated alongside dredging) could be utilised for port precinct purposes.

Depending on offset location, the results identify that for a lower dredge cost, the capital-dredged material could be used to create an island up to 1.4 km longer if it was offset by 1.5 km from shore (18,000 TEU vessel) and 650 m for the 14,000 TEU vessel.

This length would be reduced if the clay was placed to a higher level above Chart datum.

**Table 38 Extra island length that can be created from surplus clay (m)**

| | 18,000 TEU vessel case | | 14,000 TEU vessel case | |
|---|---|---|---|---|
| **Dist. from shore (m)** | **Sand Bund** | **Sheet Pile** | **Sand Bund** | **Sheet Pile** |
| 1000 | 2560 | 1853 | 1593 | 296 |
| **1500** | 1398 | 772 | 647 | 0 |
| **2000** | 630 | 13 | 0 | 0 |
| **2500** | 0 | 0 | 0 | 0 |
| **3000** | 0 | 0 | 0 | 0 |
| **3500** | 0 | 0 | 0 | 0 |
| **4000** | 0 | 0 | 0 | 0 |

Note: this assumes clay is placed to +1.0 mCD, a level would reduce the extra length that could be created.

In summary:

- There is benefit of utilising all the capital dredged material to create land
- The site provides opportunity to keep costs to a minimum.
- The site bathymetry provides flexibility for determining a final port configuration and offers opportunity to expand land footprint to accommodate other port functions.

### 7.9.2 Scenario 1 – Sand materials

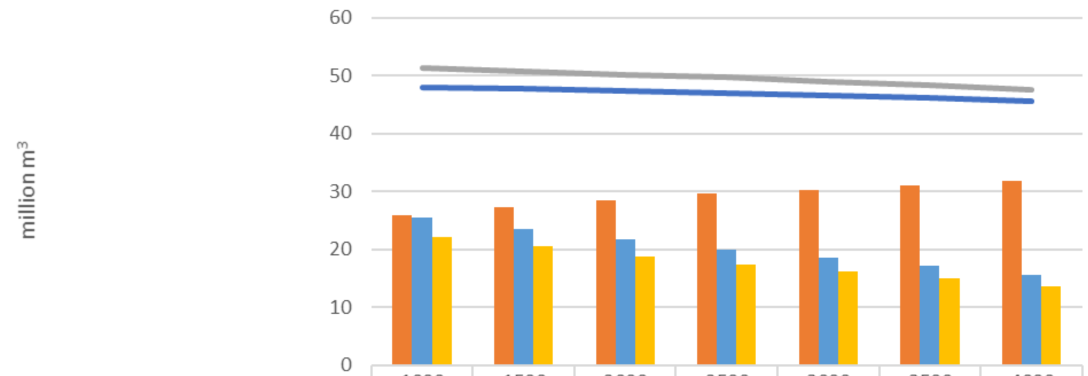
The same assessment method has been applied to the work method considering the use of dredged sand for the creation of the land (clay materials dredged and transferred to a DMG).

The resulting dredge task is presented in Figure 59, which indicates:

- Total filling volumes (using sand) are estimated to vary between 27 $Mm^3$ and 32 $Mm^3$ in the zone out to 4 km from shore.
- The total dredging task, comprising the clay (for disposal) and sand (for reclamation) would be expected to be between 47$Mm^3$ and 52$Mm^3$.

As previous, the volumetric estimates are based on an island of 4.1 km length, with sand placed to +5 mCD and exclude provisions for additional material that may be required for surcharging the material.

The implications on cost are presented Figure 60 for the 18,000 TEU vessel. This output considers unit rates for sand placement using a jumbo TSHD and disposal of the capital dredge clay using a large CSD. Like for like, the results suggest this work method is more costly.




| | 1000 | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 |
|---|---|---|---|---|---|---|---|
| Amount of sand (Mm3) | 25.8 | 27.2 | 28.5 | 29.6 | 30.3 | 31.1 | 31.8 |
| 18,000 TEU vessel case clay | 25.47 | 23.52 | 21.67 | 20.03 | 18.57 | 17.23 | 15.66 |
| 14,000 TEU vessel case clay | 22.16 | 20.46 | 18.85 | 17.45 | 16.21 | 15.08 | 13.70 |
| Total dredge - 18,000 TEU vessel case | 51.27 | 50.72 | 50.17 | 49.63 | 48.87 | 48.33 | 47.46 |
| Total dredge - 14,000 TEU vessel case | 47.96 | 47.66 | 47.35 | 47.05 | 46.51 | 46.18 | 45.50 |

**Figure 59 Estimated total dredge task with distance from shore (scenario 1)**

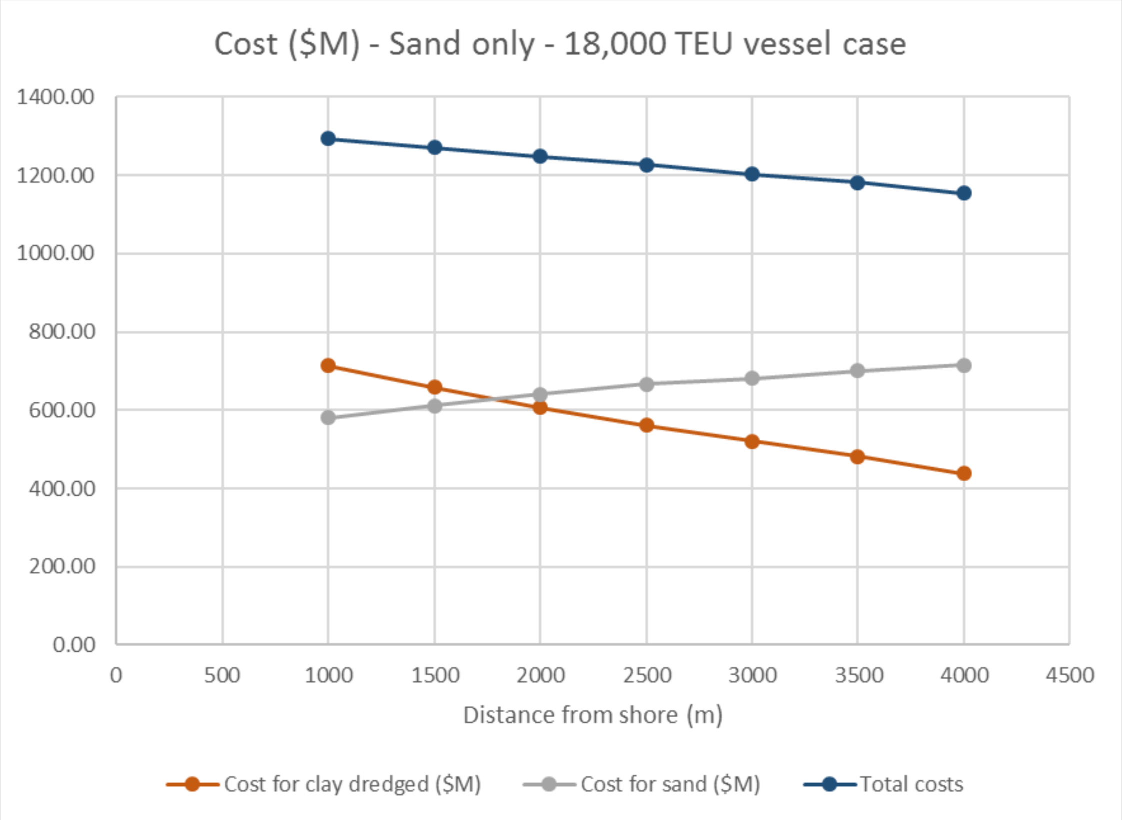



**Figure 60 Estimated total dredge cost with distance from shore (scenario 1)**

### 7.9.4 Observations on the optimised location and work scenario

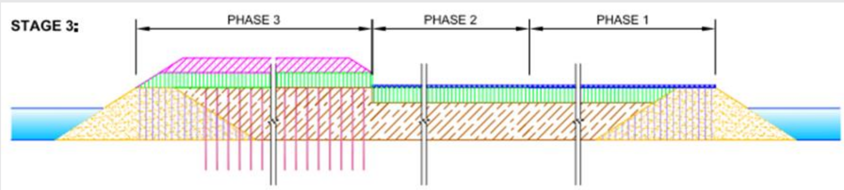
The observations from the assessment of the dredge and reclamation work scenarios are:

- Forming the land using the capital dredged material results in the lowest total amount of dredging of all methods, and hence could be considered most sustainable.
- The arrangement of the terminal both in length and distance from shore can be adjusted to enable the capital dredge volume to be fully utilised and reduce costs proportionally.
- Based on the application of unit rates, work method 2 (clay with sand bunds) results in a lower outturn cost if the clay material volume for disposal is kept to a minimum.
- Work method 2, provides further opportunity to create additional land using surplus clay materials if required.

### 7.9.5 Summary dredging task arrangement

Table summarises the key components of the resulting arrangement at Bay West that is adopted for the cost estimate and options assessment for each vessel size scenario.

**Table 39 Dredging & reclamation metrics associated with each vessel size**

| | 14,000 TEU vessel | 18,000 TEU vessel |
|---|---|---|
| Island offset (m) | 2,000 | 2,500 |
| Construction work method | Method 2<br>Clay containment using sand bunds and sand capping<br>Mega BHD, 40 m³ bucket size, 6 box barges, 2 unloaders<br> | |
| Dredging: sand ($m^3$) | 8.45 M | 8.65 M |
| Dredging: clay ($m^3$) | 18.8 M | 20 M |
| Ratio clay soft/firm : stiff | 50/50 | 50/50 |
| Dredge cost (incl. mob) ($AUD) | 1.08 bn | 1.13 bn |
| Mob / demob | 6-10 weeks / 4 to 6 weeks | |
| Dredge duration(s) | Clay volume 4.4 years<br>Sand bunds 10 months | Clay volume 4.7 years<br>Sand bunds 10 months |

## 7.11 Engineering feasibility

### 7.11.1 Sea walls

Rock armoured sea walls are assumed to be installed to all sides of the permanent land reclamation works at Bay West, with materials placed on the southern face being integrated within the quay construction.

The eastern, western and southern faces will be exposed to the largest waves, and will require slightly larger rock that the northern (landside) face, which is most protected.

Table 40 and Table 41 present the rock quantity estimates for the three island faces for the two island offset scenarios adopted. Volumes for the main wharf face are considered as part of the quay structure options.

For each side face, it assumed that 50 m of sheet piled quay will be provided in lieu of revetment for tug berthing.

**Table 40 Rock armour required at Bay West – 18,000 TEU (2.5km offset)**

| Island face | Rock thickness (m) | bed level (m) | crest (m) | slope length (m) | island length (m) | volume ($m^3$) | geotextile area ($m^2$) |
|---|---|---|---|---|---|---|---|
| Northern | 0.94 | -6.7 | 5 | 31 | 4100 | 120,000 | 127,100 |
| Eastern | 1.85 | -7 | 5 | 32 | 550 | 32,500 | 17,600 |
| Western | 1.85 | -7 | 5 | 32 | 550 | 32,500 | 17,600 |
| | | | | | sum | 185,000 | 162,300 |
| Placement density | | | | @1.65t/$m^3$ | = 305,250 tonnes | | |

**Table 41 Rock armour required at Bay West – 14,000 TEU (2.0km offset)**

| Island face | Rock thickness (m) | bed level (m) | crest (m) | slope length (m) | island length (m) | volume ($m^3$) | geotextile area ($m^2$) |
|---|---|---|---|---|---|---|---|
| Northern | 0.94 | -5.7 | 5 | 29 | 4100 | 111,800 | 118,900 |
| Eastern | 1.85 | -6 | 5 | 30 | 550 | 30,525 | 16,500 |
| Western | 1.85 | -6 | 5 | 30 | 550 | 30,525 | 16,500 |
| | | | | | sum | 172,850 | 151,900 |
| Placement density | | | | @1.65t/$m^3$ | = 285,200 tonnes | | |

The land protection rock works to the northern, eastern and western faces are expected to be undertaken as part of the stage 1 construction in line with the single dredging campaign.

With quay length being built to suit demand, it is assumed that the reclamation along the wharf face will have a temporary protection in place up until the wharf is built. A grouted mattress system is proposed to be installed in phase 1.

Table 42 summarises the assumed distribution of rock and grouted mattress works by phase for both the 14,000 TEU and 18,000 TEU vessel.

### Table 42 Indicative phasing of sea wall by development phase

| | Phase 1 | Phase 2 | Phase 3 | Total |
|---|---|---|---|---|
| Temporary protection (grouted mattress) (m) | 2,650 | - | - | 2,650 |
| Armour type 1 – (marine face) (t)<br>(18000 TEU / 14,000 TEU vessel) | 107,000 / 101,000 | - | - | 107,000 |
| Armour type 2 – (landward face) (t)<br>(18000 TEU / 14,000 TEU vessel) | 197,000 / 184,400 | - | - | 197,000 |
| Quay side works (m) | 1450 | 1350 | 1300 | 4100 |

### 7.11.2 Terminal pavements

Table 43 provides an estimate of terminal pavement quantities at Bay West by development phase. The description of the different types is set out in Section 5.13.13.

### Table 43 Estimated area schedule ($m^2$) of pavement at Bay West

| | Phase 1 | Phase 2 | Phase 3 | Total |
|---|---|---|---|---|
| Berth length (m) | 1450 | 1350 | 1300 | 4,100 |
| Container stacking | 539,400 | 502,200 | 483,600 | 1,525,200 |
| Heavy Duty | 139,200 | 129,600 | 124,800 | 393,600 |
| Light duty | 17,400 | 16,200 | 15,600 | 49,200 |
| Gravel balance | 174,000 | 162,000 | 156,000 | 492,000 |

### 7.11.3 Causeway / bridge structure

Figure 61 illustrates the concept for the transport bridge link to shore. This assumes a structure of at least 27 m width, to accommodate four number 3.5 m wide vehicle lanes, two number rail tracks (8 m) and a services corridor. Two concepts are contemplated: - bridge form and causeway.

In bridge form, the concept comprises an in-situ concrete deck supported on a series of 1.8 m deep pre-cast T beams that span between piled cross head beams; the piled supports comprise sets of 8 number (914 mm diameter) piles at 30 m centres along the line of the bridge. As the bridge approaches the shoreline, the likelihood of shallow rock being present will increase and the piles would require socketing. At each pier four of the piles are to be raked to assist with the transfer of longitudinal loads due to forces such as thermal expansion and road and rail traffic braking. Containment barriers will be provided on each side of the structure, they will be designed to resist both rail and road traffic collision loads.

In causeway form, the concept comprises a sand bund formed from dredged or imported material protected with rock armour on either side. The structure would likely be around 30 m width at the top, to incorporate the above transport infrastructure and accommodate a rock armour crest to control wave overtopping. The base of the structure may be up to 60 m wide. Where the causeway interacts with piled bridge, a piled abutment would be constructed.

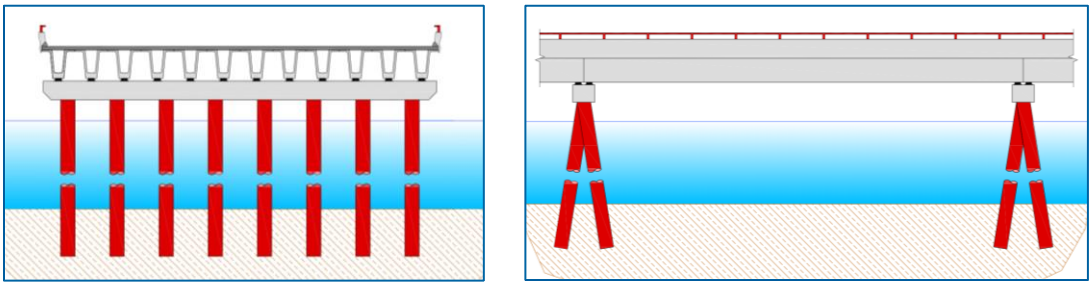


**Figure 61 Conceptual arrangement for the bridge link to shore**

## 7.12 Quay structures

### 7.12.1 Review of structure options

The key design parameters relating to the quay structure are:

- A 100-year design life,
- a berth pocket dredge depth of – 17 mCD,
- a cope line level of + 5 mCD
- a quay crane rail gauge of 35 m (to service vessels with a maximum beam of 59 m),
- a seaside crane rail setback distance from cope line of 5 m and
- a fender line offset seaward of the cope line of 2 m consistent with PIANC guidelines.

For Bay West a variety of structural forms have been considered taking in to account factors such as constructability, construction sequencing, geotechnical conditions, durability, maintenance and whole of life costs.

The sequencing assumes the construction would be staged across three phases of development.

The assessment has identified two technically and economically viable solutions for the proposed facility at Bay West.

The shortlisted solutions are described in Table 44 and include:

- A gravity retaining caisson structure; and
- A suspended deck structure.

### Table 44 – Desktop analysis of the advantages and disadvantages of different quay structure types at Bay West

| Selected Option | Description | Advantages | Disadvantages |
|---|---|---|---|
| Piled Quay | Steel or concrete tubular piles driven to underling soil strata.<br>Composite concrete deck comprising precast beams and deck panels with an in-situ concrete topping supported by piles. | Provides and maintains a fixed separation between the front and rear crane rail within a rigid structure.<br>Eliminates residual settlement and residual differential settlement along and between the crane rails.<br>Sloping seawall section tailored to underlying ground conditions without need for soil improvement.<br>Minimises the height of structural cut-off wall needed to retain the reclamation.<br>Low wave reflectivity from revetment slope relative to vertical quay wall.<br>Provides environment for new marine habitat within the rocks and around the piles.<br>Minimises impact on the currents and flow of the channel.<br>Normal piling equipment which is readily available. | Driving of marine piles expensive, time consuming & noisy<br>Installation costs may increase where rock strata exist, but shorter piles and therefore decreased material costs may result.<br>Relatively large surface areas of the steel pile exposed to marine environment and maintenance burden requires pile encasement above water and cathodic protection system below water or extensive reinforced concrete pile infills.<br>Difficulty in maintaining seawall under quay deck requires revetment design to be very low maintenance.<br>Piling works are required to be undertaken over water.<br>Cannot be built in advance of land reclamation or serve as a temporary works bund to land reclamation activities |
| Reinforce Concrete Caisson Quay | Large precast cellular structures.<br>Rectangular Prism - Typically 40x20x20 m (length,width,depth).<br>Manufactured off-site and floated to site and then sunk into position. | No marine piling works.<br>Effective earth retaining structure that may benefit land reclamation.<br>Fast construction.<br>Minimal slope protection required.<br>Front crane beam can be incorporated into caisson.<br>Low ongoing maintenance.<br>Following construction, failures tend to be local such as differential settlement. This possibility can be reduced by preloading the structure before casting the cope beam. | Dredging and underwater ground preparation necessary.<br>Suitable only when stiff underlying geotechnical conditions exist.<br>Differential settlement risks.<br>Potential for future berth deepening may be limited<br>Additional dredging and imported rockfill is required below the gravity structure with underwater operations that also requiring use of divers.<br>Aggregates and rock material have to be imported. |

### 7.12.3 Piled quay

A piled quay would comprise a reinforced concrete deck structure supported on steel piles overlying a sloping rock revetment as shown in Figure 62. The structure will be designed for temporary container stacking loads and accommodate both land and seaside crane rails on the structure.

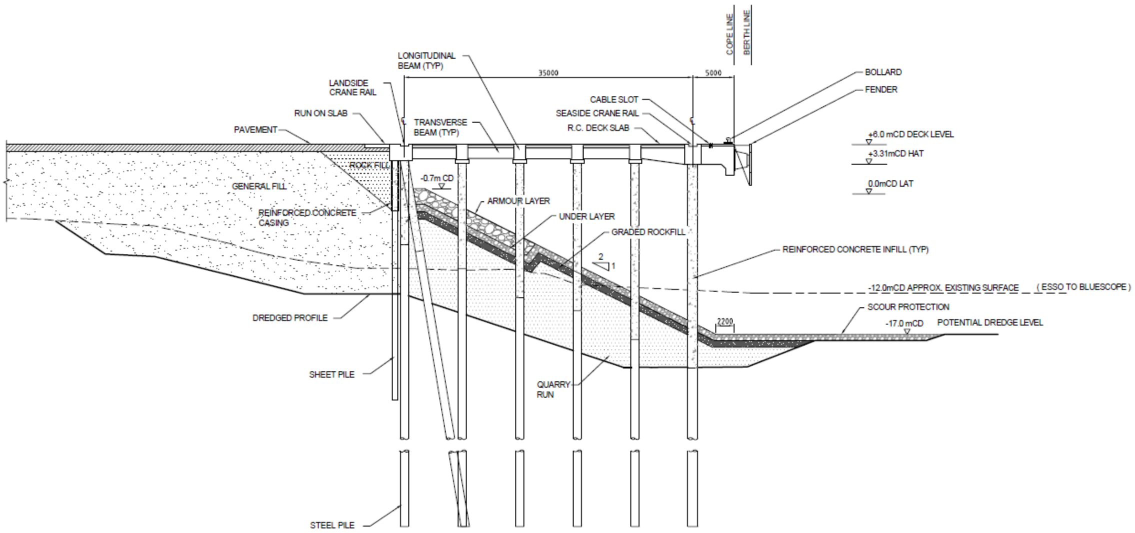



**Figure 62 Typical cross section of an open piled quay at Bay West**

The concrete superstructure will consist of a two-way beam and slab system with precast concrete beams running longitudinally and transversely with precast concrete panels forming the deck. An in-situ topping slab will be cast on top of the precast concrete panels to ensure the concrete sections acts as monolithically. This form of construction allows for a simple, standardised and efficient construction method and a safe method of working over water.

The concrete beams are expected to be supported typically by 1000 mm steel tubular steel piles, with 1200 mm diameter vertical steel tubular piles supporting the front crane rail beam and alternating vertical and raked 1200 mm diameter steel tubular piles supporting the rear crane rail beam.

The use of raker piles assists with reducing the bending on the vertical piles due to lateral forces (i.e. berthing and mooring loads). The transverse spacing of the piles is proposed at 7 m with pile bents centred at 7 m longitudinally. The tubular piles are estimated to be 40 m long in a clay substrate. If a basaltic layer is encountered at a shallow depth the steel piles will likely be shorter. Depending on the depth of the rock, tension piles may require socketing into the rock formation to gain anchorage while vertical piles may be driven to refusal and terminated accordingly. Where the vertical piles are terminated due to encountering shallow rock layers some of the piles may require to be concrete filled to their toe - depending on the quality of the founding rock and their length of embedment. The anchorage of tension piles would be expected to increase their cost for installation due to increased works and time. The vertical piles may benefit from a costs saving by virtue of the saving in material.

The exposed lengths of the steel piles will require both passive and active cathodic protection measures to ensure they satisfy the required design life. Alternatively, the steel section can be considered sacrificial with the reinforced concrete infill ultimately taking all pile loads to below the sea bed.

The rock revetment on the underlying slope is required to ensure that any reclaimed land or exposed seabed does not suffer erosion during the design life of the structure. The primary factors causing erosion are wave action, current flow, scour and vessel thruster operation.

The sand bund material from the reclamation works will form the core material. This would be trimmed to the desired 1 vertical: 2 horizontal gradient. The revetment will comprise a primary rock armour layer underlain by a rock under layer, overlying a geotextile membrane to prevent the migration of fine soil particles through the rock armour layers. The concept analysis has shown armour rock of around 0.8 to 1.0 t may be required.

The rock armouring layer will be installed once the steel tubular piles have been driven but before the concrete deck is installed. The rear retaining wall, above the revetment will consist of driven steel sheet piles. To ensure they satisfy their design life a combination of catholic protection and concrete encasement of the upper, exposed face will be required.

### 7.12.4 Reinforced concrete caisson quay

Concrete caissons are ground bearing gravity structures and require ground preparation in the form of the creation of a foundation trench, before the units can be installed along the quay line. The ground preparation ensures a suitable bearing surface for the units allowing the weight of the caisson units to be evenly dispersed to the underlying ground, reducing the potential for differential settlement between caisson units.

A major advantage of caissons or other mass gravity structures over traditional wharf types (steel piled structures) is the reduced maintenance burden and opportunity to reduce whole of life cycle costs due to the absence of exposed steel members and heavy reinforcement. Other advantages are the increased construction productivity and quality as the caissons can be wholly prefabricated in a factory like environment on or off-site.

A concrete caisson is considered to be a valid option where harder geological formations are found. The presence of rock or other hard founding materials can affect the viability of a piled structure. The caissons are also well suited to resisting lateral forces, such as berthing and mooring loads.

A quay comprising caisson units would be established by placing a series of interlocking open topped precast concrete cells side by side. The design of the concrete caisson will depend on the site conditions and the available construction equipment; this includes the availability of nearby slipways or dry docks.

The concept design that has been proposed is indicated in Figure 63 below.

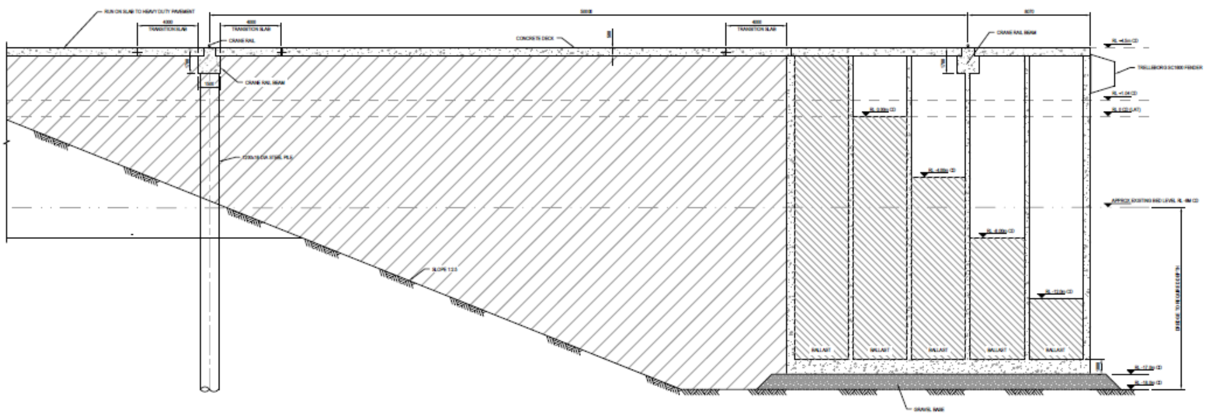


**Figure 63 Typical cross section of a land backed caisson berth**

Preliminary calculations indicate a concrete caisson of 40 x 20 x 21 m (length x width x depth) with a granular ballast would be suitable for the proposed operation of the new terminal, assuming geotechnical conditions permit.

The caissons would be constructed ashore and then launched to sea, towed by barges and sunk into position. The subsoil conditions are prepared by dredging/excavating the soft

sediments and constructing a base of either one, or a mix of sand, gravel and rubble, this base will be well compacted and accurately levelled. The caissons will be positioned side by side and joined together by in-situ concrete key joints.

It is important during the placement of the caissons that settlements are minimised, particularly any differential settlement between units. Any differential settlement, either longitudinally between units or transversely between landside and seaside crane rails will have significant operational impact on the ship to shore cranes.

Once the caisson units are in place they will be filled with sufficient granular material to resist the lateral earth sliding forces. The caissons will contain discrete cells, allowing varying heights of fill to be placed such that the overturning forces can be balanced, and a more uniform ground bearing pressure be obtained. The units will then be capped with a reinforced concrete slab. The front crane rail will be cast once the caisson segments are aligned.

Once the caissons are placed and filled, the area between the concrete caissons and the top of any reclaimed land is to be backfilled with a granular material to prevent the build-up of hydrostatic forces against the rear wall of the caisson, improve stability, reduce requirements for ground improvement in this zone and minimise post-construction settlement.

Depending on the size of the caisson, the rear crane can be integrated or otherwise installed as an independent structure consisting of a concrete crane rail beam supported by concrete or steel piles. The area in between the caisson and rear rail would be finished with container stacking pavement.

#### 7.12.5 Proposed wharf type

For the purposes of the assessment, a piled quay structural form has been assumed as indicated in Figure 62.

## 7.13 Utility & services connections

At Bay West, the study work has suggested that the required network connections exist locally, although capacity has not been verified.

The estimated power demand for the terminal at 9M TEU is estimated at 92 MVA. The current WTP demand for power is approximately 10% of this.

The ability to provide such power together with other services and utilities at Bay West is not expected to be a fatal flaw, as with exception of gas, there appears to be suitable trunk infrastructure running past or to the WTP site which can be utilised. With the site being largely, agricultural there appears to be numerous alignment options for its distribution to the terminal.

There is a 220 kV supply at the WTP boundary, a local 22 kV distribution across the WTP site and there is a local power generating facility on the site. Assuming the power supply from the AGL facility is reliable, it is noted that this would provide close to 50% of the stage 1 terminal power needs (30 MVA).

The staging of the terminal development beyond stage 1 and associated landside areas will impact on how the future service and utilities are rolled out. With the majority of the WTP site being agricultural land, and not currently highly serviced, this may be protracted, but it will allow for local distribution to be optimised accordingly.

The benefit of having existing supplies in the area suggests there is potential to get a Stage 1 terminal facility connected, with minimal upfront capital expenditure on service related infrastructure.

## 7.14 Construction sequence and timing

### 7.14.1 The basis of the procurement and construction programme

The procurement and construction timing estimate for Bay West has been developed from the PoHDA studies that evaluated lead in times and similar construction stage steps, with adjustment to reflect the larger stage 1 capital dredge profile and extents of transport corridor works.

The programme is based on the normal Australian landlord port model where the port authority builds the reclamation for the terminal, the quay wall, the access roads and the external utilities. The port authority also provides the access channel and swinging basin dredging. The Stevedore provides the pavement, drainage, equipment and buildings.

### 7.14.2 Stage 1 implementation programme

The programme for stage 1 is dependent on the extent of data and understanding of the principal geotechnical, hydrodynamic and environmental factors at play.

At Bay West, where baseline data exists for the WTP site and Port Phillip, it is assumed that a lead time (around 3 – 5 years) would exist before an application for the consents to develop new port facilities could be made.

Figure 64 subsequently illustrates the estimated schedule for Bay West for the development of the initial stage. This indicates a timeline of 8-9 years from obtaining consent to when the first container could be handled. A main feature is the ongoing dredging works for the future stages 2 and 3.

The timing for subsequent stages is not expected to be lengthy, as the requirements for consents are expected to be straightforward, and land would be in place. The main driver will be the timelines for ground improvement and wharf construction.

A simplified approach would be to assume subsequent tranches of development over 3-4 years.

### 7.14.3 The construction sequence

For a suspended deck structural form and using all the dredged clay with sand bunds for the reclamation, the construction sequence for stage 1 can be summarised as follows: -

1. Dredge to remove the soft overburden material and provide access for the trailer dredge to place sand for containment bunds
2. Place dredged sand to form the bunds and dredge the proposed berth area and turning basin using a large BHD to place material into the core of the reclamation.
3. Place the required surcharge on the reclamation and treat the sand bunds and the clay core to reduce future settlement
4. Continue with the land formation for stages 2 and 3 and build the transport link.
5. Remove the surcharge material from the stage 1 area and place this on stage 2.
6. Trim the sand bund slope, install piles and construct the quay structure
7. Build the terminal infrastructure
8. Build the road/rail and power links
9. Install the operating equipment and commission

| Bay West Container Expansion Project - Stage 1 | Months |
|---|---|
| **Project team contracting entity establishment** | **12** |
| **Preparation for the construction procurement processes** | **12** |
| **Construction procurement processes** | **12** |
| **Construction dredging, reclamation and wharf** | **64** |
| Design, fieldwork, management plans and approvals | 6 |
| Mobilisation for dredging and reclamation | 2 |
| Containment system construction | 6 |
| Dredging (entire footprint) | 54 |
| Ground improvement (stage 1) | 30 |
| Wharf construction (stage 1) | 22 |
| **Preparation for stevedore procurement process** | **6** |
| **Stevedore procurement process** | **9** |
| **Construction and fit out of operating infrastructure** | **32** |
| Design, fieldwork, management plans and approvals | 6 |
| Mobilisation | 3 |
| Civil construction (pavements, beams and etc) | 14 |
| Terminal equipment and systems | 28 |
| Installation and commissioning | 9 |
| **Preparation for other infrastructure and services procurement processes** | **6** |
| **Other infrastructure and services procurement processes** | **9** |
| **Delivery of other infrastructure and services** | **36** |
| Design, fieldwork, management plans and approvals | 6 |
| Port precinct | 19 |
| Transport links | 30 |
| Associated infrastructure (utilities) | 27 |
| Maritime services | 15 |
| **Operational proving period (stage 1)** | **6** |

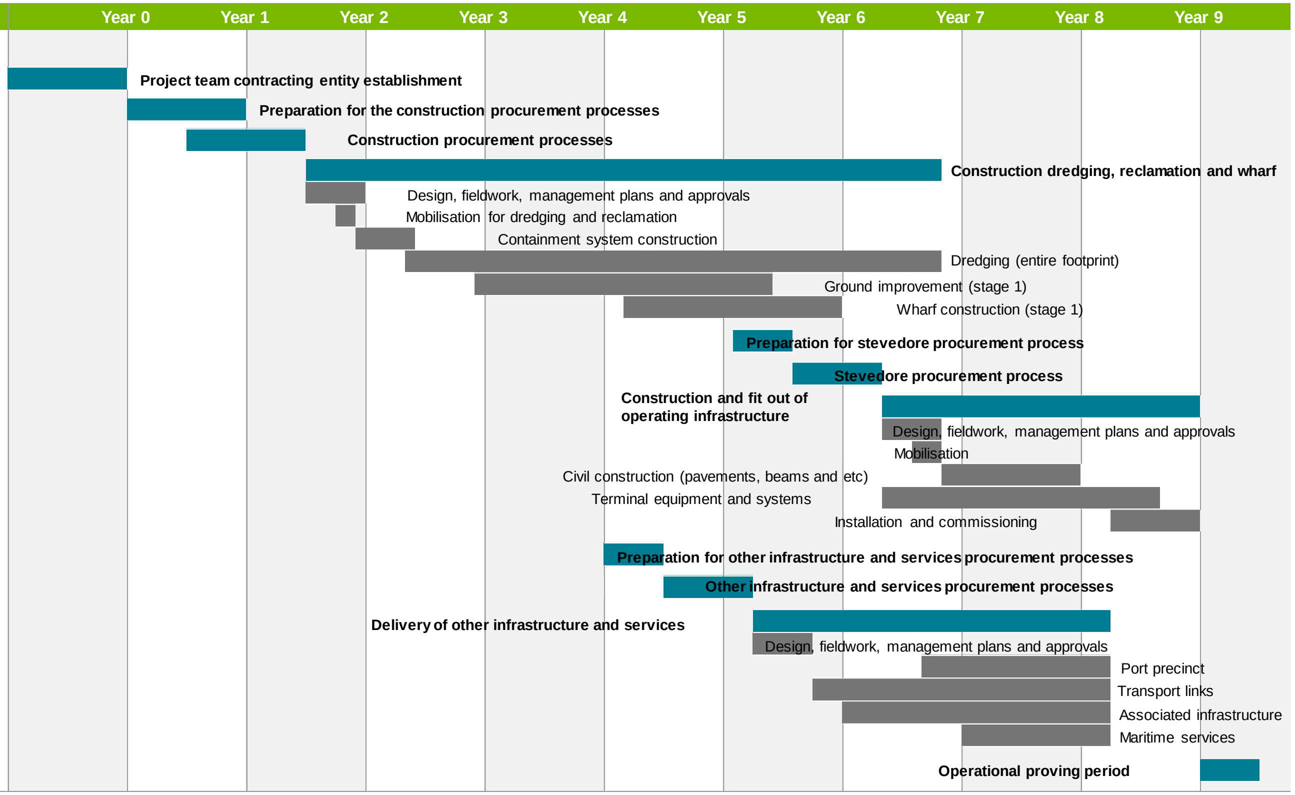



**Figure 64 Estimated procurement and construction programme (Bay West)**

# 8. Hastings Concept

This Section summarises the findings and key directions resulting from previous study work undertaken for the Port of Hastings Development Authority. That work has not been reproduced here. Further detail is available in the accompanying (referenced) report(s).

## 8.1 Site attributes

### 8.1.1 The site location

The study has focussed on container terminal planning at Long Island Point within the Port of Hastings. The Long Island precinct is located in the north-east of Hastings township, around Long Island Point within Western Port. Figure 65 presents the study area within Western Port.

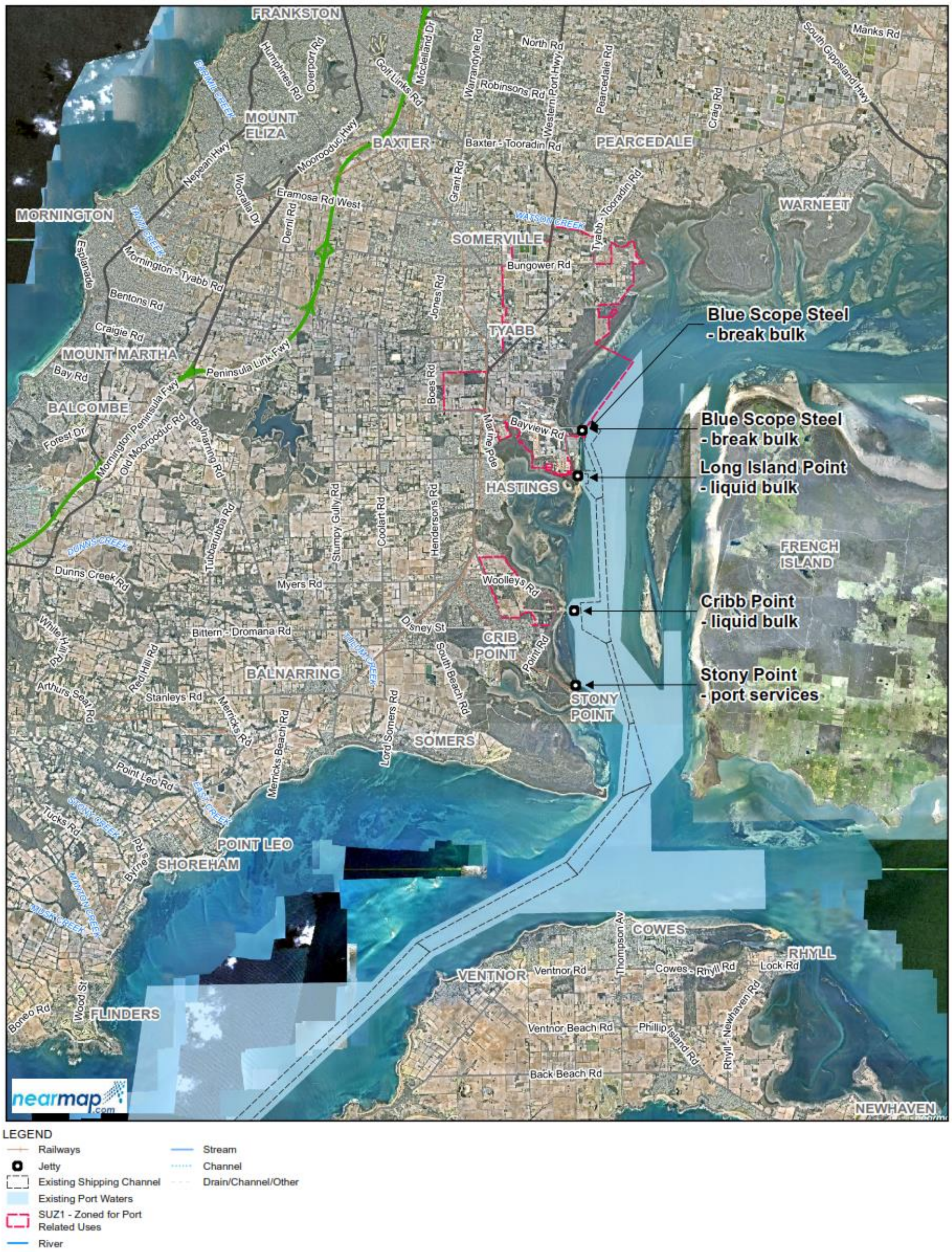



**Figure 65 Study area within Western Port**

### 8.1.2 Implications of adjacent properties

The development location is bounded to the west by the Esso facility and BlueScope facilities. At the southern end of the site, the extent of the development is limited by safety and security clearances required to the Long Island Point Jetty and its approach.


**Figure 66 Adjacent properties**

### 8.1.3 Impacts of the Esso operation at Long Island Point

The Esso facility at Long Island Point is used to store crude oil and LPG for export. It also contains four gas fractionation trains which produce the LPG and also send Ethane to Altona by pipeline. This facility is registered as a Major Hazard Facility with Worksafe Victoria. The risk assessments that go with this registration include a number of electrical safety zones, overpressure zones and heat radiation zones to match a range of possible incidents. Several of these zones would impinge on any development contemplated in front of them.

In this regard, these zones have been examined and it is proposed to build an earth bund approximately 15 m high along the Esso boundary to shield the rear section of a terminal from heat radiation and pressure waves. The height selected would give a line of sight shielding between the likely heat and pressure source and the tallest manned equipment on the terminal. Similar solutions have been used elsewhere but their use on this site will have to be checked by a formal risk assessment carried out with Worksafe Victoria.

Esso also leases an area of land north of their operational area extending up to the south of the BlueScope compound. This area includes a large storage building that has direct rail access. It is understood that this building is sub-let for a non-port related business.

### 8.1.4 The Long Island Point Jetty

The Long Island Point jetty is owned by the Port of Hastings Development Authority and currently operated by Patrick Ports. The present user is Esso who export crude oil and LPG from their facilities inshore of the jetty. These operations are expected to continue at their present level. The berth occupancy is very low at present, offering the opportunity to use the jetty for a number of other compatible operations. Commercially operated liquid bulk jetties commonly have berth occupancies in the region of 70%.

**Figure 67 Existing Long Island Point jetty**

It is understood that the jetty structure is designed to take tankers up to 160,000 DWT although at full load, these would have insufficient water depth. At present the crude oil is exported using Aframax size tankers (up to 115,000 DWT) while the LPG export tankers are approximately 6,000 DWT.

LPG is considered to be a very hazardous material because it can produce a Boiling Liquid Expanding Liquid Explosion (BLEVE). All handling of hydro carbon material requires safety clearances under a number of regulations, with LPG requiring the largest safety zones.

A review of the clearances from the Long Island Point Jetty was carried out, as part of the work commissioned by PoHDA, taking into account the hydrocarbon safety distance both from the jetty and the ship and the security regulations for such berths. There are also clearances required by the structure of the jetty, in particular the raking piles on the northernmost mooring dolphin.

Considering all these criteria, the closest point of the operational area of the new berth has been taken as 250 m north of the centre point of the Long Island Point Jetty. The south side of the operational area should be at least 100 m from the northern edge of the Long Island Point Jetty approach.

These clearances will have to be reviewed with the users of the Long Island Point Jetty, the security authorities and Worksafe Victoria before detailed design is undertaken.

To prevent difficulties with ship handling and siltation, the berth line of the Stage 1 terminal will align with the berth lines of the Long Island Point Jetty and the BlueScope RoRo berth.

### 8.1.5 The BlueScope operation

Because of fluctuating energy costs, BlueScope have intermittently imported slab steel across their jetty. In 2012 marine supply stopped, and the coating mill was supplied with steel coils by rail averaging one train a day. This year, marine operations have recommenced, with several vessels per month using the facility.

The Ro-Ro berth consists of a number of platforms and dolphins which are structurally independent of the general cargo berth. It is therefore considered possible to demolish the Ro-Ro without interfering with operation of the general cargo berth.

The BlueScope jetty is presented in Figure 68.

**Figure 68 Existing BlueScope steel jetty (left) and Ro-Ro berth (right) at Long Island**

## 8.2 Representative option for Hastings

The studies undertaken in 2014 identified two potential options for the development of a 9M TEU container terminal at Hastings that are presented in Figure 69.

The options were defined as the '**along the shore**' option, and as the '**dig-out**' option.

The along the shore option has been selected as the representative option for Hastings. This is based on an estimated lower capital cost and a review of the key differences existing between the two, which are summarised in Table 45.

Whilst the 'along the shore' option is proposed it should be noted that both options are considered equally feasible and each offer advantages. Both options would warrant further investigation if planning for a container port at Hastings were to continue

The 'along the shore' option incorporates development along the front of the Old Tyabb reclamation and BlueScope wharf with further land reclamation off to the north east to provide 4,100 m of container quay and a 600 m deep land area for the container terminal. The 'cranked' section is separated from shore to facilitate water movement across existing intertidal areas.

The 'dig out' option was proposed to reduce the development footprint on sensitive habitat areas, incorporates the same first section of development at the BlueScope Wharf area, but directs further stages of port development around a basin formed in a north-westerly direction by cutting into the SUZ1 land.

**Table 45 Differences between the 'dig-out' option and 'along the shore' at Hastings**

| Item | Along the shore | Basin |
|---|---|---|
| Capex (based on capital cost estimates undertaken for PoHDA) | Estimated to be around $450M lower capex than the Basin option | Estimated to be higher by virtue of the larger volume of earthworks material to be handled |
| Opex | Marginally lower opex due to better berth utilisation<br>Lower siltation risk (maintenance dredging) | |
| Port operations | Fewer berth faces provide a more flexible operation<br>Ship handling potentially easier | |
| Reclamation (sand assumed) $Mm^3$ | 17 | 7 |
| Dredging $Mm^3$ | 27 | 24 |
| Excavation $Mm^3$ | - | 34 |
| Dredge / excavated material management | Similar dredge material challenges exist, and both are expected to require an offshore disposal site due to estimated volumes. The 'dig-out' option is expected to have the smaller dredge disposal task, but incorporate a larger excavated material management task. | |
| Environmental Impacts | Cranes further from Tyabb airfield<br>Potentially lower impact on groundwater<br>Greatest intertidal footprint | Less visually intrusive from seaward. Greater heritage risk.<br>Least intertidal footprint<br>Further from National Park boundary |
| Future Expansion | Limited opportunity, beyond 5 km quay length | Potential to create a second basin for future expansion, although excavated material management challenges exist. |
| Road / Rail interface | Greater flexibility for road, rail, empties storage layout | Some challenges for rail connectivity to both sides of basin |
| Land Use | Additional 300 Ha of land created. Greatest area available for port environs / precinct use. | Basin does reduce the amount of land that is available for port precinct / environs. |
| Constructability | More land based earthworks / ground improvement | Less imported sand fill / reduced ground improvement |

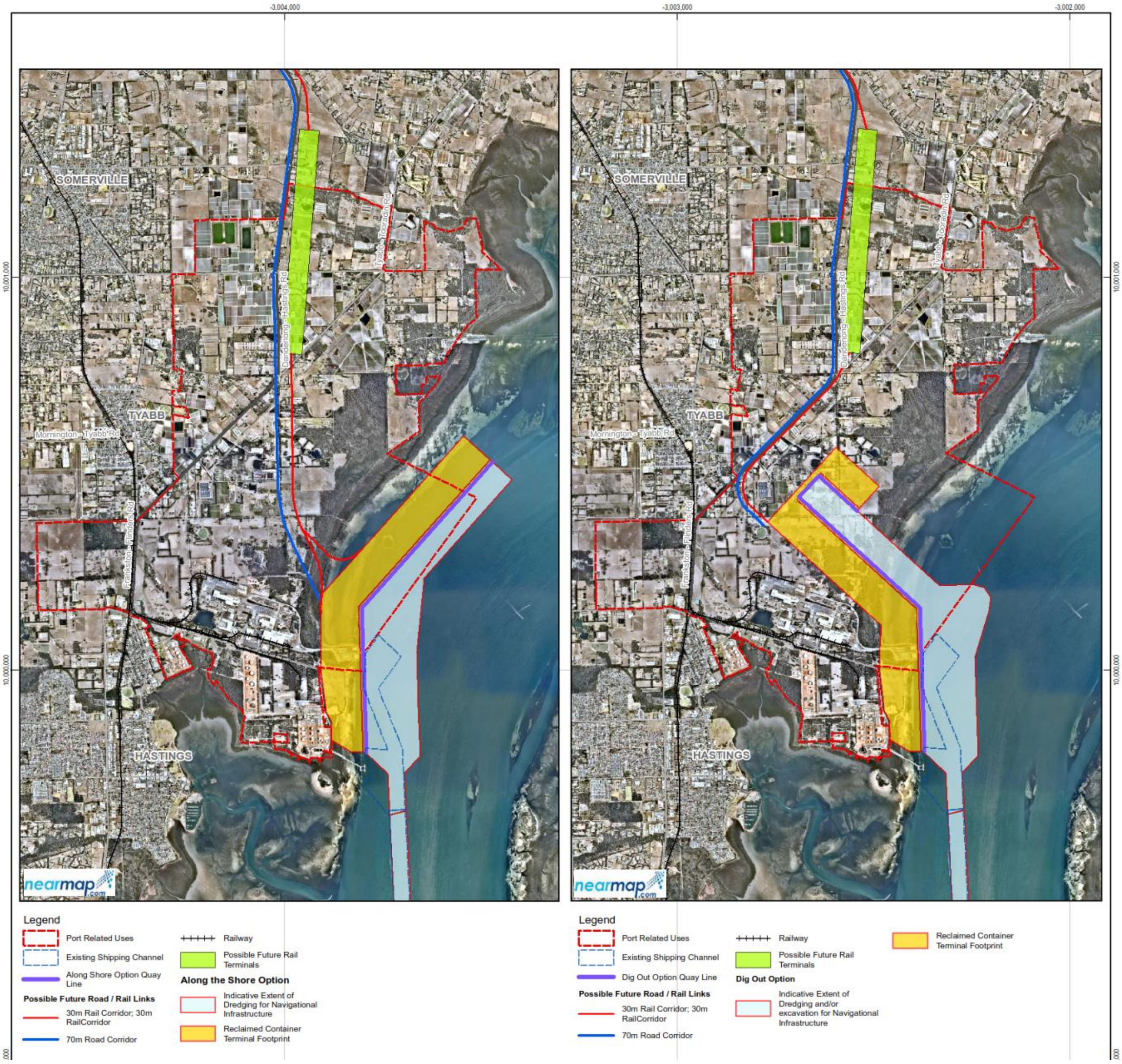



**Figure 69 'Along the Shore' and 'Dig-out' concepts for the Port of Hastings**

## 8.3 Navigational infrastructure

### 8.3.1 Existing channel

Figure 71 illustrates the channel arrangement at Hastings.

The existing channel is able to take two-way traffic in the western section south of Sandy Point.

The channel up to the Liquid Bulk terminal is able to accept tankers with draughts up to 15.0 m with tidal assistance. The northern part of the channel is one way but there is a parallel channel further east with a declared depth of 10 m.

### 8.3.2 Upgrade of the existing channel – alignment and width

Calculations have shown that the existing channel (excluding berth pocket and swing areas) needs very little dredging to accept even the largest container ship considered. The significant work is to widen the channel over a 3 km length between buoys 19 and 23 (off Stony Point) by approximately 25 m.

The volume to be dredged to upgrade the main channel to handle the 14,000 TEU and 18,000 TEU vessels, with 90% channel availability, is approximately 1.7 million and 2.7 million cubic

metres respectively. The outer part of the channel will also have to be re-aligned slightly to avoid local high spots.

The proposed layout of the channel is shown in Figure 71. This channel layout will serve the full Hastings development. The turning basin layout shown is for the Stage 1 development.

Because Western Port has a significant tidal range (3.4 m on spring tides), it is possible to accept some ships only when the tide is above a certain level. If for example the channel is designed for ships with a draught of 14.5 m at any state of tide, a ship with a draught of 15.0 m can still use the channel approximately 90% of the time. Access with a tidally restricted window is very common for major container terminals receiving the largest ships in the world.

### 8.3.3 Turning circle & berth pocket

In the immediate area of the berth, the ship will be turned ready to go out to sea and there must be enough water depth for the ship at all states of tide when she can navigate the channel.

At Hastings, close to Long Island Point, there can be a tidal flow of up to 1.2 knots along the wharf, the turning circle becomes an ellipse to allow for the ship drifting during the turn. When the ship has completed her turn, she is then manoeuvred onto the berth using the same tugs that have helped with the turn. Alongside the berth the water depth must allow the ship to float at all states of tide.

The proposed layout of the turning area is shown in Figure 70 for both the proposed stage 1 and full development. This area has been designed to accommodate the 18,000 TEU ship. Allowing for clearances to moored ships, the main turning area has a width of 1.75 times the design ship length. Along the tide, the area has a length of 3 times the design ship length.

The northern berths (beyond stage 1) of the along the shore option will be accessed by turning the ship and then towing her astern along the full length of the development. Whilst this is a common manoeuvre and is done successfully under similar conditions elsewhere, the implications of the high tidal flows and change in direction result in a recommended berth pocket zone of 400 m being proposed.

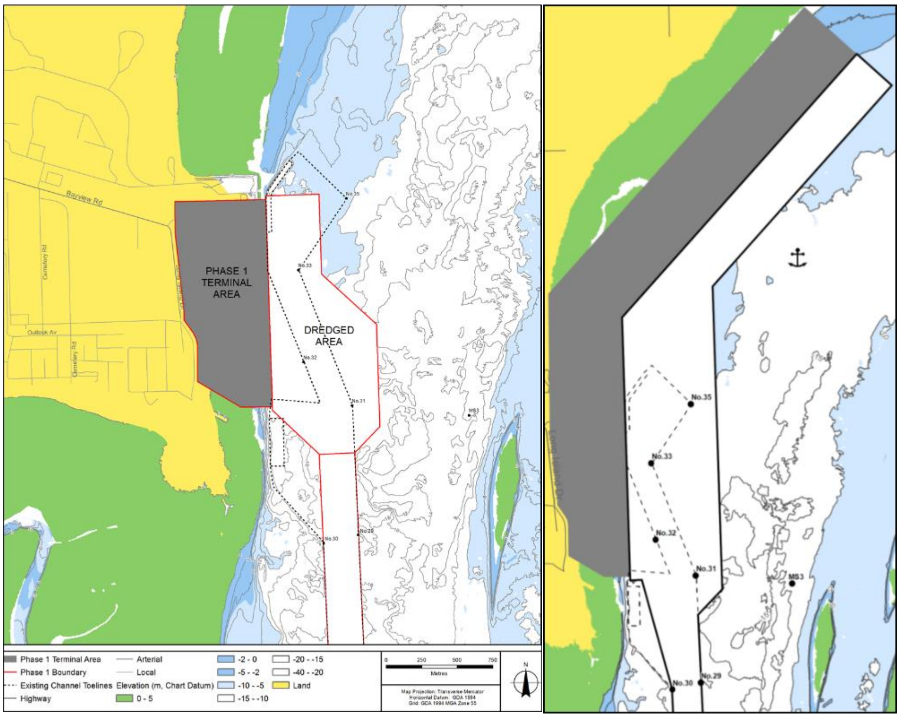



**Figure 70 Proposed channel and swinging basin arrangement for Hastings**

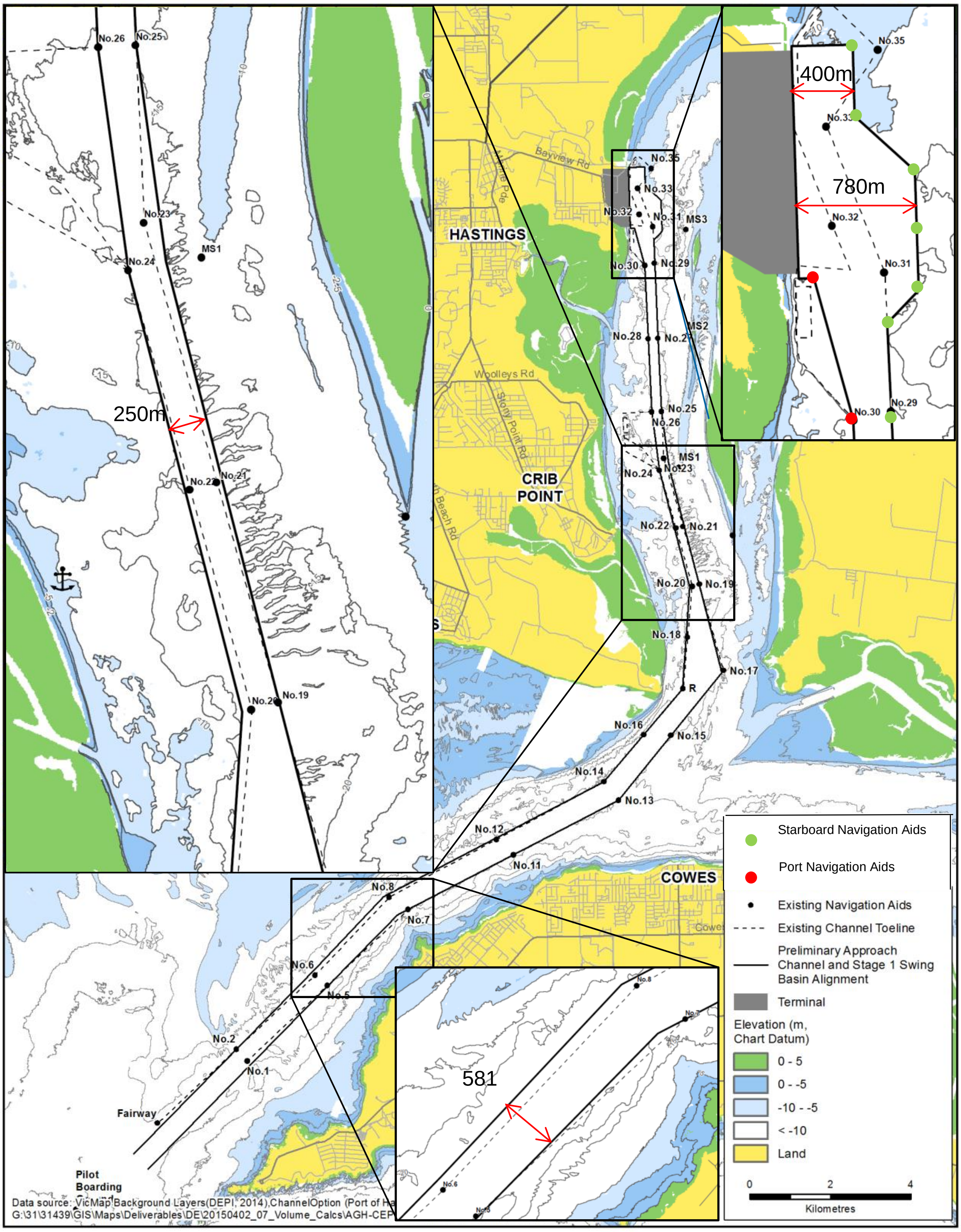



**Figure 71 Channel layout proposed for Hastings**

### 8.3.4 Estimated dredge volumes (for navigation purposes)

The following information on channel depth and potential dredge volumes has been extracted from the report "Channel Design for Navigation Report" completed for the PoHDA in 2015.

The volumes are summarised in Table 46 to Table 49. These reflect the two vessel sizes and channel accessibility. The volume estimates reflect the depth provisions set out in Table 21 for the channel, swing basin and berth pocket.

All volumes are in situ volumes and include an average over dredge provision of 0.3 m, with a further provision for the removal of soft sediment (silt) underneath the future reclamation areas that is estimated at around 3 to 5 M $m^3$. The analysis suggests:

- The total volume of dredging required in the channels is between 1.4 M and 2.6 M $m^3$ depending on channel accessibility and vessel size.
- The stage 1 volume of dredging (as dimensioned in Figure 70) is around 6 to 7 $Mm^3$.
- The total development volume is estimated at around 27 $Mm^3$ to 29 M $m^3$ depending on vessel size and the corresponding channel access requirements.

**Table 46 Channel dredge volume for 18,000 TEU vessel (equivalent 95% channel availability)**

| Segment | Dimensions | Declared Depth | Dredge Volume ($m^3$ in situ) | | |
|---|---|---|---|---|---|
| | | | To Dredge Clearance Level | Allowance for Overdredge | Total Incl Allowance for Overdredge |
| **APPROACH CHANNEL** | | | | | |
| Western Channel 1 | 519m | 17.5 | 55,000 | 59,000 | 114,000 |
| Western Channel 2 | 577m | 17.0 | 18,000 | 10,000 | 28,000 |
| Western Channel 3 | 500-577m | 17.0 | 95,000 | 29,000 | 124,000 |
| Western Channel 4 | 250-1,057m | 17.0 | 173,000 | 52,000 | 225,000 |
| North Arm 1 | 250m | 16.3 | 659,000 | 207,000 | 866,000 |
| North Arm 2 | 250m | 16.2 | 909,000 | 313,000 | 1,222,000 |
| **Channel Total** | | | **1,909,000** | **670,000** | **2,579,000** |

**Table 47 Channel dredge volume for 14,000 TEU vessel (equivalent 85% channel availability)**

| Segment | Dimensions | Declared Depth | Dredge Volume (m3 in situ) | | |
|---|---|---|---|---|---|
| | | | To Dredge Clearance Level | Allowance for Overdredge | Total Incl Allowance for Overdredge |
| **APPROACH CHANNEL** | | | | | |
| Western Channel 1 | 519m | 17 | 10,543 | 19,799 | 30,342 |
| Western Channel 2 | 577m | 16.5 | 6,522 | 6,174 | 12,696 |
| Western Channel 3 | 500-577m | 16.5 | 53,992 | 23,488 | 77,480 |
| Western Channel 4 | 250-1,057m | 16.5 | 105,227 | 37,670 | 142,897 |
| North Arm 1 | 250m | 15.7 | 323,963 | 152,507 | 476,470 |
| North Arm 2 | 250m | 15.7 | 435,382 | 211,648 | 647,031 |
| **Channel Total** | | | **935,630** | **451,287** | **1,386,917** |

**Table 48 Berth pocket dredge & fill volume for 18,000 TEU vessel**

| Section | Reclamation (sand) ($m^3$) | Berth & swing dredge ($m^3$) | silt under reclamation | estimated dredge ($m^3$) | estimated fill ($m^3$) |
|---|---|---|---|---|---|
| | A | C | F | C+F | A+F |
| Stg 1 - A | 3,319,941 | 7,044,562 | | 7,044,562 | 3,319,941 |
| Stg 2 - B | 1,802,824 | 5,985,940 | 1,350,000 | 7,335,940 | 3,152,824 |
| stg 2 - C | 3,099,074 | 4,071,731 | 1,620,000 | 5,691,731 | 4,719,074 |
| stg3 - D | 4,745,330 | 4,493,391 | 1,980,000 | 6,473,391 | 6,725,330 |
| | **12,967,169** | **21,595,623** | **4,950,000** | **26,545,623** | **17,917,169** |

**Table 49 Berth pocket dredge and fill volume for 14,000 TEU vessel**

| Section | reclamation (sand) ($m^3$) | Berth & swing dredge ($m^3$) | silt under reclamation | estimated dredge ($m^3$) | estimated fill ($m^3$) |
|---|---|---|---|---|---|
| | A | C | F | C+F | A+F |
| Stg 1 - A | 3,319,941 | 6,425,756 | | 6,425,756 | 3,319,941 |
| Stg 2 - B | 1,802,824 | 5,703,608 | 1,350,000 | 7,053,608 | 3,152,824 |
| stg 2 - C | 3,099,074 | 3,911,606 | 1,620,000 | 5,531,606 | 4,719,074 |
| stg3 - D | 4,745,330 | 4,263,393 | 1,980,000 | 6,243,393 | 6,725,330 |
| | **12,967,169** | **20,304,363** | **4,950,000** | **25,254,363** | **17,917,169** |

## 8.4 Geotechnical understanding

### 8.4.1 Soil investigations

Within Western Port there are existing borehole results in the areas of the existing wharf structures and PoHDA (in 2014) drilled further boreholes on an approximate 500 m grid and commissioned a geophysical survey of the water areas.

The geophysical investigation identified rock levels but did not differentiate between the various soil layers, hence the boreholes have been used to gain an understanding of material type.

In the area around the BlueScope and Long Island Point jetties, the soil conditions are fairly uniform. Where man has not interfered with the geology, the conditions onshore appear very similar to those underwater.

### 8.4.2 Geotechnical profile

The basic soil profile is presented across the port area, channel and Tyabb zone as follows:

#### Port area

Ground conditions in the zone of likely dredging and reclamation are typically a surface layer of dark grey and black very soft and loose recent marine deposits to depths of 0.5 to 6 m. These weak materials overly more competent stiff to very stiff sandy clay and silt and medium dense to dense clayey and silty sand, of the Baxter and Sherwood formations.  By inspection of borehole

logs there does not appear to be any significant lateral continuity of material type between adjacent boreholes.  Soil type also repeatedly changes with depth with the typical thicknesses of material beds in individual boreholes ranging from one to five metres. In the Stage 1 offshore area Silurian bedrock was encountered at depths of around 30 to 40 m below the seabed.

In addition to the Stage 1 summary report, the Geotechnical Interpretive Report contains the following:

- Baxter Formation soils are deemed to be suitable founding strata on which to place reclamation fill. The Baxter Formation and the underlying Sherwood Formation (and deeper Silurian bedrock where present), are also expected to be suitably competent to found quay structures and associated facilities supported on appropriately designed foundations.
- Recent marine clays would be unsuitable as reclamation fill. It may be beneficial to remove low strength recent marine deposits in areas of reclamation prior to filling. Where reclamation filling using dredged Baxter and Sherwood Formation soils is proposed, careful management of fluidised silts and clays derived from trailing suction and/ or cutter suction dredging processes would be required, so that unconsolidated slurry does not become entrapped within the reclamation fill. Backhoe dredging could be considered for cohesive soils in some circumstances with the benefit that in situ moisture content and soil consistency can be largely retained.
- Bedrock is not expected to be encountered during dredging in the Port Area or the North Arm although local dredging and removal of high spots in the Western Channel and Anchorage would likely encounter weathered basalt.

### The channel

The ground conditions in the channel vary from mixed clay and sand deposits at the north end to an area of sand waves off Stoney Point. There are no borehole records in the channel itself but the geophysical survey has recorded the level of the rock. The required channel dredge depths will not require any dredging in rock and some of the material recovered may be sand. The indications are that this will be very fine sand and the quantities are such that it will not make a significant contribution to the reclamation volume.

### The Tyabb reclamation

Onshore between Long Island Point and the BlueScope wharf there is an existing reclamation, which was formed in the early 1970s. The soil sequence here is generally a variable thickness of between 1.3 m and 4.0 m of very loose to medium dense sand and soft to firm clay. In places this was observed to include cobble sized lumps of clay in a sand/sandy clay matrix interpreted as being remnant “balling” of material from cutter suction dredge operations.

Natural soils underlying the fill were typically dark grey to black very loose and loose clayey/silty sand and very soft to firm silts and clays between 0.9 m to 2.5 m thick. This material included organic matter and shells. These weak soils are inferred to be recent marine or swamp deposits, which were left in place beneath the reclamation fill. Groundwater was encountered within the fill at 1.6 to 2.4 m below ground level. The reclamation fill and weak recent deposits lay over more competent Baxter and Sherwood Formation soils similar to the offshore areas. The Tyabb Reclamation is under approximately 30% of the proposed Stage 1 terminal area.

Figure 72 shows a typical cross section of the soils through the Tyabb Reclamation. Chainage zero on the left hand side of the section is close to the inland boundary of the site. The proposed alignment of the quay wall is located at approximately chainage 650 m.

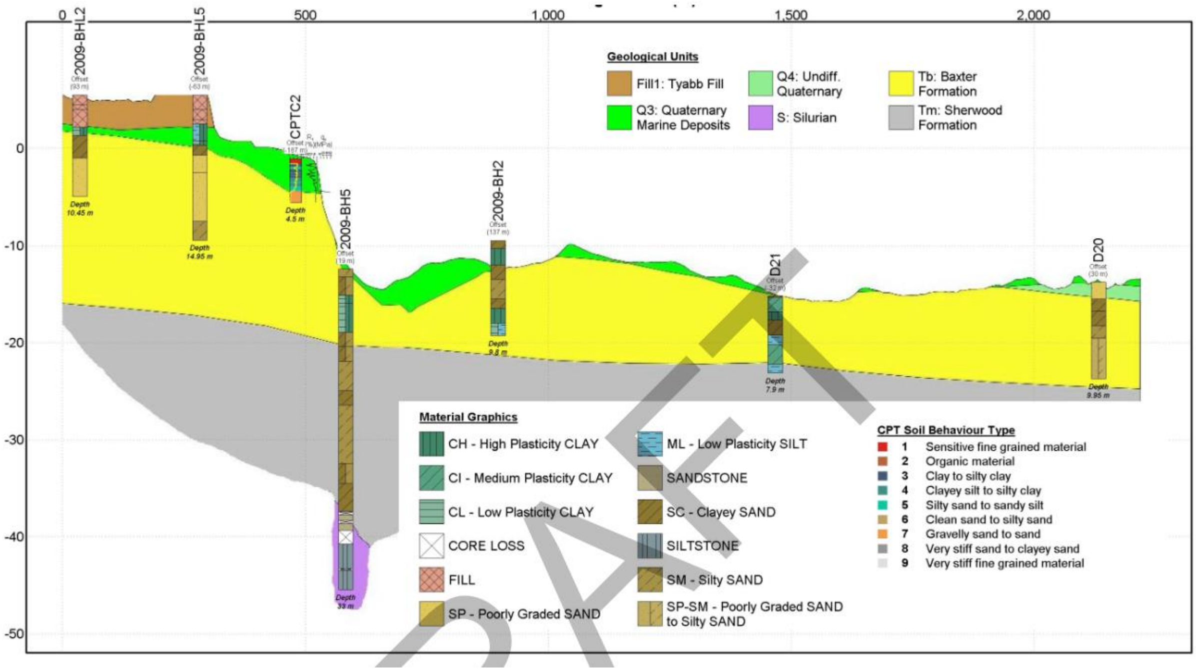



**Figure 72 Typical soil section through the Tyabb reclamation (Source: Stage 1 Development Summary)**

### 8.4.3 Impacts of dredging

The document “Geotechnical Interpretive Report” completed in 2014 for the PoHDA concluded the following:

- Dredge materials in the Port Area and the North Arm are not expected to pose significant challenges for conventional dredging plant and equipment.
- Bedrock is not expected to be encountered during dredging in the Port Area or the North Arm, however dredging of cemented materials will be required.
- Localised dredging and removal of high spots in the Western Channel and Anchorage would likely encounter weathered basalt rock.
- The dredge materials, predominantly comprising Baxter and Sherwood Formation soils, exhibit vertical and lateral variability. As a result of this variability it may not be possible to selectively dredge these sand and clay deposits. Ground improvement would be required for reclamation fills derived from these materials to densify soils and reduce post reclamation settlement. Recent soft marine clays would be unsuitable as fill for reclamation.
- Foundation materials are expected to be suitably competent to support quay structures and associated facilities using conventional forms of construction including piled bulkhead walls or piled quay decks. Piles for wharf structures are expected to be driven to refusal on bedrock or a specified driving resistance in Baxter or Sherwood Formation soils. Foundations for gravity structures may require construction of a rockfill base along the quay line within the Baxter or Sherwood Formations due to the high bearing pressures associated with these structure types.

## 8.5 Terminal layout and infrastructure

### 8.5.1 Terminal layout

Earlier sections have confirmed the requirement for a berth length of around 4.1 km and terminal depth of 600 m to provide 9 M TEU capacity. However, due to agreements in place with BlueScope, there is a requirement to provide a replacement berth to account for the loss of the BlueScope jetty.

At Hastings, the concept incorporates a total berth length of 4,250 m as proposed in Figure 73. The components and basis for the arrangement are discussed further below.

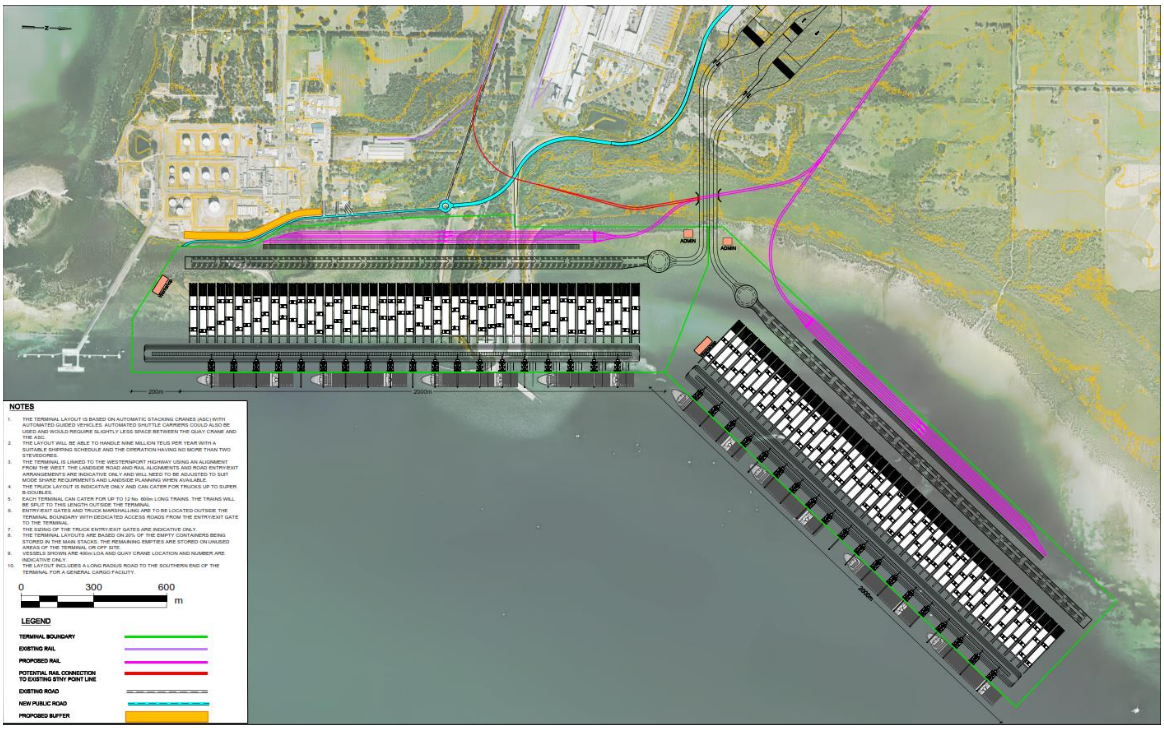



**Figure 73 Proposed terminal layout at Hastings**

### 8.5.2 Berth alignment & proximity

The berth is proposed to have the new wharf berth line aligned with the Long Island Point berth line and be offset to allow a 250 m long tanker to be berthed up to 25 m north of its central position (manifold offset provision). This alignment has been proposed to avoid causing siltation of the existing tanker berth, and reduce the risk of shedding eddies on onto the Tanker berth on an ebb tide that would potentially impact the handling of a tanker.

This proposed arrangement includes berth space as a replacement to the BlueScope jetty at the southern end of the main quay line. This area has been identified because the landward dimensions are constrained by the proximity of the Esso storage facilities and proposed earth bund. This makes the land unsuitable for high capacity container operations.

### 8.5.3 Stage 1 arrangement

The Stage 1 development is considered to be between the existing Long Island Point tanker jetty and the BlueScope general cargo wharf with a quay length of 1,450m that could handle up to 3 million TEU per year.

The existing BlueScope RoRo berth would be demolished and the BlueScope general cargo wharf would remain to service the construction of Stage 1 and other general cargo requirements. To enable dredging close to the existing structures, it may be necessary to

undertake some strengthening works to the existing wharf. The scope of these works will need to be determined during any subsequent stages of the study.

The proposed layout of the Stage 1 terminal is outlined in Figure 74. The associated transport connections are outlined in Section 8.6


**Figure 74 Proposed stage 1 terminal layout**

Within stage 1, the quay crane rail is proposed to extend to the southern end of the berths to provide maximum flexibility, although the automated area between the quay crane and the ASCs may not extend into this area. The ASC modules are expected to start about 250 m north of the southern boundary where there is sufficient width to cater for the trucks at the landside end of the ASCs.

A workshop is nominally positioned at the southern end of the terminal so that it does not interfere with the future expansion of the terminal to the north.

The stage 1 arrangement arising from PoHDA studies does not feature rail sidings. The PoHDA planning work assumed that these would be installed at a later date. The arrangement assumes trucks would enter from the north western corner of the site, with the truck marshalling and entrance gate being located in an area that could eventually contain rail sidings in the future. The developed arrangement for rail is highlighted in the previous Figure 73.

A truck circulation area is provided at the rear of the ASC stacks and the trucks will exit the terminal from the southern end to a gate about halfway along the rear of the terminal as shown. The land between the entrance/exit gates can be used to store empties or out of gauge cargo.

When rail is integrated into the terminal, the entrance/exit gates and truck marshalling will need to be moved outside of the existing terminal as shown in the full development options in Figure 73. It should be noted that the figures demonstrate ‘possible layout’, each terminal operator will have its own operational preferences and preferred layout for the terminal.

### 8.5.4 Ultimate development

Ultimate development contemplates two further extensions of quay and terminal. The second stage would comprise 1500 m of quay length, and the third around 1300 m of quay length.

The second stage would include 2 sections of 750 m length either side of the 'kink' in the quay line. The installation of this 2nd stage length, would then allow the BlueScope jetty function to be established on the southern end of the quay and the dedicated container berths shunted along.

The layout of the terminals for the full development options are the same as for the Stage 1 development with the exception of the entrance/exit gates and truck marshalling areas.

On the assumption that rail connectivity is provided and rail sidings are installed at the rear of the terminal, the truck marshalling area is proposed to be moved outside the terminal on built up land with a dedicated road between the entrance/exit gate and terminal for each terminal.

The rail alignment is expected to connect from the east to a rail corridor along the Western Port Highway (with an optional connection to the existing Stony Point line if required in the future). It should be noted that this alignment will require the access roads to be elevated on its approach to the junction of stage 1 and stage 2 so it can cross the rail lines coming onto the port facility. Figure 75 highlights the development staging and key components.

Further details on rail alignment options to the terminal are discussed in Section 8.8.5

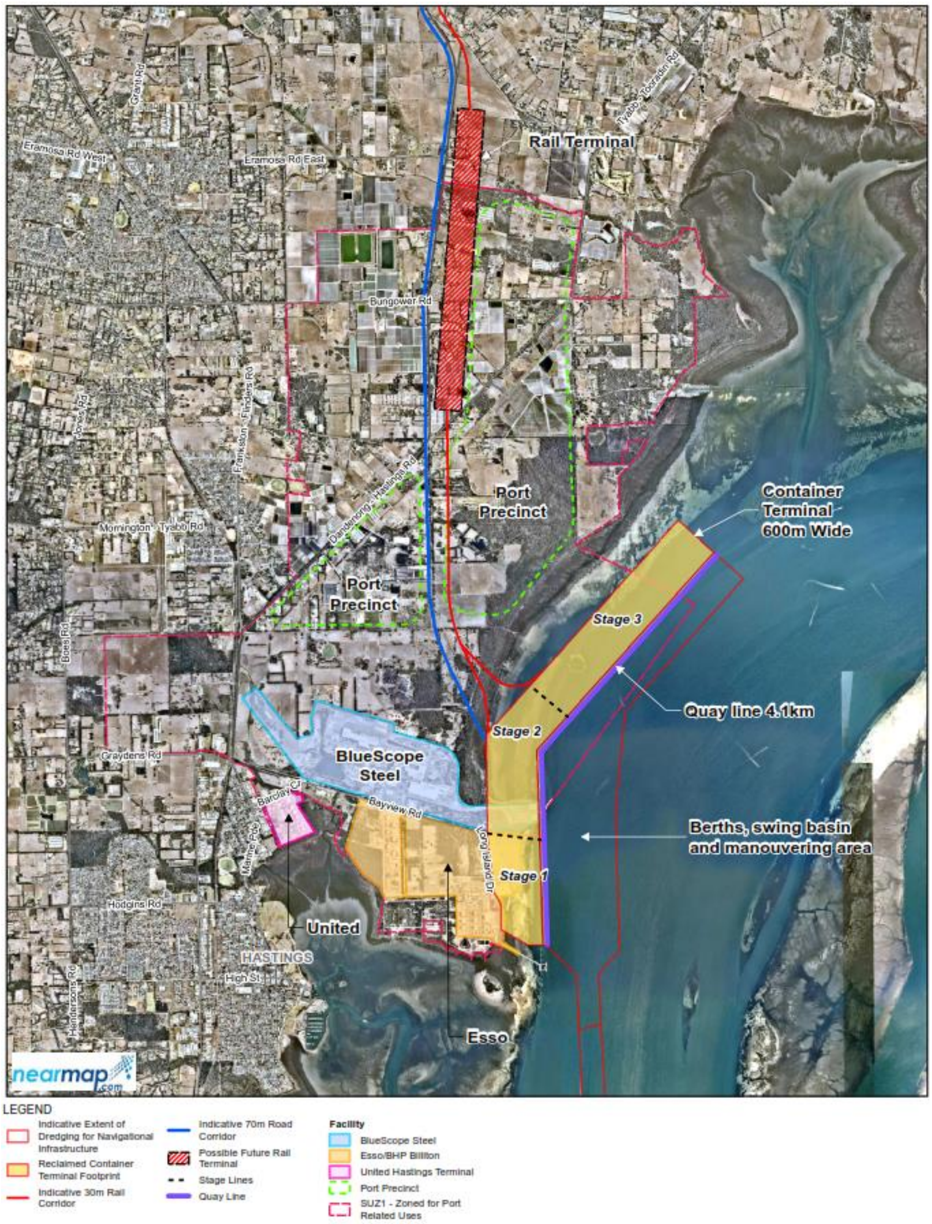



**Figure 75 Development staging details for Hastings**

## 8.6 Surrounding land use

### 8.6.1 Planning zones and overlays

The existing Port of Hastings area, as well as the area proposed for port-related uses as part of future port development, is currently zoned SUZ1 pursuant to the Mornington Peninsula Planning Scheme.

The purpose of the SUZ1 is:

- *To provide a location for selected port and industrial uses which depend upon or gain significant economic advantages from the natural deep water channels in Westernport.*
- *To enable the effective implementation of the Hastings Port Industrial Area Land Use Structure Plan (Department of Planning and Development 1996).*
- *To protect the environmental values of the waters, coastline and intertidal areas of Westernport and adjoining land.*
- *To provide for the interim rural use of land to the extent consistent with maintaining land resources for future port and port related development.*
- *To protect the towns of Tyabb, Hastings, Crib Point and Bittern by ensuring that no port industrial development which may have an adverse effect on the amenity or safety of residents occurs in proximity to residential areas.*

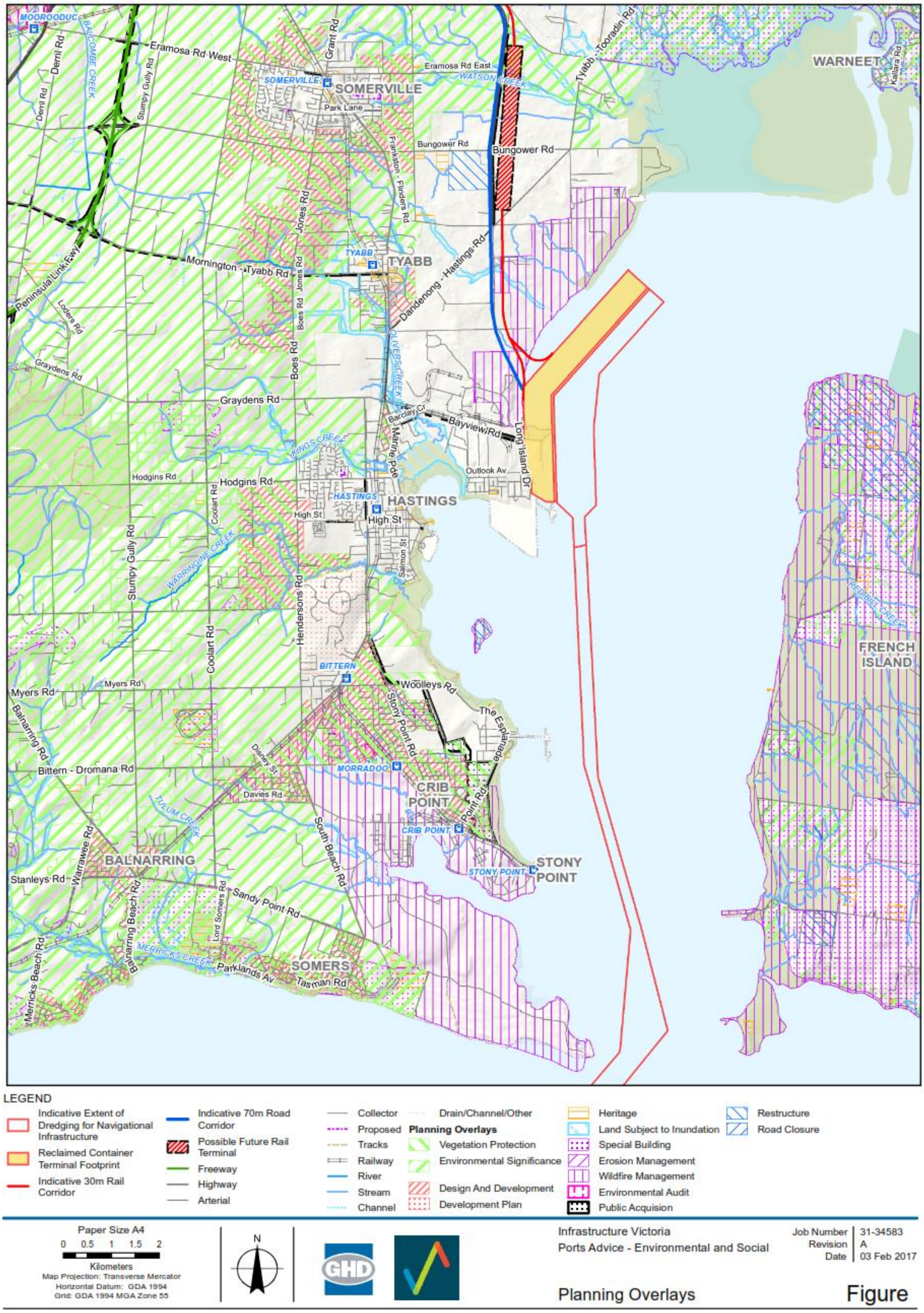
The provisions of the SUZ1 apply to a wide geographical area. The SUZ1 includes the entirety of Esso and BlueScope Steel sites, a number of smaller industries and rural uses, some with residential properties. The provisions of the SUZ1 encourage uses that ‘create’ effective buffers to port related uses.

Much of the surrounding area is within the Green Wedge Zone. The Western Port Coastal Reserve is within the Public Conservation and Resource Zone. Residential zones and smaller areas zoned for commercial and industrial uses are concentrated within the townships of Hastings, Tyabb, Somerville, Crib Point and Pearcedale (further to the north-east).

A Bushfire Management Overlay covers much of the area proposed for port development. There are Environmental Significance Overlays, the Significant Landscape Overlay and Vegetation Protection Overlay within the study area, largely to the west of Dandenong-Hastings Road and north of Bungower Road. There are areas prone to flooding that are covered by a Land Subject to Inundation Overlay, largely along tributaries and creeks within the study area.

Of relevance to the proposed transport corridor and development of the port container terminal and port-related uses, there are Public Acquisition Overlays along the Western Port Highway from Tyabb-Tooradin Road extending close to the intersection with Queens Road, and along Bayview Road (the current main access road to the Port of Hastings from Western Port Highway).

Planning zones and overlays are shown in Figure 76 and Figure 77.




## Figure 76 Planning overlay at Hastings

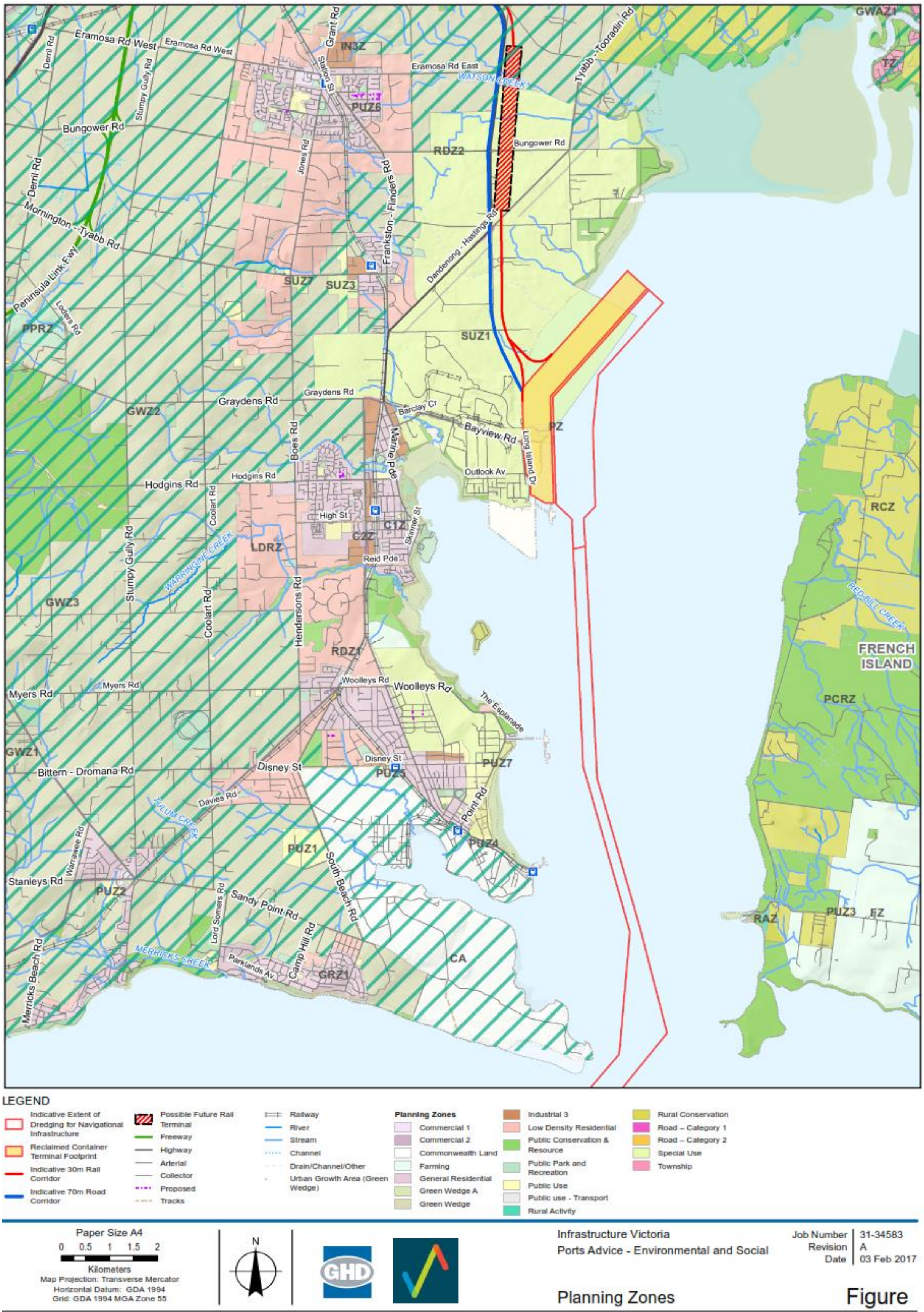



**Figure 77 Planning zones at Hastings**

### 8.6.2 Potential impacts of port development on existing land uses

#### Transport networks

The current proposed alignment of the road and rail corridor along the Western Port Highway is supported by planning policies that include upgrades to the highway, as outlined above.

Development and widening of this corridor and construction of an adjacent rail terminal would impact private rural landholdings, creating potential severance issues and impact upon landowners.

#### Port-related warehousing and freight logistics precincts

The SUZ1 at Hastings provides opportunity for selected port and industrial uses that is in alignment with the effective implementation of the Hastings Port Industrial Area Land Use Structure Plan. The interim rural use of land is consistent with maintaining land resources for future port and port related development.

However, the protection of the environmental values of the waters, coastline and intertidal areas of Westernport and adjoining land and protection from adverse effects on the amenity are also defined purposes of the SUZ1. Therefore, although current recreational uses and activities within SUZ1 may become incompatible with future port related activities, the primary purpose of the land tenure within SUZ1 is for port related activities.

The environmental values within the areas protected by an Environmental Significance Overlay, Significant Landscape Overlay and Vegetation Protection Overlay (as described above) could be impacted by development of the transport corridors and areas designated for port-related uses.

Outside of the SUZ1, the Green Wedges within the study area limit the potential for residential development further encroaching into the SUZ1. However, the potential expansion of the townships of Tyabb and Hastings has the potential to limit available land for port-related uses. It is acknowledged that there must be provision for buffers between sensitive uses (such as residential development) and port-related uses. One way of doing this may be to locate low impact land uses on the periphery of the area designated for port-related uses.

The Tyabb airport runway ends at the northern boundary of the SUZ1, west of the Frankston Flinders Road. Obstacle limitation surfaces radiate out from the runway and this would affect the height and nature of land uses that can be developed in this part of the SUZ1.

Existing land uses are defined in Figure 78.

### 8.6.3 Protection of land for future port-related uses

The following planning scheme mechanisms might be considered to facilitate additional port related use and development (noting no additional land is required for port function) and land based transport connections:

- Planning Scheme Amendment:
  - Investigate any need to amend the existing Special Use Zone 1 (Pot Related Uses) as currently applying to the Port of Hastings environs to ensure it does not prohibit any potential future industrial / transport logistics related activity.
  - Apply a Pubic Acquisition Overlay for transport purposes to reserve land for road and rail connections (i.e. PAO1 – Road construction and widening and PAO5 – Port Services and access corridor).

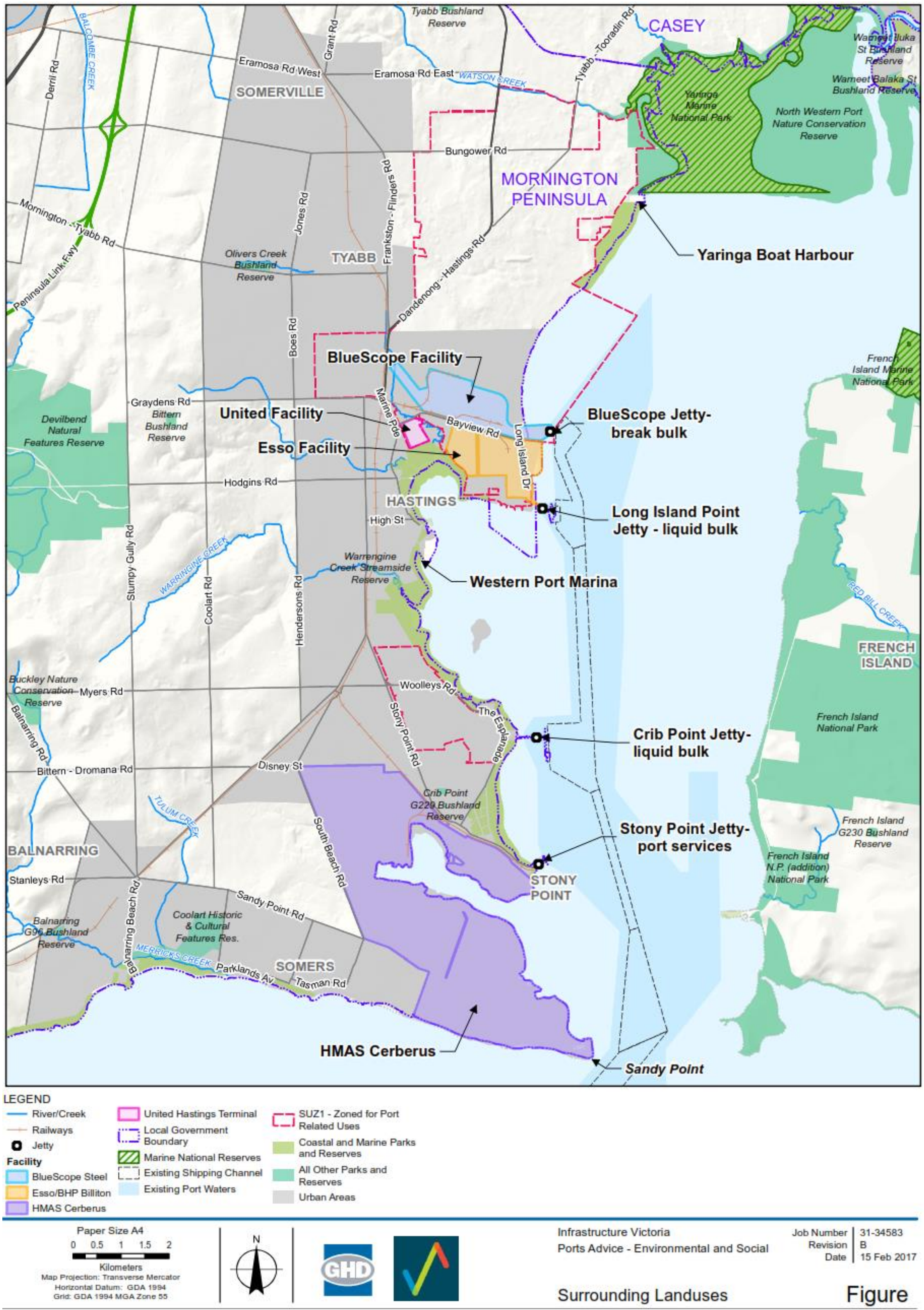



**Figure 78 Surrounding land uses at Hastings**

## 8.8 Transport connections

The following section discusses site suitability, concerning transport infrastructure required of a 9M TEU container port. This describes local transport needs within the port precinct and the wider transport network connections beyond the port precinct separately.

### 8.8.1 Highway connections

Access to the Port area will be provided by major highways, and for Hastings, there are four broad access routes between Melbourne and Western Port.

On the Mornington Peninsula side, Peninsula Link currently provides access, including the strategic connecting routes east west to the Port of Hastings. To the north the Monash Freeway and Western Port Highway and on the eastern coast, the South Gippsland Highway and Healesville-Koo Wee Rup road routes provide strategic access.

The most recent planning for the port of Hastings has assumed a major road and rail transport corridor through the south east of Melbourne, utilising the Monash freeway and the Westernport Highway for road and the Dandenong and Cranbourne rail corridors linking to a new rail link along the Westernport Highway corridor.

Planning for upgrades of the Westernport Highway from Lyndhurst to the port of Hastings include a rail reserve and capability within the overall transport corridor.

The proposed arrangement of the Western Port Highway and the proposed alignment into the port site area together with consideration of road capacity is discussed further in Section 8.8.3.

### 8.8.2 Local road connections

To provide transport access to the stage 1 terminal it is proposed to use a route north of the terminal through BlueScope land to McKirdys Road which runs north to connect to the Western Port Highway. This is indicated in Figure 79.


**Figure 79 Stage 1 road & utility connections**

McKirdy's Road will need to be upgraded over time, and beyond stage 1 it is expected to comprise four lanes to accommodate the number of trucks expected. The new road would also connect to the intersection of Bayview Rd and Long Island Drive to provide access to the port precinct behind the terminal.

### 8.8.3 Transport corridor options

Road transport options considered to the port of Hastings focused on two key alignments from the Monash Freeway to Hastings via:

- Eastlink and Peninsula Link with connections in a south-easterly or easterly direction to the port.
- South Gippsland Highway and Western Port Highway aligned to long term planning for access to the port precinct.

Both corridors would require upgrades of capacity to provide for port traffic in the initial stage with improvements in road conditions to align with larger truck configurations required at the port terminal and precinct.

Consideration of a joint road and rail corridor providing transport needs for the port was a key element of the assessments, as this would reduce the size of the land impacts overall compared to separate corridors and reduce the impact of environmental factors including noise, light spill and other factors. The rail grade requirements were much more stringent than the needs of road and the requirement for a large rail terminal to disassemble trains for short movements to the port terminal on essentially flat land was a key factor in the joint corridor assessments.

The options for a joint transport corridor from Peninsula Link to the west were limited by the falling grades which were significantly in excess of the rail terminal and corridor requirements.

An alignment from the north on Western Port Highway has already progressed through planning processes to cater for a joint freeway standard road and rail corridor southwards to the Frankston-Cranbourne Road and further planning and development remains to be progressed south of this point.

The Western Port Highway south of Frankston-Cranbourne road rises sharply over a hill for 3-4 km to North Road forming a single lane in each direction and falling progressively for a further 5.5 km to Queens Road. A generally flat area lies between this point and Tyabb Tooradin Road with additional favourable level areas for a rail terminal east of the highway.

Several alignments were considered to assess potential impacts on residential and business activities, environmental and service infrastructure impacts and the levels required for a rail terminal. Corridor alignments directly along the Western Port Highway were considered highest risk in terms of residential impacts, which prompted assessment of alternative parallel alignments to the east. It should be noted that these were not developed by PoHDA, and the Western Port Highway alignments are proposed at the current time.

While the focus of a joint transport corridor for rail and road is indicated along Western Port Highway from the north, access by road from Peninsula or from the east via Tyabb-Tooradin road remain as options for road traffic.

### 8.8.4 Capacity of Western Port Highway

Western Port Highway has the capacity to handle the traffic generated by the Stage 1 development within the scope of its development southbound to Frankston-Cranbourne Road and North Road. Beyond this point the roadway becomes a single lane with limited shoulders and run off which would require upgrades for access of larger trucks to the port. Roundabouts along this alignment are also likely to be in need of change to manage the increases on traffic volumes, the nature of heavy vehicle (HPFV) traffic changes.

The development needs of the roadway are to increase the width and capabilities of the road to freeway standard although a possible 2 lane carriageway with a later upgrade to three lanes may be method of staging development of the corridor.

It is assumed that upgrades to the northern section down to Frankston-Cranbourne Road will be completed prior to port development to cater for residential needs in the area. In conjunction with the development timing for the port of Hastings the development of the road corridor will be required along the general alignment of the Western Port Highway, initially as a dual corridor, four lane freeway standard roadway with capability for expansion to three lanes in either direction once port and traffic volume demand increases.

### 8.8.5 Rail network connections

Although the use of rail to transport containers in Victoria is limited largely to export traffic at present, the distance to Hastings is expected to create a demand for a rail link to the port that exceeds the existing capacity of rail connections.

The existing rail line from the Frankston rail corridor into the BlueScope facility only has capacity for up to four freight trains to be turned around each day.

As the port of Hastings is developed the current rail based export and metropolitan rail traffic will need to be accommodated. Currently there are up to nine daily regional intermodal services that operate to the port and these trains utilise both broad gauge and standard gauge rail networks to the port. Both of the these network connections will be required at Hastings to facilitate this traffic if the Port of Melbourne is no longer operational, requiring standard gauge to the east of Melbourne where it does not exist today. These nine services (18 daily trips) have some growth capability within their service schedules and train size so this regional service level is likely to remain relatively constant in the medium term. Significant growth would be a factor of market change or new developments.

In addition to current regional services, the port of Hastings rail demand requirements include proposed Metropolitan Rail Port Shuttles which will connect with terminals across Melbourne, all requiring access back along a new Hastings to Lyndhurst rail corridor and the Dandenong rail corridor (with the exception of Lyndhurst terminal traffic)

Based on Hastings being a stand-alone port (ie no share to Port of Melbourne or elsewhere) a 20 percent rail mode share leaving the Port of Hastings would represent:

- 18.6 one way  daily trips @ 3.0 M TEU
- 37.3 one way daily trips @6.0 M TEU
- 55.7 one way daily trips @ 9.0 M TEU

Regional trains would also need to be added to this task with a representative maximum of 18 one-way trips daily from region areas.

This rail task will drive a need for development of a dedicated rail corridor to service anticipated demand. The corridor will need a dual gauge capability to service current and proposed terminals and implementation would be required during the 1$^{st}$ stage of port development if the port of Melbourne was not operational at that time.

Progressive growth of the port would introduce further rail infrastructure developments necessary to cater for demand increases, including:

- moving from a single dual gauge track from Hastings to Lyndhurst with passing loops to a double track;
- providing for a new track for freight capacity enhancement on the Dandenong rail corridor (seeking two tracks overall  for 6.0 to 9.0 M TEU,)
- Increased viaduct and inner Melbourne capacity to the Dynon area
- Increased capacity on the ARTC tracks from Tottenham to Somerton and Altona.

Some of these capacity enhancements may be driven by the broader demand requirements; however the indicative port demand levels for a stand-alone port will specifically drive a new dual gauge rail corridor from Melbourne to Hastings.

This new rail alignment (defined as Regional Rail East RRE) with need for additional capacity from the west of Melbourne, through the city and along the Caulfield and Dandenong corridors before branching of towards Cranbourne to Lyndhurst.

A new rail corridor from Lyndhurst to Hastings along the Western Port Highway would complete the link. This infrastructure link will require both broad and standard gauge rail access to cater for the existing export traffic across regional areas of Victoria and southern NSW.

High level planning of the link from Lyndhurst to Hastings was completed as part of the port of Hastings development investigations, although some additional updates have also been considered to include changes that have occurred over the last 3 years. The link includes the development of an additional rail track and passing loops in the initial development with a two-track capacity required for the ultimate port of Hastings development. The associated capital cost is estimated at $1.5 bn[3].

Further detailed planning is required for the Regional Rail Link East (RRE) between the west of Melbourne, Dandenong and Lyndhurst. Provisional investigations undertaken as part of this study by GHD and also by Raylink Consulting for Infrastructure Victoria have identified that significant additional network capacity will be required (at an overall estimated cost of between $6 - $7 bn) that would result in major development works within the following rail corridor sections:

- Dynon Precinct and Port of Melbourne to Southern Cross
- Southern Cross to Flinders Street
- Flinders Street to South Yarra
- South Yarra to Caulfield
- Caulfield to Dandenong
- Dandenong to Lyndhurst

On all rail sections, additional capacity works will need to consider the needs and integration of network passenger demand and priority, although creation of a mixed network with separation of freight and passenger services where possible will remain a key goal.

The scope of these development works over 40 km of metropolitan rail network is considered a major task in this environment. The works have potential to create an extended period of disruption to adjacent train services. For the purposes of assessment, a 10 year construction programme is assumed.

Once the new rail alignment reaches Lyndhurst and joins the road corridor along the Western Port Highway, the rail corridor is planned to operate in the centre of the road corridor from Lyndhurst to Queens Road including a major reinforced cutting south of Frankston-Cranbourne road through an hilly section of the roadway to North Road.

In the vicinity of Queens road, the rail corridor leaves the freeway via a grade separated ramp to provide for a rail terminal which caters for trains up to 1800 m in length to be reconfigured for access to port and shuttle trains to be staged into the port terminal.

[3] Raylink Consulting estimates for Infrastructure Victoria

South of the rail terminal the rail corridor is separated from road alignments and the alignment avoids the potential location of a developing port precinct which should not be constrained by a rail corridor. Accordingly, the rail alignment to the port veers eastward to approach the port with limited impact on the port precinct development area.

### 8.8.6 Phasing rail infrastructure

The decision on how rail infrastructure will be upgraded to service Hastings is expected to be dictated by choices associated with the expansion of the Port of Melbourne.

Without PoM in operation, Hastings would require rail infrastructure in place from day 1, to accommodate the nine daily regional trains and a modal share from the 1st phase of development.

With PoM in operation, and being mindful of the technical challenges, it may be desirable to defer the rail infrastructure works until a later date, potentially as part of the 2nd stage. The preferences and feasibility associated with this however, would be influenced by the rail capacity connections remaining at the PoM. If Swanson Dock was not operational for example, this would require rail connectivity to be provided to Webb Dock, which has its own feasibility and capital cost challenges.

For the purposes of this study, and with agreement of IV, rail capacity upgrade to Hastings is assumed to be in place for the start of stage 2. It is recognised that deferring rail costs is of benefit to Hastings, given the challenges that exist for achieving rail capacity.

## 8.9 Port precinct

The land availability for port precinct development for a Hastings container port has been the subject of significant planning with the zoning of a large port development zone over 3500 Ha surrounding the north of the current BlueScope facilities.

Options for precinct development have considered utilisation of the entire SUZ1 planning zone for port development and staging of development in and around the port. The scope for container port development also considers the needs of access to the existing port facilities with a concentration of access and development from the north along a general alignment of McKirdy's road with the rail access corridor leaving the rail terminal area and following an easterly alignment to avoid the creation of precinct constraints in the developing area.

Planning provides for similar functional requirements to those considered for Bay West with local requirements including consideration of the following issues:

- That part of SUZ1 west of the Frankston-Flinders Road and under the flight path of the Tyabb airport has been considered unfavourable for port operational requirements
- The areas west of the indicated alignment of the WPH are to be retained for low impact commercial or industrial uses as a buffer to nearby residential communities. Some of this area may also need to be landscaped or otherwise managed to maintain a physical separation between residential communities and the port development.
- The southern part of SUZ1 and the Esso and BlueScope Steel sites are provided with an alternative access road that enables destination traffic to avoid Hastings.
- Substantial areas of warehousing and distribution activities are located as close as possible to the terminal area for transport efficiency and to maximise separation from surrounding residential communities. Limited opportunity for some manufacturing or supporting industrial activities is also provided east of the Dandenong Hastings Road to support earlier stages of development.

- A notional separation distance has been retained between development and the northern coast line of SUZ1 to provide a buffer from areas of potentially high ecological and recreational value. This area is notional only and the requirement for such buffering is subject to further investigation
- The proposed development avoids major pipelines and infrastructure to the north and makes allowance for supporting infrastructure closer to the port which forms a key element of servicing port development.

Staging options for development of the precinct were proposed in the PoHDA studies, and are included in Figure 80 and Figure 81 below. These indicate the use of the SUZ1 at each stage, potential transport corridors and land use options.

The SUZ1 area provides opportunity for the precinct to be close to port facilities, offering broader precinct development supporting port operations, storage and warehousing of products and providing land for industry to rail and road based logistics facilities which can support relevant supply chains linking the port to Melbourne and other industrial and logistics centres.

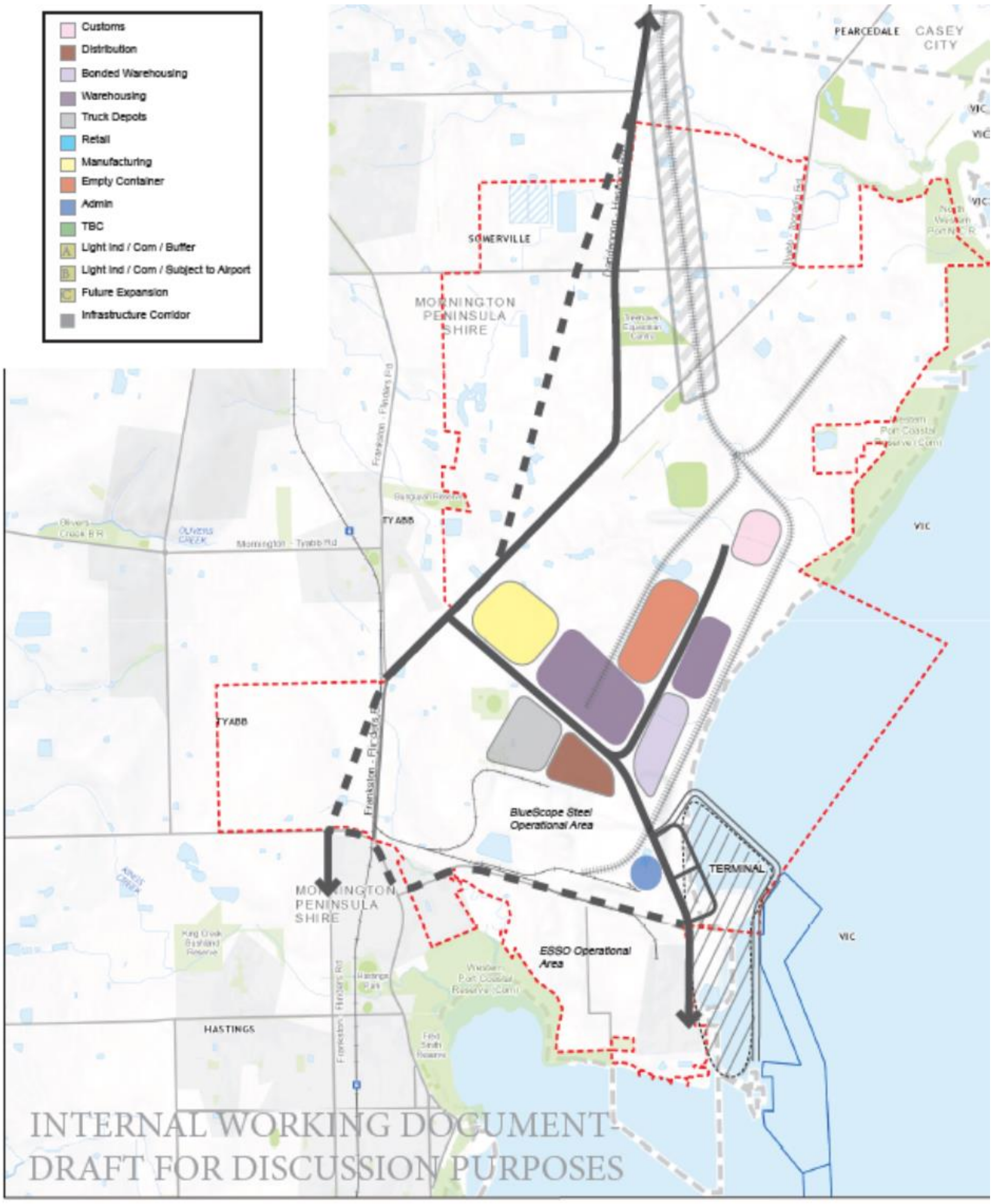



**Figure 80 Hastings port precinct 'stage 1' development option**

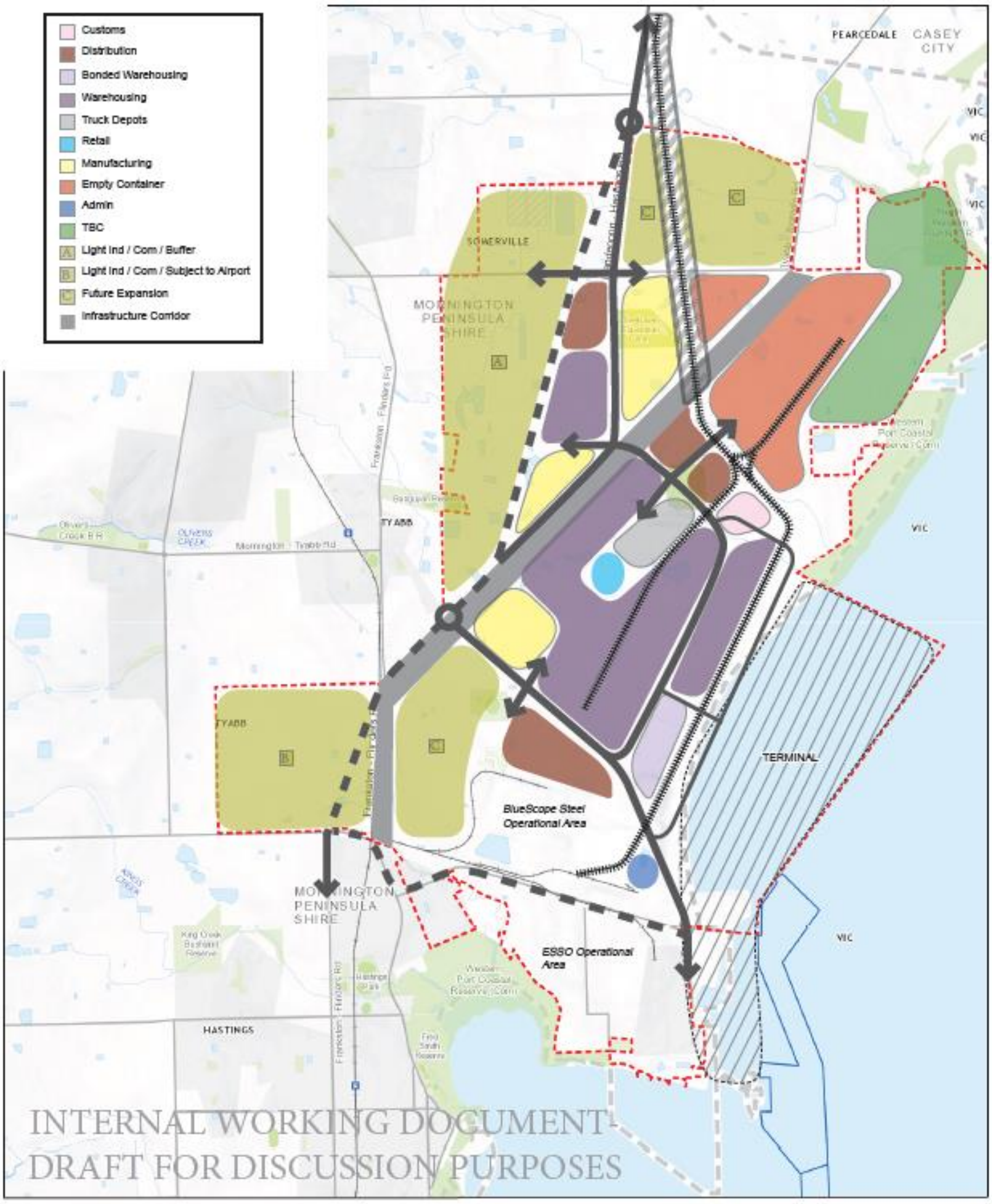



**Figure 81 Developed port precinct framework**

## 8.10 Services & utility connections

At Hastings, the study work has identified that adequate network capacity exists locally, and there is a major high voltage switch station to the north of BlueScope with surplus capacity to supply power to the Stage 1 development.

The demand for water and gas supplies is much more modest but and appear to be readily available in the immediate area.

The infrastructure connection provisions are expected to be fairly straight forward as there adequate trunk infrastructure between Tyabb and Hastings which can be utilised.

The staging of the port development and wider landside areas will have a significant impact on how the future service and utilities are rolled out. With the majority of the SUZ1 being rural land, and not currently highly serviced, local distribution may be more complex. There is also the benefit of having existing industry in the area, which has resulted in very good services coverage in the vicinity of Bayview Road. Consequently, there is potential to get a Stage 1

terminal facility connected, with minimal upfront capital expenditure on service related infrastructure, by utilising existing services along Bayview Road.

The proposed major infrastructure links are indicated in Figure 79 on page 152.

## 8.11 Dredging & reclamation feasibility

This section summarises the key issues associated with the dredging and reclamation activities for the along the shore option at Hastings.

For the purposes of the assessment, this section addresses a single (dredging) work method, based on the PoHDA studies and provides only a summary of the key data to allow a comparison to be undertaken. It must be recognised, that alternative options and dredge work methods exist, which could be considered should further port panning at Hastings be contemplated.  The selected dredge work method was selected based on lowest capital cost, with less than 40 minutes 'overflow dredging' rate (per cycle) assumed to help limit turbidity generation.

The section identifies:

- The geotechnical conditions that are relevant
- The status of previous studies and outlines the rationale for the adopted work method.

The key challenges impacting the feasibility of dredging and reclamation at Hastings include:

- The depth of water in which the dredging and reclamation is expected to take place. This impacts dredge size, method and costs;
- The geotechnical material type existing across the development footprint. This is somewhat variable, and complicates its 'useability' and performance after dredging. The material properties impact choice of dredging method, intensity of ground treatment and requirements for managing dredged material for disposal. The sea-bed surface for example, comprises deposits (up to 3 m thick) of recent weak material that has to be removed from the entire footprint of development before any reclamation can take place.
- The site met-ocean conditions, which affect the environmental management measures that would need to be applied. Strong currents at the site mean it is not practical to deploy silt curtains to limit the spread of turbidity.

Key reference documents include:

  - Report No: HAS-CEP0-HY-REP-0033-0 dated 01 May 2015. Dredging & Reclamation. Preliminary Assessment of Work Methods
  - HAS-CEP0-HY-REP-0032-0 dated 28 April 2015. Dredging & Reclamation Options Report that was produced by Royal Haskoning DHV (Haskoning Australia Pty Ltd) for PoHDA in 2015.

### 8.11.1 Performance factors

The container handling system requires high quality surfacing that does not settle and which can support varying local loads. Hence, the performance of existing land and/or land that is created to stack containers needs to be addressed.

With the selected concept for Hastings involving areas of existing land (historically reclaimed at the Old Tyabb reclamation) and newly reclaimed land, different approaches are required.

### 8.11.2 Old Tyabb reclamation

This reclamation which potentially forms part of an initial stage of development at Hastings was constructed over 30 years ago using dredged material from a cutter suction dredger to form the reclamation. The result is land that comprises clay balls within a sandy/silty slurry that is not free draining.

The geotechnical investigation has found this material to be unsuitable in its current condition, and in need of ground improvement.

The PoHDA studies reviewed ground treatment options and, for this location, adopted an approach that comprised vertical wick drains installed close centres with application of a substantial surface surcharge applied for a period of 1 to 2 years.

### 8.11.3 Dredge methods and material management

The PoHDA studies incorporated investigation of a large number of dredging and reclamation methods at Hastings. This work was undertaken by Haskoning Australia with specialist inputs from Baggerman Associates, who have also provided input into this study for IV.

Previous study work identified significant variability in unit cost, production estimates and feasibility for different options. The variability in production is presented in Figure 82, whilst details on the work methods costs and challenges is provided in PoHDA - CEP0-HY-0032.

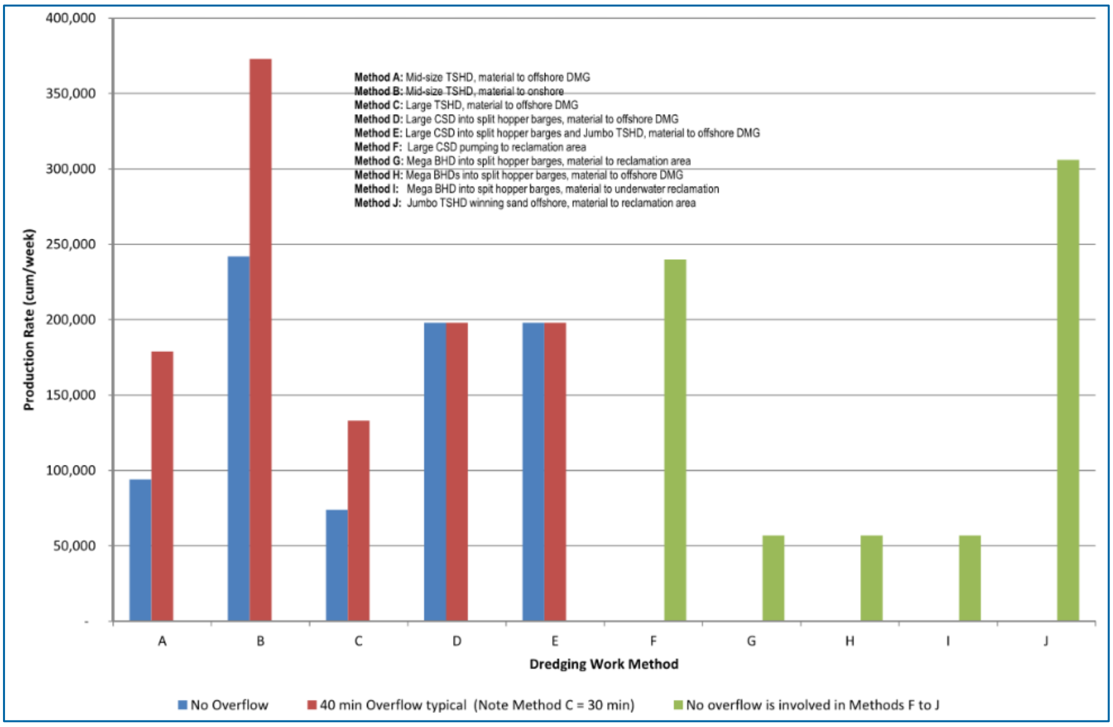



**Figure 82 Estimated production rates for alternative dredging methods considered at Hastings (Source: PoHDA - CEP0-HY-0032)**

Key challenges relate to the management of the dredged material. This relates to both the share that can be incorporated within any land reclamation, but also the share that would become surplus or unsuitable and require disposal away from the footprint of development.

The characteristics of the surplus or unsuitable material share is related to the dredge method and the in-situ properties of the material being handled.

The result, in some instances (where dredged material is pumped), is a significant volume of bulked material comprising slurries and fines that can be difficult to handle, and if placed on land, remain largely unsuitable for engineering use for lengthy periods of time.

The PoHDA studies subsequently considered disposal strategies, that encompassed marine and terrestrial options. The findings concluded:

- Marine disposal options within Western Port were seen to be limited because of the limited water depth available outside the existing channel extents. This restricted access for planet / equipment and reduced the volumetric capacity. Marine options in Bass Strait were considered more attractive, but potentially expensive and difficult to consent.
- Terrestrial options were compromised by the bulking effects of the material if pumped. As an example, if the volume of material requiring dredging from only the phase 1 basin was disposed to land, it was estimated to occupy an area of about 380 ha or approximately 13% of the entire SUZ1 (1.95 km x 1.95 km). This assumed 4 m thick material, and space being required for settling ponds, bunds and drainage systems.

Work methods mitigating the magnitude of bulking included use of a BHD, as proposed for Bay West. However, a key limitation at Hastings is the depth of water available; to enable placement, it was considered necessary to have to double handle clay from barges and transport material to the point of use by road plant followed by spreading and compaction. This process was found to be very expensive by virtue of the double handling.

Regardless of method, if the dredged material (clay / silty sands) was used for the land reclamation, it was noted that the material would require containment in some manner to prevent erosion and control turbid plumes. The review of options highlighted that a perimeter bund of free draining material (sand or rock) would be satisfactory in Western port.

Investigations have not identified any large deposits of suitable bund material within the site area either on land or within Western Port. It is assumed that bunds would be built with dredged sand from offshore in the Bass Strait or using land sourced sand from outside the SUZ1 area.

A literature search by Haskoning Australia (for PoHDA) suggested that the Bass Strait has plentiful deposits of medium to coarse sand at depths of approximately 50 m, and subject to obtaining the right consents, this sand could be brought to site using a large trailer hopper dredger. This option was identified to provide the material to site more cheaply than delivery by road and without the traffic impacts.

The availability of such material was also noted to be of benefit for land reclamation pavements, as it is much easier to produce high quality surfacing if the top 1.5 m to 2 m is free draining material. This avoids issues with saturation of the pavement subgrade and it allows the services to be placed in a material that can be re-compacted easily. Placing the services in clay material causes many problems with settlement over the services and water flow along the service lines.

### 8.11.4 Proposed dredge method

The studies whilst not complete, and requiring further investigation, essentially indicate two ‘preferred’ alternatives to form the extents of reclamation required for the along the shore option. These are:

i. Import sand from offshore to form retention bunds and then fill behind with locally dredged clay/sand/silt material. Cap off with offshore dredged sand.

ii. Import sand from offshore for all the land reclamation needs and take the locally dredged material offshore for disposal.

Alternative 1 requires a lesser amount of sand from offshore but will result in a longer overall programme and be significantly more expensive than alternative 2. This is due to the lower productivity rates applicable to such methods. The assessment of reclamation needs highlights that this option would not use all of the dredged clay material so some disposal, either to sea or on land will still be required. A major risk is the uncertainty as to within what programme and at

what cost the reclamation can be treated if the dredged material is to be beneficially used. The dredge volume and filling volume imbalance is indicated in Table 48 and Table 49 and is estimated at around 10 M $m^3$.

Alternative 2 will require the greatest amount of sand from offshore and greatest amount of material for disposal. This will require consent both to dredge sand offshore and to dispose of the dredged material by unconfined sea disposal. The use of sand for reclamation is expected to improve the performance of the land reclamation in the longer term and reduce the overall construction period, as ground improvement needs are reduced.

Alternative 2 is considered most suitable for the stage 1 development, given the imbalance in filling and dredging volumes. Later stages however, considering possible the 5 to 10 year timeline between development stages, could adopt either method.

In this regard, the following is noted:

- Alternative 1 would be better suited to an earlier reclamation construction date, so that ground improvement can be applied for longer to improve outcomes. This would however, likely necessitate a higher investment sum in the early years, or potentially as part of phase 1.
- Alternative 1 could feasibly be employed such that it does not require sea dumping of all dredged material. A proportion could be used beneficially to create the land.
- Alternative 2 would allow the later stage dredging and reclamation costs to be deferred beyond stage 1, as dredging and reclamation could be delayed up until a few years ahead of when land was required.

Alternative 2 has subsequently been adopted for the purposes of assessment and derivation of cost estimates. This assumes three separate stages of development, and (with reference to Figure 82) assumes method D (large CSD) would be used for the dredging of the berth pockets and channels with less than 40 minutes overflow and method J be used for the dredging of sand.

The features of the works are graphically illustrated in Figure 83.

With reference to Figure 82 and PoHDA - CEP0-HY-0032, the dredging production rate for clay is taken as 200,000 $m^3$ per week, with a unit cost rate of $37 per cubic metre, to reflect a 30-minute overflow scenario. The associated unit cost range is $30 to $68, for the respective overflow scenarios of 40 minutes to none.

For the sand, a dredging production rate of 300,000 $m^3$ per week is assumed, with a unit cost rate of $16 per cubic metre.

#### 8.11.5 Ground improvement

The concept at Hastings is subsequently based on the use of surcharge and wick drains to consolidate the fill material in the Tyabb reclamation and the use of vibro-compaction in the sand filled areas where there is no underlying soft material.

The indicative sequence of construction is presented in Figure 83.

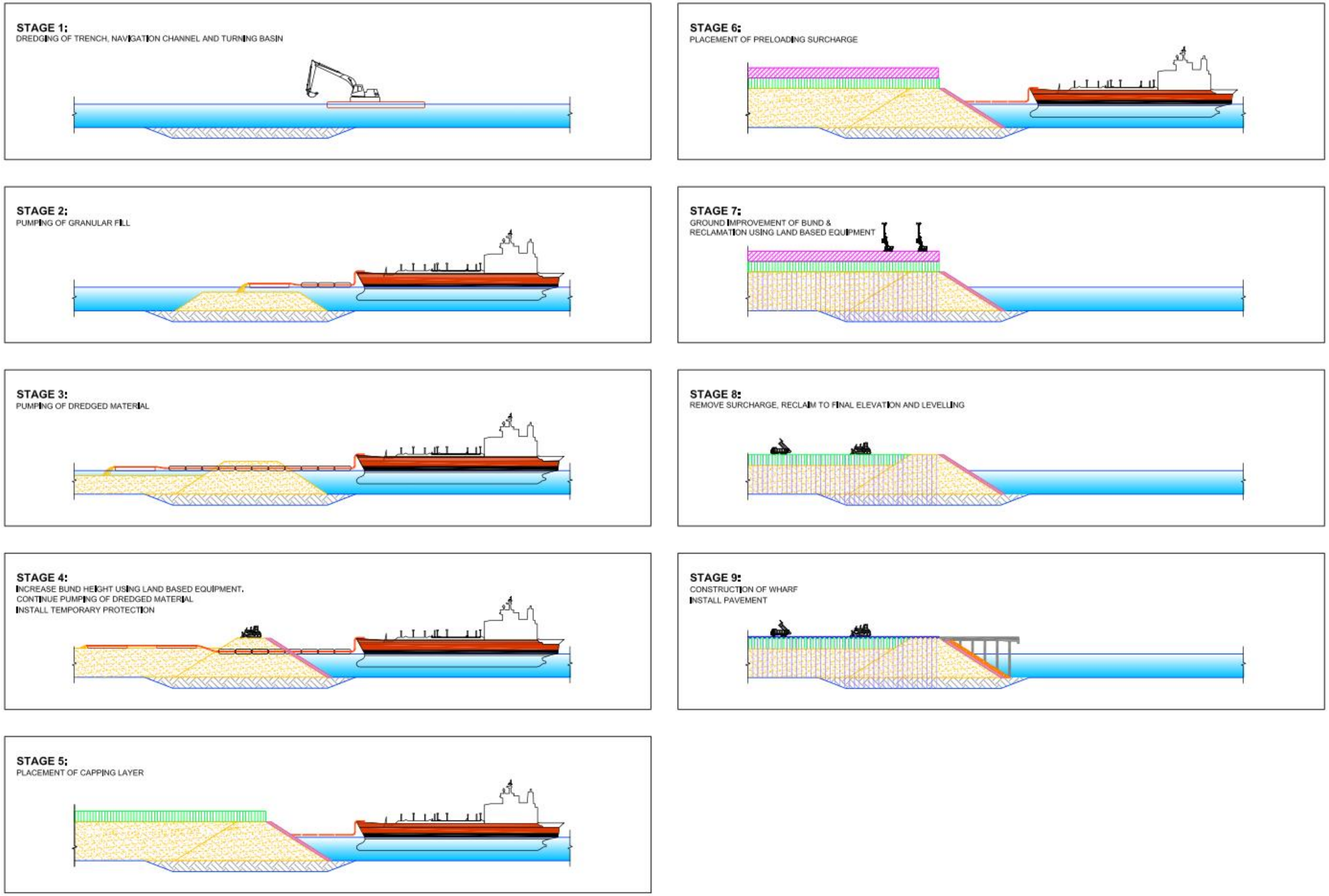
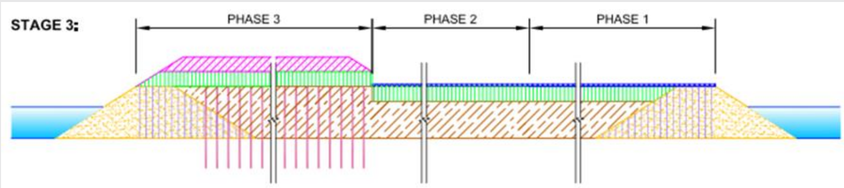



**Figure 83 Indicative sequence of works assumed for dredging and reclamation at Hastings**

### 8.11.6 Summary dredging task arrangement

Table summarises the key components of the Hastings dredge task that is adopted for the cost estimate and options assessment for each vessel size scenario.

**Table 50 Dredging & reclamation metrics associated with each vessel size**

| | 14,000 TEU vessel | 18,000 TEU vessel |
|---|---|---|
| Construction work method | Method 1<br>Sand reclamation using sand bunds and sand capping<br>Use if a Jumbo TSHD (Trailer Suction Hopper Dredger) to win sand from offshore for reclamation, with the use of a Large CSD (Cutter Suction Dredger) loading split hopper barges for disposal of port dredged material at an offshore DMG (Dredged Material Ground).<br>Overflow < 40 minutes is assumed.<br> | |
| Dredging: sand ($m^3$) | (stage 1) 6.8M; (stage 2) 4.4M; (stage 3) 6.7M<br>Total = 17.9 | |
| Dredging: silt/clay ($m^3$) | (1) 7.8M; (2) 12.6M; (3) 6.2M<br>Total: 26.7 M | (1) 9.6M; (2) 13M; (3) 6.5M<br>Total: 29.1 M |
| Dredge cost (incl. mob) ($AUD) | 1.45 bn | 1.54 bn |
| Mob / demob | 6-10 weeks / 4 to 6 weeks | |
| Dredge duration(s) | Clay/silt: 2.6 years<br>Sand: 1.15 years | Clay volume 2.8 years<br>Sand: 1.15 years |

## 8.12 Engineering feasibility

### 8.12.1 Quay walls

The PoHDA studies identified the relatively weak sub-soil conditions at Hastings to be unsuitable for any sort of gravity structure. The outcomes of the options appraisal indicated either a bulkhead wall solution or a suspended slab over a rock armoured slope being most appropriate.

The two quay wall options considered are shown in Figure 84 and Figure 85.

For the purposes of the assessment, a piled quay structural form has been assumed. This is assumed to comprise a rock armoured slope under the deck.

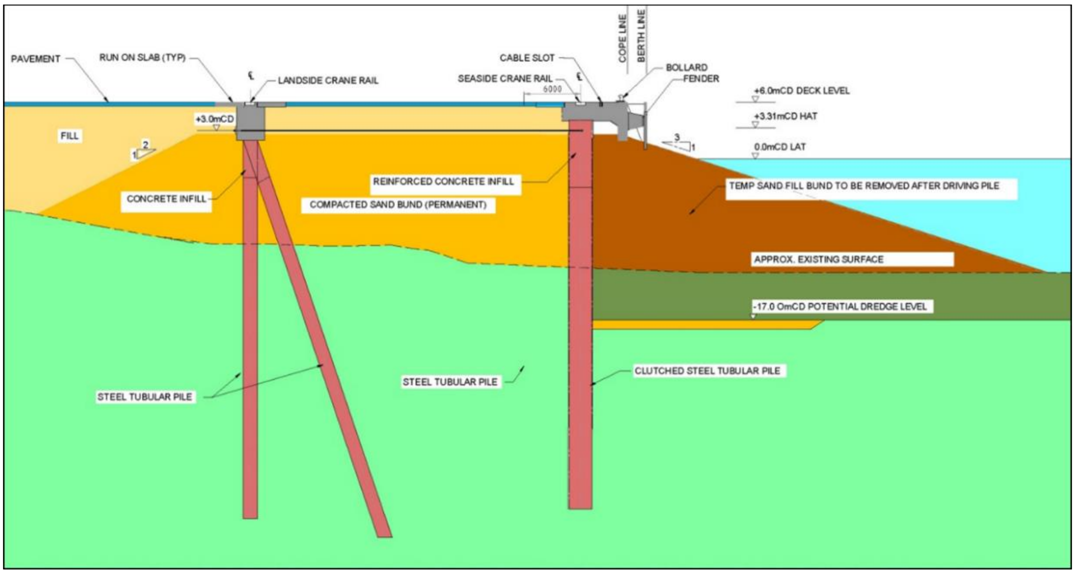



**Figure 84 Bulkhead Wall**

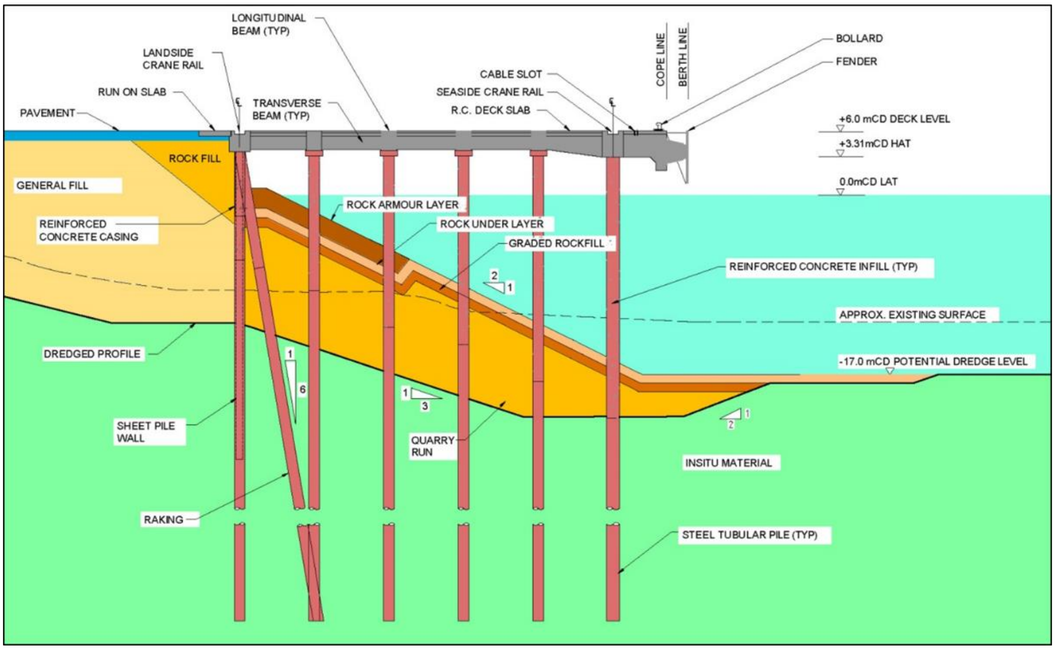



**Figure 85 Suspended slab**

#### 8.12.3 Pavements

The estimate of terminal pavement for each stage at Hastings is summarised in Table 51. The description of the different types is set out in Section 5.13.13.

**Table 51 Estimated area schedule ($m^2$) of pavement at Hastings**

| | Phase 1 | Phase 2 | Phase 3 | Total |
|---|---|---|---|---|
| Berth length (m) | 1450 | 1650 | 1150 | 4,250 |
| Container stacking | 539,400 | 613,800 | 427,800 | 1,581,000 |
| Heavy Duty | 139,200 | 158,400 | 110,400 | 408,000 |
| Light duty | 17,400 | 19,800 | 13,800 | 51,000 |
| Gravel balance | 174,000 | 198,000 | 138,000 | 510,000 |

#### 8.12.4 Sea walls

Rock armoured sea walls are assumed to be installed to all sides of the land reclamation permanent works at Hastings. The northern and southern faces are expected to see the largest waves, with the landside face being well protected.

The resulting estimate of rock quantity needs are presented Table 52.

**Table 52 Estimated volume of rock required for Sea walls at Hastings**

| Island face | Total rock thickness (m) | bed level (m) | crest (m) | slope length (m) | island length (m) | volume ($m^3$) | geotextile area ($m^2$) |
|---|---|---|---|---|---|---|---|
| landside | 0.94 | -5 | 5 | 27 | 2700 | 68,526 | 72,900 |
| Northern | 1.85 | -8 | 5 | 30 | 600 | 33,300 | 18,000 |
| Southern | 1.85 | -8 | 5 | 30 | 550 | 30,525 | 16,500 |
| | | | | | sum | 132,351 | 107,400 |
| Placement density | | | | @1.65t/m3 | = 218,379 tonnes | | |

With a three stage development, the phased requirements are reflected in Table 53. This also recognises a provision for temporary protection of the northern faces of the land development between subsequent faces. A grouted mattress system is proposed.

**Table 53 Estimated tonnage of rock by development phase**

| | Phase 1 | Phase 2 | Phase 3 | Total (t) |
|---|---|---|---|---|
| Temporary protection (grouted mattress) | 600 | 600 | - | 1,200 |
| Armour type 1 – (marine face) | 50,000 | - | 55,000 | 105,000 |
| Armour type 2 – (landward face) | - | 63,000 | 50,000 | 113,000 |

## 8.13 Construction sequence and timing

### 8.13.1 The basis of the procurement and construction programme

Studies undertaken for PoHDA considered a likely procurement and construction programme to get phase 1 underway. This section summarises the findings from that study.

The programme is based on the normal Australian landlord port model where the port authority builds the reclamation for the terminal, the quay wall, the access roads and the external utilities. The port authority also provides the access channel and swinging basin dredging. The Stevedore provides the pavement, drainage, equipment and buildings.

### 8.13.2 Programme to the start of construction

The programme to the start of construction recognised (at the time) that considerable work was underway gathering data on the geotechnical, hydrodynamic and environmental factors at play in Western Port. It assumed that with a lead time (around 3 – 5 years), PoHDA could potentially be in a position to apply for the consents to develop the new port facilities at Long Island Point.

The resulting schedule (Figure 86) subsequently presents an estimated 9 year timeline from obtaining consent to when the first phase could handle its first container.

The lead in period to obtain consents now, is considerably different. The data collection has stopped and the business case is not progressing. In this regard, the overall schedule could be expected to require a further 4 to 5 years in order to complete the necessary research and documentation. An extra year is also required if there is no entity in place to act as the landlord and manage the project process.

A revised estimate to get Phase 1 open would be around 15 years.

The timing for subsequent stages is difficult to predict, as the requirements for consents and approvals may be very different. A simplified approach would be to assume an approximate 8 to 9 year programme based on a similar schedule to that presented in Figure 86.

### 8.13.3 The construction sequence (to Stage 1)

For the option of providing a suspended deck wharf and using all imported sand for the reclamation and the construction sequence for the stage 1 port can be summarised as follows: -

1. Dredge to remove the soft overburden material and excavate to reduce the level of the existing Tyabb reclamation to accept a sand topping
2. Dredge the proposed berth pockets and import sand from offshore to form the bunds, core reclamation and provide sufficient surcharge material (ground improvement)
3. Treat the sand filling and the existing Tyabb reclamation to reduce future settlement
4. Construct the quay structure
5. Carry out the main local dredging and remove the surcharge material (potentially putting in the subsequent phase of development area).
6. Build the terminal infrastructure
7. Build the road, rail and power links
8. Install the operating equipment and commission

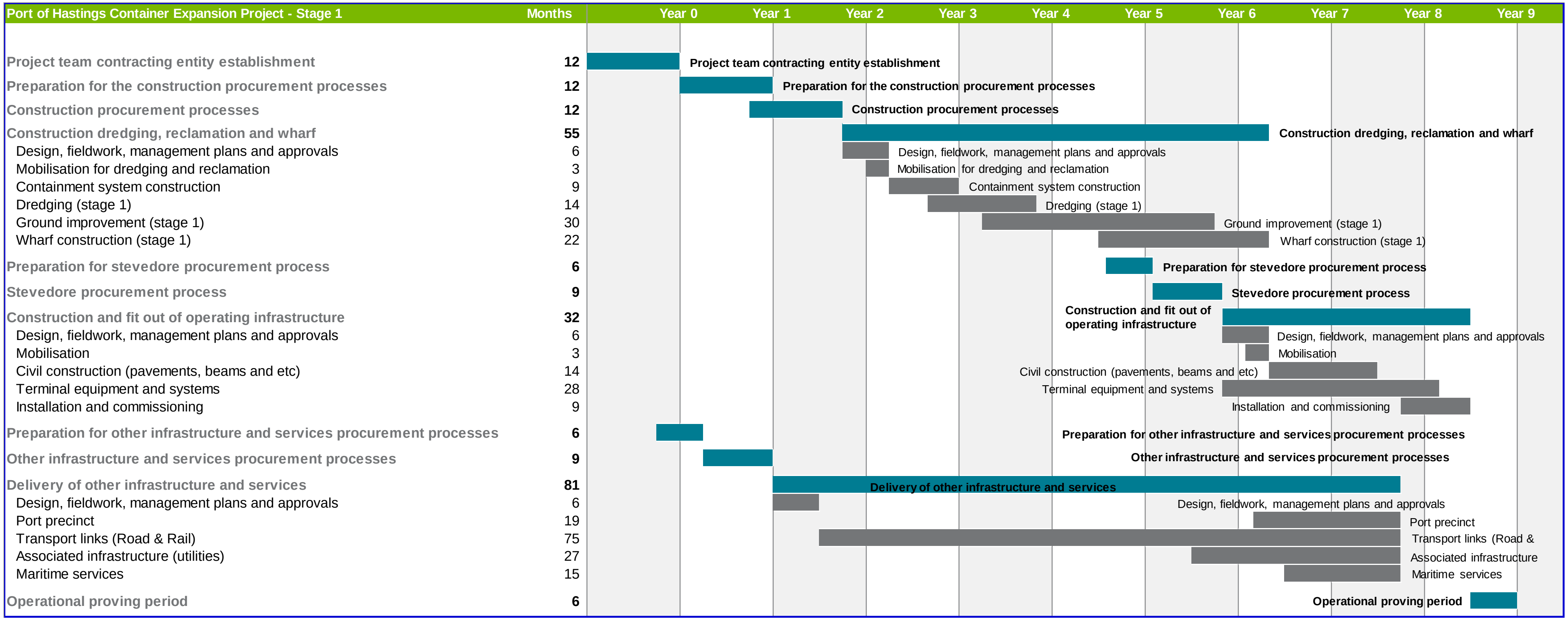



**Figure 86 Estimated procurement and construction programme (Hastings)**

# 9. Options Comparison

This section summarises the key differences between the two site locations against the following criteria:

- Future capacity and fit with potential future vessel sizes
- Phasing and staging the port developments
- Capital cost estimates
- Economic factors, associated risks and opportunities

## 9.1 Capacity & fit

### 9.1.1 Vessel size

The maximum size of vessel able to service Bay West currently is limited by the Great Ship Channel dimensions. A 14,000 TEU vessel can navigate the heads, but anything larger would require the Heads to be widened through dredging. Such dredging is considered feasible, but challenging.

Hastings is not constrained by the forecast maximum vessel size.

### 9.1.2 Ultimate capacity (ability to grow beyond 9M TEU)

- The along the shore footprint at Hastings is constrained in length to the north-east. The proximity of nearby coastal reserves, shallow water and Yaringa suggest a maximum quay length of 5 km could be considered. This limits ultimate capacity to around 10 M TEU.
- A dig out option at Hastings offers better options for expandability than the along the shore, but at higher cost, and subject to the feasibility of disposing of the excavated material.
- The introduction of other trades in combination with container operations at Hastings would reduce its ultimate container handling capacity.
- Bay West, by way of its configuration, and with alternative options for its final location could be developed beyond 4 km quay length. The site location and possible configuration options allow for capacities in excess of 10 M TEU. The ability to expand the facility beyond the initial development would need consideration of the availability of fill material.
- The Bay west development could be expanded to incorporate other trades, with jeopardising its ultimate container handling capacity.

### 9.1.3 Fit with 'planned' principal road network

- Bay West is well placed to benefit from the OMRR & Princes Freeway to provide sufficient future road freight network capacity and flexibility of routes to and from the port.
- Hastings requires the upgrade of the southern section of the Western Port Highway, which is not currently planned. This is estimated at $350M.

### 9.1.4 Fit with 'planned' principal rail network

- A key element of the fit with the rail and overall transport networks to the port options is the Regional Rail East along a busy Dandenong rail corridor and the ability to accommodate the reasonable rail mode share of the task to accommodate a 9 Million TEU port at Hastings. Limited space within the current rail corridor would require further tunnelling to Caulfield and changes to suburban passenger services to accommodate required network capacity.
- The rail share that can be accommodated at Hastings is significantly limited without RRE. RRE is a significant major dual gauge project development linking the current port access with Lyndhurst along the Dandenong Rail Corridor (estimated $5bn - 6bn This project has potential for significant disruption to other services during construction, however without investment in rail capacity to Hastings, the switch of port (to Hastings) from PoM would likely result in a significant reduction in modal share.

  Original high level scoping of this project was undertaken in 2013, costs were updated in 2016 and a further comparative review was undertaken during this project (2017)
- A dual gauge rail connection would be required to connect to Hastings to provide rail access for the current port customers. This requires construction of the RRE and new additional rail infrastructure between Lyndhurst and Hastings, at an estimated additional cost of $1.5bn.
- Bay West is adjacent to Standard Gauge and Broad Gauge networks and is well located to benefit from the proximity of the future Western Interstate Freight Terminal (WIFT) at Truganina.
- To maintain a high rail share capacity, additional network upgrades will be required on rail network connections towards the CBD from the OMRR, and along relevant standard gauge terminals to the north and west and the broad gauge terminal at Lyndhurst. The estimated base capital cost is $290M.

### 9.1.5 Port precinct & environs

- The Bay West site is partly constrained by existing WTP land uses. Whilst this does not constrain the options for transport connectivity, it does affect options for the location of the port precinct which could affect landside efficiency. A rail marshalling terminal at the OMRR for example, is around 12 km away.
- The demand for near-port warehousing at Bay West, may be mitigated, because of its proximity to existing and future freight precincts around Melbourne's west.
- Bay West land reclamation can feasibly be configured to create extra land needed for some port precinct operations, without the need to dredge additional materials.
- The SUZ1 area at Hastings provides opportunity to accommodate all port precinct functions close to the port, which is critical to Hastings, given its location from established distribution centres and the CBD.

### 9.1.6 Interface with PoM capacity

- If Hastings was used to accept trade that is displaced by PoM as part of its own capacity enhancement steps, this would reduce its ability to handle 3M TEU containers as part of the stage 1 development.
- Bay West - could be optimised to be able to handle non-container trade without detriment to its ultimate container handling capacity.

## 9.2 Staging the port

### 9.2.1 Hastings

Although some upgrading of the Western Port Highway will be required, and with the exception of rail capacity, most of the infrastructure needed to support the operation of the Stage 1 development is already in place.

The land required for the development is all owned by the State or BlueScope giving a limited number of parties to negotiate with.

The upgrades to the rail network (RRE) are significant, and could be expected estimated to run for up to 10 years and would need to commence well in advance of any stage. If they are scheduled for the stage 2 operations, they may well be underway in parallel with stage 1 construction works.

Later stages can developed with separate dredging and reclamation campaigns to suit demand. Later stages may impact the maintenance dredging regime and operability of stage 1.

### 9.2.2 Bay West

The optimum dredging and land reclamation method for Bay West comprises a single campaign of dredging works to create the development footprint. The basis being high dredge mobilisation costs, but also the fact that dredging works are required to get phase 1 operational form a substantial part of the total dredging volume.

Figure 87 illustrates the dredging extents in the berth pocket area that would relate to phase 1, phase 2 and phase 3 berth length needs. Phase 1 will also include the dredging of the channel.

| | Phase 1 | Phase 2 | Phase 3 |
|---|---|---|---|
| Area (m2) | 1,079,770 | 214,202 | 409,419 |
| Approximate percentage of total berth pocket and turning basin dredge | 63% | 13% | 24% |

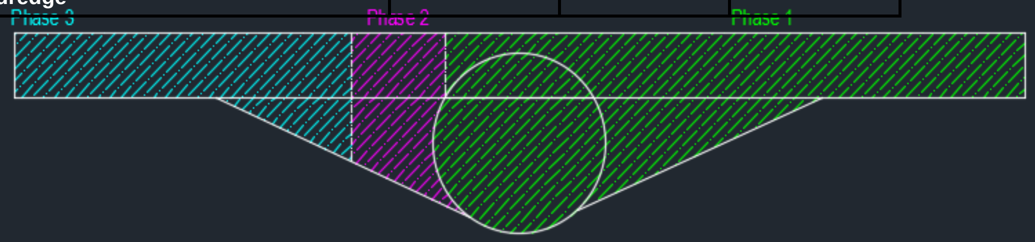



**Figure 87 Indicative extents of dredging required by phase to provide vessel access and capacity**

The development of the terminal topside areas would be completed in phases to suit operational needs.

The surplus and undeveloped land areas would be left to naturally consolidate over time. The additional land, could also be used to supplement any other port precinct operational needs if land access on the WTP site is restricted.

## 9.3 Environmental management observations

### 9.3.1 Hastings

Dredging and reclamation in Western Port has potential to create turbid plumes, and whilst work methods have been selected to minimise generation of turbidity. Strong currents at the site mean it is not practical to deploy silt curtains to limit the spread of turbidity

Further controls on dredging operations to reduce turbidity will impact productivity and add cost.

The selected work method has a low beneficial re-use potential for dredged materials. Other work methods, whilst better are impacted negatively by productivity and cost factors.

### 9.3.2 Bay West

The selected dredging method can be undertaken entirely within a silt curtain screened area. The low magnitude tidal currents are not of major concern. A substantial proportion of dredged material can be used beneficially within the works.

Material arising from maintenance dredging of the PoM channels could be stockpiled and safeguarded for future use in the development. The location for any stockpile could be selected to minimise impacts and costs associated with capital dredging at a later date.

## 9.4 Economic factors, risks & opportunities

### 9.4.1 Job creation

Employment for each port is exoected to be the same. This is estimated at around 2000 staff at 9M TEU capacity, as set out in Table 54.

**Table 54 Employment estimate at 9M TEU**

| Employment | Total @9m TEU |
|---|---|
| Operations | 1250 |
| Management & administration | 250 |
| Marine Services | 150 |
| Mooring teams | 350 |
| **Total** | **2000** |

### 9.4.2 Dredging factors related to approvals

Notable issues include:

- Both locations have significant environmental risk management undertakings, and for both options many of the environmental values to be maintained will require a very long lead time for planning, developing and receiving the necessary approvals.
- Both sites offer opportunities to enhance or mitigate impacts through the beneficial re-use of dredged material.

### 9.4.3 Opportunities aligned to development

- The study has identified a potential need for PoM maintenance dredging activities to create a new DMG in the near future. The Capel Sound location will run out of suitable

water depth. The Bay West site could be used as an alternative or considered as part of its planning. This may allow development costs to be reduced further.

- The Bay West development lowers the longer term erosion risk to shoreline at WTP, hence providing opportunity for MW to revisit its capital maintenance spending plan.
- Bay West and Hastings development provides opportunity to enhance shoreline habitat through creation of additional intertidal areas.

## 9.5 Capital cost estimates

This section summarises the capital cost estimates for both options. The basis of the cost estimate is provided in Appendix E.

### 9.5.1 Hastings port development cost estimate

Figure 88 and Table 57 describe the project components that are included in the capital cost estimate for Hastings. Table 55 and Table 56 present the capital costs for the 18,000 and 14,000 TEU vessels respectively.

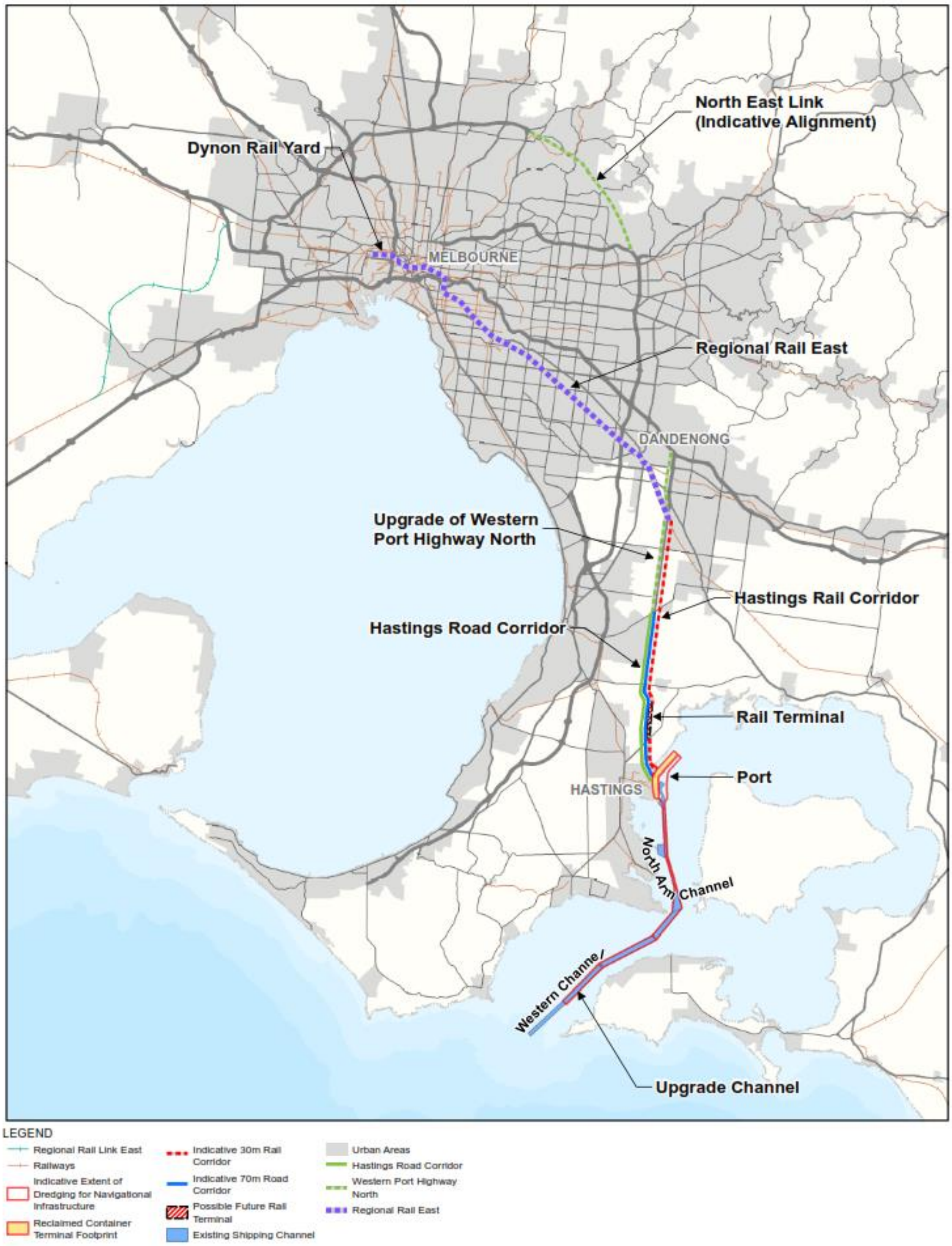



**Figure 88 Total concept plan for Hastings**

## Table 55 Cost estimate for an 18,000 TEU vessel at Hastings

| Item | phase 1 | phase 2 | phase 3 | Total |
|---|---|---|---|---|
| **Dredging & Reclamation** | | | | |
| Dredging (channel + berth pockets) | $ 525,283,000 | $ 609,783,500 | $ 408,192,500 | $ 1,543,259,000 |
| Earthworks & Ground Treatment | $ 166,792,684 | $ 99,634,743 | $ 78,402,557 | $ 344,829,984 |
| **Port Terminal** | | | | |
| Wharf & Terminal | $ 990,331,371 | $ 1,113,190,746 | $ 778,496,478 | $ 2,882,018,596 |
| Bridges, Utilities & Demolition | $ 408,540,385 | $ 76,617,403 | $ 58,326,545 | $ 543,484,332 |
| **Transport Connections** | | | | |
| Local Road & Rail (includes WPH (S) upgrade) | $ 1,032,175,167 | $ 1,540,720,774 | $ - | $ 2,572,895,941 |
| **Associated Infrastructure** | | | | |
| Regional Rail East (RRE) | $ - | $ 6,500,000,000 | $ - | $ 6,500,000,000 |
| Land Purchase | *not defined | *not defined | *not defined | $ - |
| **Total** | **$ 3,123,122,607** | **$ 9,939,947,166** | **$ 1,323,418,080** | **$ 14,386,487,854** |

## Table 56 Cost estimate for a 14,000 TEU vessel at Hastings

| Item | phase 1 | phase 2 | phase 3 | Total |
|---|---|---|---|---|
| **Dredging & Reclamation** | | | | |
| Dredging | $ 458,462,533 | $ 593,437,615 | $ 398,762,193 | $ 1,450,662,340 |
| Earthworks & Ground Treatment | $ 166,792,684 | $ 99,634,743 | $ 78,402,557 | $ 344,829,984 |
| **Port Terminal** | | | | |
| Wharf & Terminal | $ 990,331,371 | $ 1,113,190,746 | $ 778,496,478 | $ 2,882,018,596 |
| Bridges, Utilities & Demolition | $ 408,540,385 | $ 76,617,403 | $ 58,326,545 | $ 543,484,332 |
| **Transport Connections** | | | | |
| Local Road & Rail (includes WPH (S) upgrade) | $ 1,032,175,167 | $ 1,540,720,774 | $ - | $ 2,572,895,941 |
| **Associated Infrastructure** | | | | |
| Regional Rail East (RRE) | $ - | $ 5,000,000,000 | $ - | $ 5,000,000,000 |
| Land Purchase | *not defined | *not defined | *not defined | $ - |
| **Total** | **$ 3,056,302,140** | **$ 9,923,601,281** | **$ 1,313,987,773** | **$ 14,293,891,194** |

### Table 57 Hastings capital cost elements

| Works item | Description |
|---|---|
| Demolition of BlueScope Jetty | Ro-Ro jetty |
| Dredging | 3 stages of dredging, 17.9 M $m^3$ of sand fill and 29 M $m^3$ of clay / silt to berth pockets, swing basin and channel areas. |
| Earthworks & Ground treatment | Land reclamation (as part of the dredging)<br>3 stages of ground improvement comprising vibro-compaction to sand material filled zones and vertical wick drains on the Old Tyabb reclamation<br>Earth filled safety bund in front of the Esso facility<br>Temporary stormwater drainage systems and surface stabilisation to reclaimed surfaces.<br>Grouted mattress temporary edge protection to reclamation surfaces between construction stages<br>218,000 t of armour rock |
| Wharf Construction/Terminal Construction | 4.25 km of open piled quay construction including bollards and fendering<br>Container stacking pavements, heavy and light duty pavements<br>Main services distribution and lighting<br>Perimeter security fencing |
| Transport infrastructure | RRE rail upgrade (twin track freight rail)<br>Lyndhurst – Hastings rail corridor upgrade – SG connection + passing loops<br>WPH (south) road upgrade - Freeway standard<br>4 x grade separated rail bridges crossing roads / services<br>3 x grade separated road bridges crossing rail / services<br>Single 5km x 250 m wide rail marshalling terminal + 28 km rail track, signalling and crossovers in port precinct zone<br>7.7km long x 40m wide primary road corridor from McKirdy's Rd to terminal<br>100,000 $m^2$ of secondary port precinct roads |
| | |
| Common elements | Site clearance cost provisions<br>3 port office buildings / workshops – construction & fitout<br>1 x trunk services connection<br>3 x truck marshalling and gate complex<br>Aids to navigation |

### 9.5.3 Bay West port development cost estimate

Figure 89 and Table 60 describe the project components that are included in the capital cost estimate for Bay West. Table 58 and Table 59 present the capital costs for the 18,000 TEU and 14,000 TEU vessels respectively.

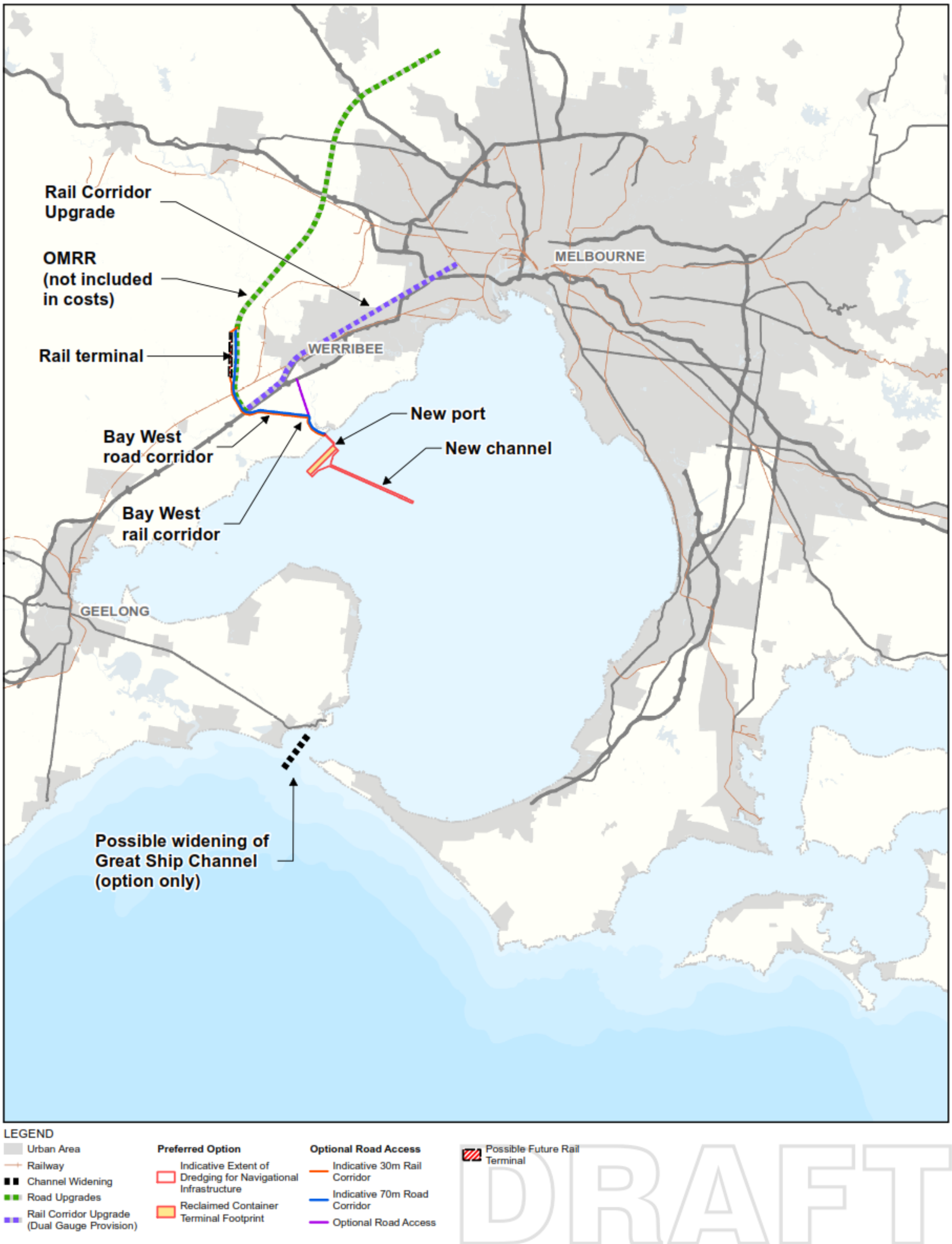



Figure 89 Total concept for Bay West

## Table 58 Cost estimate for an 18,000 TEU vessel at Bay West

| Item | phase 1 | phase 2 | phase 3 | Total |
|---|---|---|---|---|
| **Dredging & Reclamation** | | | | |
| Dredging (channel + berth pockets) | $ 1,133,195,000 | $ - | $ - | $ 1,133,195,000 |
| Earthworks & Ground Treatment | $ 148,159,737 | $ 180,841,204 | $ 119,121,650 | $ 448,122,591 |
| **Port Terminal** | | | | |
| Wharf & Terminal | $ 1,003,662,441 | $ 912,319,178 | $ 878,911,889 | $ 2,794,893,509 |
| Bridges, Utilities & Demolition | $ 732,116,305 | $ 39,914,338 | $ 39,608,741 | $ 811,639,383 |
| **Transport Connections** | | | | |
| Local Road & Rail | $ 746,248,176 | $ 22,919,760 | $ 12,733,200 | $ 781,901,136 |
| **Associated Infrastructure** | | | | |
| Rail Network Upgrade (Dual gauge) | $ - | $ 290,000,000 | $ - | $ 290,000,000 |
| Widening of Great Ship Channel | $ - | $ 160,000,000 | $ - | $ 160,000,000 |
| **Total** | **$ 3,763,381,659** | **$ 1,605,994,480** | **$ 1,050,375,481** | **$ 6,419,751,619** |

## Table 59 Cost estimate for a 14,000 TEU vessel at Bay West

| Item | phase 1 | phase 2 | phase 3 | Total |
|---|---|---|---|---|
| **Dredging & Reclamation** | | | | |
| Dredging | $1,077,315,000 | $- | $- | $1,077,315,000 |
| Earthworks & Ground Treatment | $143,743,627 | $180,841,204 | $119,121,650 | $443,706,481 |
| **Port Terminal** | | | | |
| Wharf & Terminal | $1,003,944,784 | $912,319,178 | $878,911,889 | $2,795,175,851 |
| Bridges, Utilities & Demolition | $676,189,623 | $39,914,338 | $39,608,741 | $755,712,702 |
| **Transport Connections** | | | | |
| Local Road & Rail | $ 746,415,381 | $ 22,919,760 | $ 12,733,200 | $ 782,068,341 |
| **Associated Infrastructure** | | | | |
| Rail Network Upgrade (Dual gauge) | $ - | $ 290,000,000 | $ - | $ 290,000,000 |
| Widening of Great Ship Channel | $ - | $ - | $ - | $ - |
| **Total** | **$ 3,647,504,027** | **$ 1,445,994,480** | **$ 1,050,375,481** | **$ 6,143,873,987** |

### Table 60 Bay West capital cost elements

| Works item | Description |
|---|---|
| Demolition | Farm Rd highway bridge over Princes freeway |
| Dredging | 1 stage of dredging, 8.6 M $m^3$ of sand fill and 20 M $m^3$ of clay to berth pockets, swing basin and channel areas. Potential 100,000 $m^3$ of dredging in Great Ship Channel |
| Earthworks & Ground treatment | Land reclamation (as part of the dredging)<br>3 stages of ground improvement comprising vibro-compaction to sand material filled zones and vertical wick drains to clay filled areas<br>Temporary stormwater drainage systems and surface stabilisation to reclaimed surfaces.<br>Grouted mattress temporary edge protection to the open piled wharf reclamation surfaces between construction stages<br>300,000 t of armour rock |
| Wharf Construction/Terminal Construction | 4.1 km of open piled quay construction including bollards and fendering<br>Container stacking pavements, heavy and light duty pavements<br>Main services distribution and lighting<br>Perimeter security fencing |
| Transport infrastructure | Local mainline rail network upgrade (dual gauge connectivity)<br>4 x grade separated rail bridges crossing roads / services<br>1 x elevated road bridge crossing rail / services<br>1 x grade separated road / rail crossing (underground)<br>2km – 2.5km open piled bridge connection over water<br>Single 3km x 250 m wide rail marshalling terminal + 24 km rail track, signalling and crossovers<br>11 km long x 40m wide primary road corridor from OMRR to terminal and associated earthworks to bring land above flood risk levels<br>4 km long x 40m wide primary road corridor from PF to terminal and associated earthworks to bring land above flood risk levels<br>50,000 $m^2$ of secondary port precinct roads |
| | |
| Common elements | Site clearance cost provisions<br>3 port office buildings / workshops – construction & fitout<br>1 x trunk services connection<br>3 x truck marshalling and gate complex<br>Aids to navigation |

### 9.5.4 Capital cost comparison

Table 61 summarises the development cost for both options by vessel size. This indicates that Bay West is estimated to have a lower capital cost than Hastings. The main difference relate to the transport related costs and associated rail infrastructure (RRE).

**Table 61 Estimated ultimate development costs for Bay West & Hastings**

| | Hastings | | Bay West | |
|---|---|---|---|---|
| | 18,000 TEU | 14,000 TEU | 18,000 TEU | 14,000 TEU |
| Dredging / Reclamation | 1.9 bn | 1.8 bn | 1.6 bn | 1.5 bn |
| Port Terminal | 3.4 bn | 3.4 bn | 3.6 bn | 3.6 bn |
| Transport | 2.6 bn | 2.6 bn | 0.8 bn | 0.8 bn |
| Associated Infrastructure | 5.0 bn | 5.0 bn | 0.5 bn | 0.3 bn |
| **Total** | **$12.9 bn** | **$12.8 bn** | **$6.4 bn** | **$6.1 bn** |

## 9.7 Summary comparison

Table 62 provides a summary comparison of the two options.

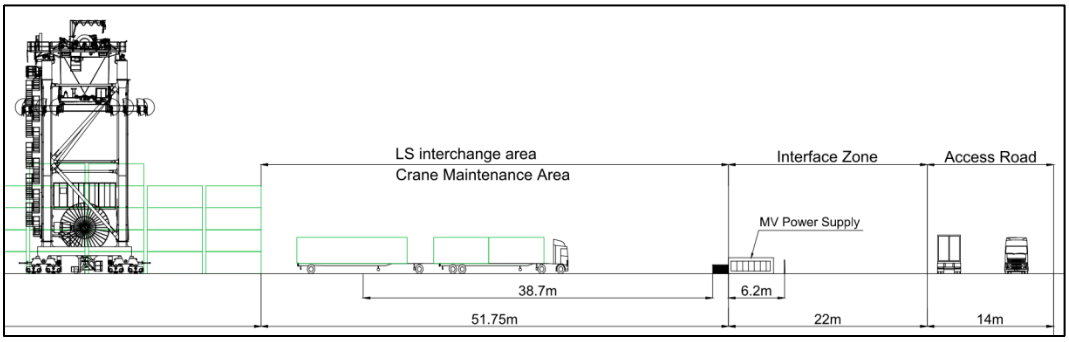
**Table 62 Differences between Bay West and Hastings**

| Item | Bay West | Hastings |
|---|---|---|
| Capex | Lower ($6.1 bn – $6.4 bn) | Highest($14.3 bn – $14.4 bn) |
| Terminal Opex | Container operations are identical. | |
| Supply chain Opex | Rail shuttle operations potentially higher at BW, if rail terminal is further away from container terminal | |
| Port operations | Fewer berth faces provide a more flexible operation<br>Ship handling potentially easier | Multiple berth faces reduces flexibility marginally |
| Reclamation (sand assumed) $Mm^3$ | 8.6 | 17 |
| Dredging Clay $Mm^3$ | 19 - 20 | 30 |
| Total dredge M $m^3$ | 28 – 29 M | 47 M |
| Dredge material opportunities | Minimal disposal volumes in PPB<br>Alternative sand material sources exist | CSD material could be used beneficially within Western Port<br>Significant volumes of offshore disposal still required |
| Environmental Impacts | Reduces coastal erosion on lagoon shoreline, reducing opex / risks for MW<br>Can be built in 1 phase, fully enclosed within a silt curtain<br>Groundwater risk<br>Flood risk to MW operations | Impacts quality of foreshore<br>Likely to be built in multiple phases creating ongoing dredge impacts.<br>limited opportunity to control turbidity.<br>Groundwater risk |
| Future Expansion | Good opportunity to extend quay length and/or accommodate alternative trades. May require additional dredged fill material. | Limited opportunity, beyond proposed quay length<br>Alternative trades, reduce container handling capacity |
| Road / Rail interface | Good flexibility for road, rail connections. Reduced connection costs and community disruption. | Major challenges for rail connectivity with disruption<br>Higher cost for road connectivity |
| Land Use | Limited land areas available for close proximity port precinct<br>Ample land for port environs | enough land available for Port precinct and Environs |
| Constructability | No major challenges foreseen | |

# Appendices

# **Appendix A** – Terminal Equipment Information

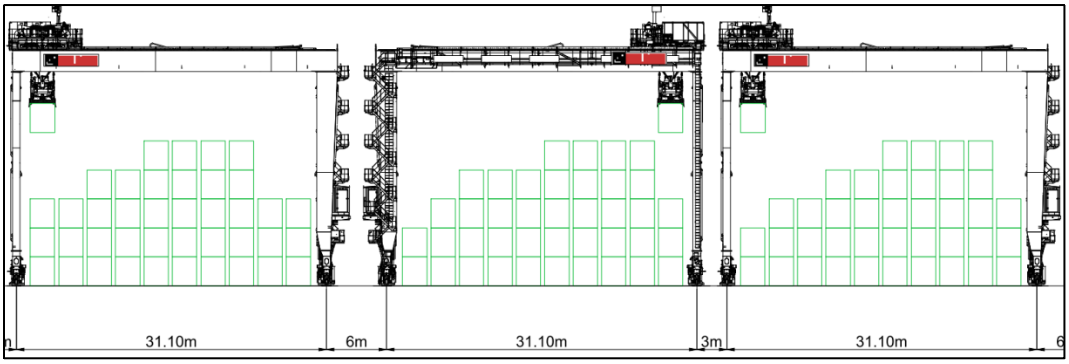
### Table 63 Cross Section Landside Handover & Truck Area



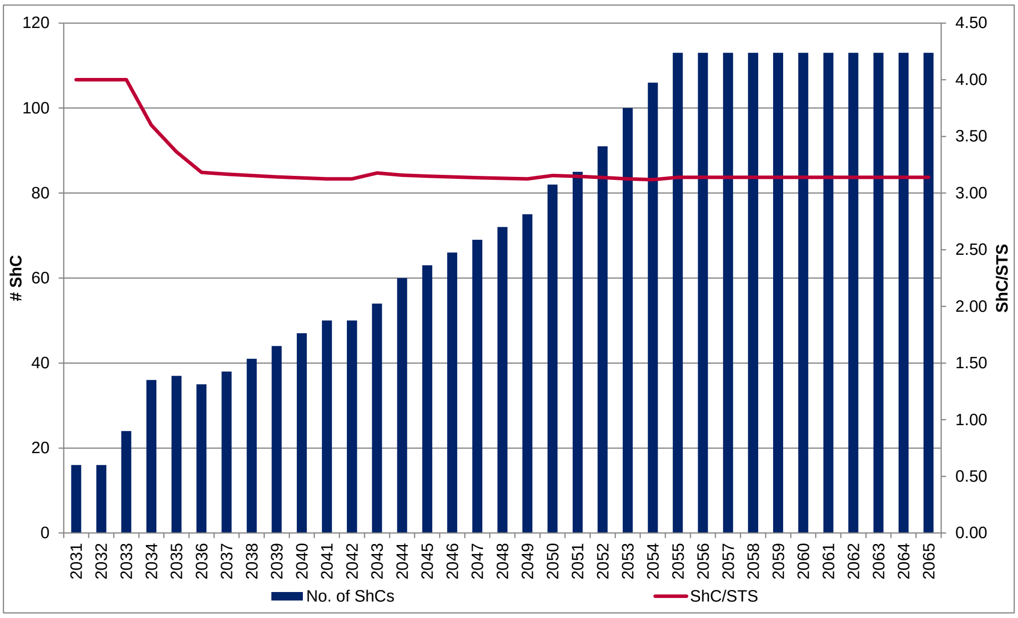

Source: Cargotec, 2015

Each ASC has a rail gauge of 31.1 metres, serving a 10 container rows wide and 25 TEUs long stack at 1 over 5-high stacking. The configuration is illustrated in the sketch below.

### Table 64 Block Configuration Twin ASC




### Table 65 Automated Shuttle Carrier Requirements



# **Appendix B** – Existing Channels, Anchorages and Berth Pockets at Hastings

The shipping channel to the Port of Hastings terminals consists of a two-way channel starting from the west of Phillip Island and heading in a north easterly direction to Sandy Point where it turns to the north to the existing berths. The channel has a one-way capacity from north of Sandy Point to the existing berths at BlueScope. Channels, approaches, swing basin, anchorage and berth pocket details are listed in Table 66 and Table 67 and are shown in Figure 90.

### Table 66 Channels, Anchorages and Swing Basins in the Port of Hastings

| Channel section | Length (km) | Min. width (m) | 1-Way / 2-Way | declared depth (m)[4] | Description |
|---|---|---|---|---|---|
| **Primary channels** | | | | | |
| Western Channel – South | 8.0 | 400 | 2 | 14.8 | Fairway Buoy to Buoys 7 & 8 |
| Western Channel – Centre | 6.0 | 400 | 2 | 14.8 | Nos.7 & 8 to 13 & 14 Buoys |
| Western Channel – North | 3.80 | 400 | 2 | 14.8 | Nos.13 & 14 to 17 & 18 Buoys |
| North Arm – South | 3.2 | 180 | 1 | 14.2 | Nos.19 & 20 Buoys to Crib Point |
| North Arm – North | 5.81 | 245 | 1 | 14.2 | Nos.25 to 29 Buoys |
| **Approaches and Swing Basins** | | | | | |
| Crib Point Approach | - | - | 1 | 12.7 | 24 Buoy to Crib Point Jetty |
| Crib Point Swing Basin | - | - | 1 | 14.2 | Adjacent to Crib Point Jetty |
| Long Island Point Swing Basin | - | - | 1 | 14.2 | Adjacent to Long Island Point Jetty |
| Steel Wharves Approach | | 200 | 1 | 9.0 | North of Long Island Point to Steel Wharves |
| Steel Wharves Swing Basin | - | - | | 9.0 | Adjacent to Steel Wharves |
| **Anchorages** | | | | | |
| East Arm Anchorage | | | | 10 to 20 | Primary anchorage, immediately north of Cowes |
| Old Tyabb Anchorage | | | | 9.2 | East of Old Tyabb Reclamation |
| Flinders Anchorage | | | | | Between Flinders and Phillip Island |

### Table 67 Existing Berth Pockets

| Berth | Depth (m) | Length (m) | Width (m) |
|---|---|---|---|
| Stony Point Jetty | 2.5 to 6.5 | - | - |
| Crib Point Jetty No. 1 | 15.7 | 350 | 90 |
| Long Island Point Jetty | 15.7 | 350 | 90 |
| BlueScope No.1 (Dedicated RORO berth) | 12.0 | 290 | 30 |
| BlueScope No. 2 | 12.0 | 290 | 30 |

[4] Maintained depth source = Chart AUS 150 – Western Port (Edition No. 2 dated 4 Jun 2010)


**Figure 90 Port of Hastings approach channel**

# **Appendix C** . Assumptions for estimating services demand

## Power assumptions

The following assumptions were made in regards to the forecast for power demand:

- Provision has been included for power supply to all ships (cold ironing).
- The demand for cold ironing was based upon a 14,000 TEU Maersk E class ship.
- Navigation aids will be solar powered.
- The terminal will operate 365 days per year.
- The terminal will operate at an average berth occupancy of 70%.
- Ship to shore gantry cranes have 60% utilisation.
- Rail mounted yard gantry cranes have 80% utilisation.
- Refrigerated containers (reefer) will comprise 8.7% of the total TEU and have 100% utilisation.
- Terminal lighting required for 14 hours per day.
- Office and workshops will operate 18 hours per day.
- Trains will be diesel powered.
- Customs and Quarantine area assumed to consist of 50% office space and 50% warehousing.
- Trucking depots area assumed to consist of 20% office space and 80% carpark.
- No allowance has been made for specific requirements associated with manufacturing and industrial related industries. At this stage a general provision has been made based on light industrial use.
- No allowance for diversity factors when calculating power demand. Diversity factors will need to be considered in the next stage.

## Potable water assumptions

The following assumptions were made in regards to the forecast for potable water demand:

- Ships will produce their own potable water. No allowance for topping up ships from the potable water supply network.
- No allowance for potable water for fire protection systems. However, it is anticipated that adequate pressure and capacity is available in the existing network.
- No allowance has been made for specific requirements associated with manufacturing and industrial related industries as the demand is highly variable. A detailed assessment will be required once the industry type can be better defined.

## Sewage assumptions

The following assumptions were made in regards to the forecast for sewerage demand:

- Ships will manage their own sewage. No allowance for the transfer of waste from ships to the sewerage network.

- No allowance for disposal of trade waste associated with manufacturing, industrial and trucking depots.
- The impact of groundwater infiltration on the sewer network has not been estimated at this stage. Infiltration factors should be discussed and agreed with South Water in the next stage.

### Gas assumptions

The following assumptions were made in regards to the forecast for domestic gas demand:

- Supply of ships with LNG will be via a barge.
- No allowance has been made for specific requirements associated with manufacturing and industrial related industries as the demand is highly variable. A detailed assessment will be required once the industry type can be better defined.
- 50% of the total Customs and Quarantine area is supplied with gas.
- 20% of the total Warehousing area is supplied with gas.
- 20% of the total Industrial area is supplied with gas.

### Stormwater assumptions

The following assumptions were made in regards to the stormwater:

- The rational method was used to undertake a high level estimate of the expected increase in runoff within the proposed port development areas. This is due to the impermeable surfaces (i.e. roofs, roads and hardstand). Runoff for the 10 ARI storm has been assessed as this typically corresponds to the capacity of the underground drainage network. Runoff for the 100 ARI storm has been assessed as typically corresponding to the capacity of overland flow in roads / flood channels and retarding basins.
- External catchments have not been included in this preliminary assessment. Detailed hydraulic modelling will required to quantify the existing flow conditions and the likely impact due the proposed development. Melbourne Water and Mornington Peninsula Shire have already commenced hydraulic modelling of existing catchments, however they have not included the likely impacts associated with proposed port development. Results from these models will be useful in establishing existing conditions.

### Telecommunications assumptions

The following assumptions were made in regards to the forecast for telecommunications demand:

- The assessment is limited to the supply of external telecommunications into the port development from adjacent trunk infrastructure. It is noted that there will be a high volume of internal telecommunications within the port; however this infrastructure will be installed separately and is unlikely to impact the external network.

## Potable water unit rates

The following table describes the unit rates used as a guide for the unit rates adopted for potable water demand in the model. The unit rates listed in Table 68: Potable water demand unit rates are in accordance with the Water Supply Code of Australia, Melbourne Retail Water Agencies Edition, Version 2.0 (WSA 03-2011-3.1):

### Table 68: Potable water demand unit rates

| Use | Demand Type | Peak Hour Demand | Unit |
|---|---|---|---|
| Office, workshops, trucking depots, retail and accommodation | Commercial | 0.6 | l / s / Ha |
| Warehousing, distribution centres and container park | Commercial | 0.2 | l / s / Ha |
| Industrial | General heavy > 200 Ha | 0.8 | l / s / Ha |
| Manufacturing | Industrial General heavy > 40 Ha | 1.0 | l / s / Ha |
| Industrial | Light | 0.4 | l / s / Ha |
| Industrial | Designated high usage | 2.5 | l / s / Ha |

#### *Sewage rates*

Table 69: Sewage demand unit rates describes the unit rates used as a guide for the unit rates adopted in the model to forecast the capacity of a sewer system to support the port development. The unit rates are in accordance with the Sewerage Code of Australia, Melbourne Retail Water Agencies Edition, Version 1.0 (WSA 02-2011).

### Table 69: Sewage demand unit rates

| Use | Classification | Rate | Unit |
|---|---|---|---|
| Offices and workshops (Terminal) | Commercial | 500 | Equivalent Population / Ha |
| Warehousing, bonded warehousing | Commercial | 50 | Equivalent Population / Ha |
| Customs, distribution centres and trucking depots | Commercial | 75 | Equivalent Population / Ha |
| Container Park | Commercial | 10 | Equivalent Population / Ha |
| Industrial | Industrial | 150 | Equivalent Population / Ha |
| Retail | Commercial | 300 | Equivalent Population / Ha |
| Manufacturing | Industrial | 600 | Equivalent Population / Ha |
| Accommodation | Hotel, motels | 600 | Equivalent Population / Ha |

### *Gas unit rates*

Table 70: Gas demand unit rates describes the unit rates used as a guide for the unit rates adopted in the model to forecast the demand for domestic gas to support the port development. The unit rates are based on previous experience.

### Table 70: Gas demand unit rates

| Use | Classification | Rate | Unit |
|---|---|---|---|
| Offices and workshops | Commercial | 270 | MJ / $m^2$ / year |
| Warehousing, bonded warehousing | Commercial | 135 | MJ / $m^2$ / year |
| Future Industrial | Industrial | 135 | MJ / $m^2$ / year |
| Retail | Commercial | 270 | MJ / $m^2$ / year |
| Manufacturing | Industrial | 135 | MJ / $m^2$ / year |
| Accommodation | Commercial | 270 | MJ / $m^2$ / year |

### *Stormwater*

The following impermeable percentages have been adopted in the model to forecast peak flow for each land use. The unit rates are based on previous experience and Australian Rainfall and Runoff (ARR), 1987.

- Terminal: 90 %
- Port Precinct: 70%
- Port Environs: 50%
- Stony Point: 50%
- Cribb Point: 50%
- Existing: : 10%

The Time of Concentration was estimated based on the following:

- Travel length: Estimated by taking the square root of the catchment area
- Pipe diameter: 1000mm
- Gutter time: 7 mins
- Slope: 1 in 100

### *Telecommunications*

Based on previous experience the number of anticipated trunk conduits for each precinct has been estimated. It is anticipated that all conduits will be laid during stage 1 and fibre optic cables will be installed to satisfy demand for each subsequent stage.

- Terminal: 2 no. 100mm conduits
- Port Precinct: 2 no. 100mm conduits
- Port Environs: 2 no. 100mm conduits
- Stony Point: 1 no. 100mm conduit
- Crib Point: 1 no. 100mm conduit

# **Appendix D** – Bay West Site Assessment Results

### Environmental and social comparison results

A workshop was conducted to assess and compare the three Bay West options.

The following tables present the comparison findings for Environmental and Social related criteria:

#### Table 71 Biodiversity Conservation

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Marine Ecology impacts | Loss of habitat based on the proposed permanent footprint of the port. | Loss of habitat primarily marine soft sediment communities. Lower presence of seagrass communities. No reef communities.<br>Marine inshore waters habitat for a number of waterbirds. (Black Swan, Chestnut Teal, Australasian Shoveler. Crested Tern, Pied Cormorant). Not a differentiator between the three options. | Werribee River |
| | Impacts to ecological character of the Ramsar site based on the proposed permanent footprint of the port. | Werribee River option transport corridors avoid crossing extensive intertidal mudflats and saltmarsh which are utilised as migratory bird foraging habitat.<br>Kirk Point and Point Wilson options corridors cross closer to the high value bird habitats<br>Potential influence on aspects of critical ecosystem components primarily waterbirds. Limited potential for fish, invertebrate impacts. | |
| | Impacts to marine parks and reserves based on the proposed permanent footprint of the port. | Werribee River option not in immediate vicinity to The Spit Reserve. Other options are closer, situated on either side | |

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| | Effects on ecological processes and nutrient cycles | Seabed Footprint area is similar for all options.<br><br>Potential for lower impacts at Werribee River as the shoreline lacks extensive intertidal mudflats. | |
| Terrestrial ecology impacts | Loss of habitat based on the proposed permanent footprint of the port and transport corridors | Road/rail transport corridors are different for each option and affect different habitats.<br><br>Pasture habitat adjacent to the Werribee River is identified habitat for Ibis at WTP. Only the Werribee River option will have an impact on this area.<br><br>An agriculture and biodiversity zone has been identified in the eastern portion of the WTP. Only the Kirk Point option will have an impact on this area.<br><br>The Point Wilson option has a transport corridor outside the WTP, and crosses quarry land and agricultural land. For this reason, the Point Wilson options has the lowest impact on the loss of habitat. | Point Wilson |
| | Impacts to ecological character of the Ramsar site based on the proposed permanent footprint of the port | The Werribee River transport corridor crosses the shoreline away from saltmarsh communities and Orange Bellied Parrot (OBP) habitat. Although, it does cross in vicinity of northern most site of OBP habitat at WTP.<br><br>Higher value Ramsar areas are located around intertidal mudflats and coastal saltmarsh, which are present west of the WTP. Here, there is potential influence on aspects of critical ecosystem | |

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| | | components including waterbirds and frogs. This area is impacted by the Kirk Point transport corridor, while the Point Wilson transport corridor mostly avoids this area. | |
| | Perceived effects on ecological processes | There are low level of impacts as transport corridor primarily traverses heavily modified pasture environment. Coastal vegetation limited at the sites. | |
| | | | |

### Table 72 Contamination management

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Contamination Management | Level of occurrence of contamination of the bay from shipping spills and mitigation of the impacts of the contamination. | No difference between options | No difference |
| | Level of occurrence of contamination of coastal areas from water-side operations. | | |
| | Level of occurrence of contamination of land due to port operations. | No difference between options | No difference |
| | Level of occurrence of contamination of coastal areas from land based operations. | | |

### Table 73 Business operations continuity

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Other Business Operations Continuity | Impacts on aquaculture. | Mussel farms are located closer to Pt Wilson and not in vicinity of the Werribee River | Werribee River |
| | Impact on surrounding land use (Avalon Airport, Quarry, Market Gardens) | None of the options will have impact on the Avalon Airport, Mountain View Quarry or the Market Gardens. | No difference |
| WTP Business Operations Continuity | Perceived extent of impacts on future land use planning of WTP:<br>• primary treatment expansion (lagoons)<br>• impacts to key WTP infrastructure | Eastern portion of WTP site is expected to be engineered and developed over next 20 years. Kirk Point transport corridor is further from this area compared to Werribee River, but may impact some use of land as buffers. The Point Wilson transport | Point Wilson |

| | | | |
|---|---|---|---|
| | • recycled water distribution and buffers | corridor is the furthest from this area, however, the wave shadow from the terminal may impact on the mixing zone.<br><br>Necessary landside infrastructure can be accommodated around planned future WTP land use in eastern portion. | |
| | Perceived extent of impacts on future land use planning of WTP:<br><br>• Impacts on EPBC obligations (creating/maintaining habitat) | Western portion of WTP is recognised to be utilised most for maintaining environmental obligations, offsets, meeting biodiversity obligations. (e.g. expansion/ continuation of the recreation of saltmarsh habitat along the foreshore with provision for 'natural' retreat of the coastline.<br><br>Kirk Point is closest to this portion. Although Point Wilson is clear of this area, Werribee River is the preferred option as there is a possibility of preventing erosion and a greater opportunity for creation of new intertidal habitat to offset losses to sea level rise. | Werribee River |

**Table 74 Cultural Heritage protection**

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Cultural Heritage Protection | Perceived extent of impacts of port construction and operation to Aboriginal sites. | No difference between options | No Difference |
| | Perceived extent of impacts of port construction and operation to European sites. | No difference between options | |

**Table 75 Amenity protection**

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Amenity Protection | Public use, recreation and tourism | Construction and operation for the Werribee River option has potential to reduce access to the waters in the vicinity of the Werribee River.<br>Kirk Pt proposed as future Eco-tourism hub would be impacted by Point Wilson and Kirk Point options.<br>Point Wilson option, being furthest from boat ramps and public access areas is the preferred option. | Point Wilson |
| | Visual impact | Visual impacts not assessed but will be different based on the location of receptors. | Minor differences |
| | Impacts on recreational boating and fishing within the vicinity of the proposed port site. | Recreational boating launching locations at Werribee South and Wyndham Cove may be impacted accessing the area to the south particularly inshore waters | Point Wilson |

### Engineering comparison results

The following tables present the comparison findings for engineering related criteria:

**Table 76 Coastal processes**

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Coastal processes | Ability to reduce impacts from coastal erosion (sewage release, saltmarsh loss). | Shadow from Kirk Pt development more likely to reduce wave energy reaching mixing zone. | Werribee River |
| | Risks to negative impacts on outfall mixing (water quality). Risks to loss of intertidal areas (shorebirds) | Werribee River Site would protect shoreline to 15E lagoon and provide opportunity to reinstate a flatter intertidal area. | |

**Table 77 Transport and land use**

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Rail Connectivity | Ease of connectivity to rail network and ability to accommodate rail infrastructure | Connectivity similar for both Werribee River and Kirk Point options to link to the western line and future OMR rail alignment. Point Wilson is further from the OMR rail alignment than Werribee River and Kirk Point. Additionally, the bridge connection to the reclaimed island for Point Wilson is the longest of the three options. The preferred option for rail connectivity is Werribee River due to the decreased flood risk compared to Kirk Point. | Werribee River |
| Road Connectivity | Ease of connectivity to existing road network. | Similar distance from both Werribee River and Kirk Point to OMR and Princes Hwy link. The Werribee River location provides for alternative direct routes to road connections and a shorter distance to easterly and northern locations. | Werribee River |

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| | | The Point Wilson option is the furthest out of the three options from easterly and northern locations. Again, the bridge distance is not favourable compared to the other two options.<br><br>The preferred option for road connectivity is the Werribee River Option. | |
| Land Use Integration outside of WTP site | Perceived extent of existing/future uses impacting port operations.<br><br>Consistency with long-term land use planning objectives.<br><br>Appropriateness of zoning of land for site and potential for change.<br><br>Ability of planning and environmental overlays to affect port operations. | Key points include:<br><br>Western grasslands to NW (west of future OMR) may restrict future industrial land uses.<br><br>Land in between existing main line rail and Princes Highway (to north) is recognised to provide some complimentary benefit.<br><br>There is some risk of odour impact on areas north of WTP, which needs to be considered and mitigations clarified.<br><br>Available industrial land west of Kirk Point at Avalon provides an opportunity for integrated development subject to potential flood impacts.<br><br>Urban encroachment occurring to east/north.<br><br>Preferred option is either Kirk Point or Point Wilson due to the greater opportunity for integrated development. | Kirk Pt/Point Wilson |
| Geotechnical (land side) Considerations | Constructability considerations for transport infrastructure? | No difference. Similar constructability for all options. | No difference |

### Table 78 Dredging and reclamation

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Dredging & Reclamation | Extent of the volume of material.<br>Extent to which cut and fill volumes balance. | Less volume to dredge a channel to the Werribee River site. In addition, there is greater flexibility in balancing the dredge and reclamation for the Werribee River option. | Werribee River |
| Dredging (geotechnical factors / risks) | Dredge feasibility (material types, rock etc.) | Rock is present in all options. All three options have feasible locations to avoid rock. Dredge material is similar in all locations. | No difference |

### Table 79 Flood risk

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Flood Risk Mitigation | Risk of surface water flows through the site.<br>Potential impacts to site flooding caused by the development | Flood risk is significantly greater in the western portion of the WTP site. This increased flood risk applies to both the Kirk Point and the Point Wilson Options. Therefore, the preferred option is Werribee River. | Werribee River |

### Table 80 Operation efficiency and future development surrounding port

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Operational Efficiency | Level of efficiency of port systems and operability.<br>Degree of functionality and attractiveness for operators. | No difference in the operational efficiency of the port.<br>Some land around Point Wilson, but Werribee River is closer to existing industrial land in the western suburbs.<br>Preferred option is Point Wilson due to the greater availability of land; however, there are flood risks that would need to be addressed. | Point Wilson |
| Port Precinct Area | Ease of fit for port precinct and development areas surrounding port. | | |

### Table 81 CAPEX/OPEX

| Criteria | Factors | Commentary | Preferred Option |
|---|---|---|---|
| Capital Cost Efficiency | Extent of capital expenditure. (key differences - dredge etc.) | Less volume to dredge to the Werribee River site. Additionally, there is more flexibility in balancing the dredge and reclamation volumes. | Werribee River |
| | Extent of infrastructure requirements to avoid excessive costs. | | |
| Operational Cost Efficiency | Best outcomes for Industry / State.<br>perceived outcomes w.r.t efficiency of supply chain connections | For freight travelling north or west from the Bay West site, distances travelled are similar. However, freight travelling east from the Kirk Point option travel approximately 70% further than if they left from the Werribee River option. Out of the three options, Pont Wilson is the furthest for freight travelling east. | Werribee River |

# **Appendix E** – Cost Estimates

The costs for the dredging and reclamation have been calculated using up to date survey data and the current level of geotechnical knowledge. The dredging rates have been calculated by a specialist dredging estimator based on current industry costs and production figures. The dredging rates include contractor's overheads and profits as is normal in that industry.

The costs for the construction work and services have been calculated by a specialist team using rates from current industry knowledge. Where appropriate these rates have been built up from the cost of materials, labour and plant. The general construction rates include mobilisation with overheads and profit added separately.

The costs for the stevedore equipment are based on the use of tandem lift ship to shore cranes able to address ships with a beam of 60 m. These are supported by a fleet of automated shuttle carriers and automated stacking cranes. These are all controlled by a state of the art terminal operating system.

The cost estimating for Hastings and Bay West has been based on the following: -

- The dredging and reclamation costs include contractors overheads and profit.
- The "Sand Filling from Offshore" costs include all shore works (bunding etc) in the Mob/Demob
- In all areas where fill is to be placed, the soft alluvial material is removed under the "Clean Up Dredging" item
- The "Dredge to Sea" items are for a cutter suction dredger filling bottom dump barges.
- The treatment of the sand fill is by vibro-compaction
- The treatment of clay filled reclamation areas is by wick drains and surcharging
- The Esso safety bund is constructed using material removed from the surface of the Tyabb Reclamation
- The provision of external services brings the power water and gas supplies to the site boundary
- The rates for all civil construction (excluding dredging and reclamation and equipment) include mobilisation/demobilisation costs
- Contractor's overheads and profit have been applied to all civil construction
- Design and supervision costs have been applied to all civil construction, dredging and reclamation.
- All pricing is at January 2017 rates
- No risk cost items have been included in the pricing
- No costs have been included for pilot facilities, tugs, or harbour master's facilities

The following associated infrastructure items have been included in the estimate: -

### 9.7.2 Exclude from cost estimate

- The cost of purchasing land for the terminal and its immediate infrastructure.
- The cost of the consents procedure.

- Any compensation costs incurred.
- The cost of the procurement process.
- Environmental management costs
- Costs associated with towage, pilotage, shipping control and navigation aids. These are assumed to be self-sustaining businesses funded from the ships.

The pricing is at January 2017 levels with no contingency and no allowance for risk. It is assumed that the development is carried out under normal commercial terms and that an open international bidding system is used.

***Port of Hastings Estimate Summary*** **22/12/2016** WT PARTNERSHIP

# DRAFT

| Item | Phase 1 - 3m TEU<br>Total $ excl GST | Phase 2 - 6m TEU<br>Total $ excl GST | Phase 3 - 9m TEU<br>Total $ excl GST | Total<br>Total $ excl GST |
|---|---|---|---|---|
| **Construction Costs:** | | | | |
| Direct Construction Cost | 1,309,277,876 | 783,481,568 | 539,078,303 | 2,631,837,747 |
| Contractors Preliminaries | 261,855,575 | 156,696,314 | 107,815,661 | 526,367,549 |
| Contractors Profit and Offsite O/H | 125,690,676 | 75,214,231 | 51,751,517 | 252,656,424 |
| **Sub-Total Estimated Construction Cost** | **1,696,824,128** | **1,015,392,112** | **698,645,481** | **3,410,861,720** |
| **Escalation:** | | | | |
| Escalation N/A (Excluded) | - | - | - | - |
| **Sub-Total Escalation** | **-** | **-** | **-** | **-** |
| **CONSTRUCTION COST AS AT DECEMBER 2016** | **1,696,824,128** | **1,015,392,112** | **698,645,481** | **3,410,861,720** |
| **Consultants Fees:** | | | | |
| Consultants Fees | 194,682,413 | 101,539,211 | 69,864,548 | 366,086,172 |
| **Sub-Total Consultants Fees** | **194,682,413** | **101,539,211** | **69,864,548** | **366,086,172** |
| **Contingencies:** | | | | |
| Design Development Contingencies | 169,682,413 | 101,539,211 | 69,864,548 | 341,086,172 |
| Construction Contingency | 186,650,654 | 111,693,132 | 76,851,003 | 375,194,789 |
| **Sub-Total Contingencies** | **356,333,067** | **213,232,343** | **146,715,551** | **716,280,961** |
| **Total Estimated Project Cost (Excl GST)** | **2,247,839,607** | **1,330,163,666** | **915,225,580** | **4,493,228,854** |

**Documentation:**
- AECOM/GHD Piled Quay Deck and Rock Revetment Section A (Sketch AGH-CEP0-EG-SKE-0006)
- AECOM/GHD Open Piled Quay Deck Plan (Sketch AGH-CEP0-EG-SKE-0002)
- AECOM/GHD Fender/Bollard (Sketch AGH-CEP0-EG-SKE-0006)
- GHD Scope for all other items based on discussions with WTP on Previous Hastings Studies in 2013/2015
- AECOM GHD Memorandum AGH-CEP0-EG-MEM-0021 Wharf Materials proposed
- GHD Bridge details sketch Ref 31/29064/11 dated 31/8/12
- Port Study Estimate email from Richard Hill dated 29/11/16
- GHD Quantities email from Richard Hill dated 12/12/16
- Bay West Quantities Structure Rate Build-ups email from James Rafferty dated 13/12/16

**Key Areas:**
- All Quantities provided by GHD refer Estimate Detail

**Specific Inclusions:**
- Estimate accuracy + 60%/-40% Given the scope included
- Refer Detailed rate build-ups for specific assumptions
- Allowance 10% for Consultants Fees
- Allowance of $25m for Site Investigation
- Contractor Preliminaries and Margin 28%
- Dredging Quantities and estimates provided by GHD
- Cathodic Protection Allowance $4,800/m of Wharf length
- Concrete allowed as 50mpa with reinforcing allowances stated in detailed rate build-ups
- CHS Piles to be wrapped 2m below 0CD
- Services pavement allowances as stated
- Crane rail beam spacing 35m
- Fender size SC1600/spacing 15m
- Bollard size 150t/spacing 15m
- Wharf Base Service allowance $1.33m per 1,000m
- Services - Trunk Connection (Allowance) $7.25m
- Main Services distribution (per phase) $5m
- WAG Pipelin Crossings $2m/No.
- Allowance $5.5k/m for elevated train lines no electrics
- Rail Signalling $2m allowance
- Fueling Facilities $15m allowance

- Locomotive Facilities $15m allowance
- Train Crew Administration office & Facilities $5m allowance
- Rail Gantries $15m allowance
- Major services Alterations & Protection (Road & Rail) $10m Allowance

**Specific Exclusions:**

- Escalation
- Stevedore fitout i.e. Container cranes, warehouses, stacker crane and infrastructure, automatic gate systems, lighting, deluge and fire services etc.
- Works outside the Site boundary
- Statutory Planning approvals
- Authorities/Government studies and permits
- Road Connections to the site (unless stated)
- Rail connections to the site (unless stated)
- Rail overhead electrical
- Coatings to Exposed steelwork i.e. piles and sheet piles
- Construction in Operational Conditions
- Temporary Land Retainment structures
- Environmental costs (impact monitoring and studies)
- Decontamination and removal of hazardous materials (unless specified)
- Unforeseen Ground Conditions
- Dredging
- Creation of a DMG
- Existing utility service clashes/alterations
- Upgrading of Utility services to the site i.e. Power, Water, Sewer, Stormwater and Communications
- Cathodic Protection to Concrete elements
- Nightworks
- Staging of the works within phases
- Land acquisition and associated costs
- Risk adjusted allowance
- Future cost escalation beyond December 2016
- GST
- Common costs including:

Construction of Empty Container Park
Construction of VTS Tower
Constriction of Security Systems and Facilities (Pole mounted Pan/Tilt/Zoom Cameras with Night vision cabling back to Port Offices)
Construction of Customs/AQIS Facilities
Construction of Terminal Equipment Maintenance (1.6ha Plot with 2,000m2 single story building combining warehouse and office Facilities)
Allowance for Statutory Signage
Allowance for Feature Signage to main port Entry
Allowance for Terminal Operation System (IT and Hardware)
Port Management System
VTS Equipment
Pilot Launch Capex
Tugs
Line Boat
Survey Boat
Security Launch
Mooring Crew Vehicles
Marine Support Craft (Maintenance)

*Port of Hastings Estimate Detail* 22/12/2016 WT PARTNERSHIP

# DRAFT

| Ref No. | Item | Rate | Unit | Phase 1 - 3m TEU Quantity | Phase 1 - 3m TEU Total $ excl GST | Phase 2 - 6m TEU Quantity | Phase 2 - 6m TEU Total $ excl GST | Phase 3 - 9m TEU Quantity | Phase 3 - 9m TEU Total $ excl GST | Total Total $ excl GST |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Construction Costs:** | | | | | | | | | |
| | ***Direct Construction Cost -*** | | | | | | | | | |
| | **Demolition & Relocation** | | | | | | | | | |
| 1.0 | Demolition - Bluescope Jetty (Ro-Ro) | $ 2,100 | m2 | 903 | 1,895,796 | | - | | - | 1,895,796 |
| 1.1 | Demolition - Bluescope Jetty | $ 2,100 | m2 | | - | 2,107 | 4,423,524 | | - | 4,423,524 |
| 1.2 | Demolition of Miscellaneous Buidlings Allowance | $ 500,000 | | | - | 1 | 500,000 | | - | 500,000 |
| 1.3 | | | | | - | | - | | - | - |
| ***1.4*** | ***Sub-Total - Demolition & Relocation*** | | | | ***1,895,796*** | | ***4,923,524*** | | ***-*** | ***6,819,320*** |
| | **Dredging (Excluded Provided by GHD)** | | | | | | | | | |
| 2.0 | Dredging Clay Mobilisation/Demobilisation | $ - | Item | 1 | - | 1 | - | 1 | - | - |
| 2.1 | Dredging Sand Mobilisation/Demobilisation | $ - | Item | 1 | - | 1 | - | 1 | - | - |
| 2.2 | Environmental Monitoring | $ - | Item | 1 | - | 1 | - | 1 | - | - |
| 2.3 | Dredging (Sand) - Bunds/Permanent works | $ - | m3 | 6,820,000 | - | 4,370,000 | - | 6,725,000 | - | - |
| 2.4 | Dredging (Clay/silts for disposal) | $ - | m3 | 9,644,000 | - | 13,030,000 | - | 6,500,000 | - | - |
| ***2.5*** | ***Sub-Total - Dredging (Excluded Provided by GHD)*** | | | | ***-*** | | ***-*** | | ***-*** | ***-*** |
| | **Earthworks/Groundworks** | | | | | | | | | |
| 3.0 | Land Reclamation (included in Dredging above) | | Note | | | | | | | |
| 3.1 | Land Reclamation Imported Fill | $ - | m3 | - | - | - | - | - | - | - |
| 3.2 | Ground Improvement Mobilisation | $ 350,000 | No. | 2 | 700,000 | 2 | 700,000 | 2 | 700,000 | 2,100,000 |
| 3.3 | Ground Improvement Type 1 - Vibro Compaction land based - 2m grid (+5 to -15m), 20m deep overall | $ 45 | m2 | 72,500 | 3,262,500 | 990,000 | 44,550,000 | 690,000 | 31,050,000 | 78,862,500 |
| 3.4 | Ground Improvement Type 2 - Vertical Wick Drains (Tyabb) - 1.2m grid x 20m deep | $ 42 | m2 | 797,500 | 33,391,657 | - | - | - | - | 33,391,657 |
| 3.5 | Safety bund at Esso | $ 15 | m3 | 360,000 | 5,400,000 | - | - | - | - | 5,400,000 |
| 3.6 | Temporary Surface stabilisation (Grass Unused land) | $ 2 | m2 | 870,000 | 1,740,000 | 990,000 | 1,980,000 | 690,000 | 1,380,000 | 5,100,000 |
| 3.7 | Temporary Stormwater Drainage (during Reclamation - Allowance 10No. Humeceptors incl. Connections/piping) | $ 2,000,000 | Item | 1 | 2,000,000 | 1 | 2,000,000 | 1 | 2,000,000 | 6,000,000 |
| 3.8 | Surcharge Earthworks (moving Material to the next phase) | $ 12 | m3 | 3,500,000 | 42,000,000 | - | - | - | - | 42,000,000 |
| 3.9 | Temporary Edge Protection Ground Mattress - 15m length x 0.35m thick | $ 5,260 | m | 600 | 3,156,000 | 600 | 3,156,000 | - | - | 6,312,000 |
| 3.10 | Rock Armour Type 1 - Southern/Northern Face | $ 110 | t | 50,000 | 5,500,000 | - | - | 55,000 | 6,050,000 | 11,550,000 |
| 3.11 | Rock Armour Type 2 - Landward Face | $ 100 | t | - | - | 63,000 | 6,300,000 | 50,000 | 5,000,000 | 11,300,000 |
| ***3.12*** | ***Sub-Total - Earthworks/Groundworks*** | | | | ***97,150,157*** | | ***58,686,000*** | | ***46,180,000*** | ***202,016,157*** |
| | **Wharf Construction/Terminal Construction** | | | | | | | | | |
| 4.0 | Wharf Structure Type 1 - (Open piled structure 40 m wide) | $ 259,956 | m | 1,450 | 376,936,380 | 1,650 | 428,927,605 | 1,150 | 298,949,543 | 1,104,813,529 |
| 4.1 | Wharf Structure Type 2 - Tubular Piles with infill sheet pile wall tug harbour | $ 87,206 | m | - | - | - | - | - | - | - |
| 4.2 | Container Stacking Pavements | $ 222 | m2 | 539,400 | 119,487,888 | 613,800 | 135,968,976 | 427,800 | 94,766,256 | 350,223,120 |
| 4.3 | Pavement Type 1 - Heavy Duty | $ 156 | m2 | 139,200 | 21,701,280 | 158,400 | 24,694,560 | 110,400 | 17,211,360 | 63,607,200 |
| 4.4 | Pavement Type 2 - Light Duty | $ 139 | m2 | 17,400 | 2,411,640 | 19,800 | 2,744,280 | 13,800 | 1,912,680 | 7,068,600 |
| 4.5 | Pavement Type 3 - Gravel over balance - allowed as 200mm Crushed Rock | $ 35 | m2 | 174,000 | 6,090,000 | 198,000 | 6,930,000 | 138,000 | 4,830,000 | 17,850,000 |
| 4.6 | Main Services distribution (per phase) | $ 5,000,000 | Item | 1 | 5,000,000 | 1 | 5,000,000 | 1 | 5,000,000 | 15,000,000 |
| 4.7 | Main Lighting distribution (per phase) - Light towers on 100m x 100m Grids @ $250K per light tower | $ 25 | m2 | 870,000 | 21,750,000 | 990,000 | 24,750,000 | 690,000 | 17,250,000 | 63,750,000 |
| 4.8 | Site Fencing | $ 120 | m | 2,650 | 318,000 | 2,850 | 342,000 | 2,300 | 276,000 | 936,000 |
| 4.9 | Berth Infrastructure (Fenders, Bollards, Services and Connections etc.) | $ 11,146 | m | 1,450 | 16,162,159 | 1,650 | 18,391,423 | 1,150 | 12,818,264 | 47,371,846 |
| 4.10 | Cathodic Protection to Piles & Sheet piles | $ 4,808 | m | 1,450 | 6,971,600 | 1,650 | 7,933,200 | 1,150 | 5,529,200 | 20,434,000 |
| ***4.11*** | ***Sub-Total - Wharf Construction/Terminal Construction*** | | | | ***576,828,947*** | | ***655,682,044*** | | ***458,543,303*** | ***1,691,054,294*** |
| | **Bridges** | | | | | | | | | |
| 5.0 | Bridge Type 1 - Marine Connection | $ 65,479 | m | 100 | 6,547,858 | | - | | - | 6,547,858 |
| 5.1 | Bridge Type 2 - Rail Grade Separation elevated | $ 20,000,000 | No. | 4 | 80,000,000 | | - | | - | 80,000,000 |
| 5.2 | Bridge Type 3 - Road Grade Separation elevated | $ 30,000,000 | No. | 3 | 90,000,000 | | - | | - | 90,000,000 |
| 5.3 | Bridge Type 4 - Grade Separation (under Road/Rail) | $ 80,000,000 | No. | | - | | - | | - | - |
| 5.4 | Marine Causeway (including reclamation, rock & services trench) | $ 44,318 | m | - | - | | - | | - | - |
| 5.5 | | | | | - | | - | | - | - |
| ***5.6*** | ***Sub-Total - Bridges*** | | | | ***176,547,858*** | | ***-*** | | ***-*** | ***176,547,858*** |
| | **Rail/Roading** | | | | | | | | | |
| 6.0 | Rail Lines Type 1 at Grade no electrics | $ 1,500 | m | 19,000 | 28,500,000 | 9,000 | 13,500,000 | | - | 42,000,000 |
| 6.1 | Rail Lines Type 2 Elevated no electrics - Assume 1No. Pile every 20m @ $25K + $3k/m Beam + $750 track (Allowance $5k per m) | $ 5,750 | m | - | - | | - | | - | - |
| 6.2 | Rail Marshalling Yard | $ 128 | m2 | 1,250,000 | 159,419,000 | | - | | - | 159,419,000 |
| 6.3 | Roading Primary | $ 222 | m2 | 310,000 | 68,736,118 | | - | | - | 68,736,118 |
| 6.4 | Road Earthworks | $ 45 | m3 | - | - | | - | | - | - |
| 6.5 | Roading Culverts - Minor Services/drainage crossing 2000 x 1500 x 6m long Box culverts | $ 33,000 | No. | | - | | - | | - | - |
| 6.6 | Roading Culverts - Major Services/drainage crossing Bridge | $ 65,479 | m | - | - | | - | | - | - |
| 6.7 | Roading Culverts - Major Services WAG Pipeline crossing - $2m allowance | $ 2,000,000 | No. | 2 | 4,000,000 | | - | | - | 4,000,000 |
| 6.8 | Roading Secondary (Port Precinct) | $ 210 | m2 | 50,000 | 10,485,000 | 50,000 | 10,485,000 | | - | 20,970,000 |
| 6.9 | Rail Signalling | $ 2,000,000 | No. | 7 | 14,000,000 | | - | | - | 14,000,000 |
| 6.10 | Fueling Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.11 | Locomotive Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.12 | Train Crew Administration office & Facilities | $ 5,000,000 | No. | 1 | 5,000,000 | | - | | - | 5,000,000 |
| 6.13 | Rail Gantries | $ 15,000,000 | No. | 4 | 60,000,000 | | - | | - | 60,000,000 |
| 6.14 | Crossovers outside Marshalling Yard | $ 200,000 | No. | 36 | 7,200,000 | | - | | - | 7,200,000 |
| 6.15 | Major services Alterations & Protection (Road & Rail) | $ 10,000,000 | Item | 1 | 10,000,000 | | - | | - | 10,000,000 |
| ***6.2*** | ***Sub-Total - Rail/Roading*** | | | | ***397,340,118*** | | ***23,985,000*** | | ***-*** | ***421,325,118*** |
| | **Common Costs** | | | | | | | | | |
| 7.0 | Site Clearance (Provisional Sum) | $ 2,500,000 | Item | 1 | 2,500,000 | 1 | 2,500,000 | 1 | 2,500,000 | 7,500,000 |
| 7.1 | Clearing of Dense Vegetation 10% | $ 31 | m2 | 87,000 | 2,697,000 | 99,000 | 3,069,000 | 69,000 | 2,139,000 | 7,905,000 |
| 7.2 | Clearing of Medium Vegetation 20% | $ 4 | m2 | 174,000 | 696,000 | 198,000 | 792,000 | 138,000 | 552,000 | 2,040,000 |
| 7.3 | Clearing of Light Vegetation 70% | $ 3 | m2 | 609,000 | 1,827,000 | 693,000 | 2,079,000 | 483,000 | 1,449,000 | 5,355,000 |

*Port of Hastings Estimate Detail* 22/12/2016 WT PARTNERSHIP

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| | | | | Phase 1 - 3m TEU | | Phase 2 - 6m TEU | | Phase 3 - 9m TEU | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Ref No. | Item | Rate | Unit | Quantity | Total $ excl GST | Quantity | Total $ excl GST | Quantity | Total $ excl GST | Total $ excl GST |
| 7.4 | Topsoil/Trimming | $ 14 | m2 | 870,000 | 11,745,000 | 990,000 | 13,365,000 | 690,000 | 9,315,000 | 34,425,000 |
| 7.5 | Port Offices Workshops & Facilities | $ 10,480,000 | Item | 1 | 10,480,000 | 1 | 10,480,000 | 1 | 10,480,000 | 31,440,000 |
| 7.6 | Port Offices & Facilities (Fit-Out Component) | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.7 | Services - Trunk Connection (Allowance) | $ 7,250,000 | Item | 1 | 7,250,000 | - | - | - | - | 7,250,000 |
| 7.8 | Gate Complex and Truck Marshalling | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.9 | Navigation Aids | $ 18,000,000 | Item | 1 | 18,000,000 | 0.2 | 3,600,000 | 0.2 | 3,600,000 | 25,200,000 |
| *7.10* | ***Sub-Total - Common Costs*** | | | | ***59,515,000*** | | ***40,205,000*** | | ***34,355,000*** | ***134,075,000*** |
| **8.0** | ***Sub-Total - Direct Construction Cost -*** | | | | **1,309,277,876** | | **783,481,568** | | **539,078,303** | **2,631,837,747** |
| | **Contractor Overheads:** | | | | | | | | | |
| 9.0 | Contractors Preliminaries | 20 | % | | 261,855,575 | | 156,696,314 | | 107,815,661 | 526,367,549 |
| 9.1 | Contractors Profit and Offsite O/H | 8 | % | | 125,690,676 | | 75,214,231 | | 51,751,517 | 252,656,424 |
| **9.3** | ***Sub-Total - Contractor Overheads:*** | | | | **387,546,251** | | **231,910,544** | | **159,567,178** | **779,023,973** |
| **10.0** | **Sub-Total Estimated Construction Cost** | | | | **1,696,824,128** | | **1,015,392,112** | | **698,645,481** | **3,410,861,720** |
| | **Escalation:** | | | | | | | | | |
| 11 | Escalation N/A (Excluded) | 0.00 | % | - | - | - | - | - | - | - |
| **11.1** | **Sub-Total Escalation** | | | | **-** | | **-** | | **-** | **-** |
| **12.0** | **CONSTRUCTION COST AS AT DECEMBER 2016** | | | | **1,696,824,128** | | **1,015,392,112** | | **698,645,481** | **3,410,861,720** |
| | **Consultants Fees:** | | | | | | | | | |
| 13.1 | Design & Planning Fees | 8 | % | | 135,745,930 | | 81,231,369 | | 55,891,638 | 272,868,938 |
| 13.2 | Other Professional Fees | 2 | % | | 33,936,483 | | 20,307,842 | | 13,972,910 | 68,217,234 |
| 13.3 | Site Investigation | $ 25,000,000.00 | Item | 1 | 25,000,000 | | | | | 25,000,000 |
| **13.3** | **Sub-Total Consultants Fees** | | | | **194,682,413** | | **101,539,211** | | **69,864,548** | **366,086,172** |
| | **Contingencies:** | | | | | | | | | |
| 14.1 | Design Development Contingencies | 10 | % | | 169,682,413 | | 101,539,211 | | 69,864,548 | 341,086,172 |
| 14.2 | Construction Contingency | 10 | % | | 186,650,654 | | 111,693,132 | | 76,851,003 | 375,194,789 |
| **14.3** | **Sub-Total Contingencies** | | | | **356,333,067** | | **213,232,343** | | **146,715,551** | **716,280,961** |
| **15.0** | **Total Estimated Project Cost (Excl GST)** | | | | **2,247,839,607** | | **1,330,163,666** | | **915,225,580** | **4,493,228,854** |

Indicates Detailed Rate Build-up

***Port of Hastings Estimate Detail***

4/01/2017

WT PARTNERSHIP

| Ref No. | Item | Rate | Unit | Phase 1 - 3m TEU | | Phase 2 - 6m TEU | | Phase 3 - 9m TEU | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Quantity | Total $ excl GST | Quantity | Total $ excl GST | Quantity | Total $ excl GST | Total $ excl GST |
| | **Construction Costs:** | | | | | | | | | |
| | ***Direct Construction Cost -*** | | | | | | | | | |
| | **Demolition & Relocation** | | | | | | | | | |
| 1.0 | Demolition - Bluescope Jetty (Ro-Ro) | $ 2,100 | m2 | 903 | 1,895,796 | | - | | - | 1,895,796 |
| 1.1 | Demolition - Bluescope Jetty | $ 2,100 | m2 | | - | 2,107 | 4,423,524 | | - | 4,423,524 |
| 1.2 | Demolition of Miscellaneous Buidlings Allowance | $ 500,000 | | | - | 1 | 500,000 | | - | 500,000 |
| 1.3 | | | | | - | | - | | - | - |
| ***1.4*** | ***Sub-Total - Demolition & Relocation*** | | | | ***1,895,796*** | | ***4,923,524*** | | ***-*** | ***6,819,320*** |
| | | | | | 28% | | 72% | | 0% | |
| | **Dredging (Excluded Provided by GHD)** | | | | | | | | | |
| 2.0 | Dredging Clay Mobilisation/Demobilisation | $ - | Item | 1 | - | 1 | - | 1 | - | - |
| 2.1 | Dredging Sand Mobilisation/Demobilisation | $ - | Item | 1 | - | 1 | - | 1 | - | - |
| 2.2 | Environmental Monitoring | $ - | Item | 1 | - | 1 | - | 1 | - | - |
| 2.3 | Dredging (Sand) - Bunds/Permanent works | $ - | m3 | 6,820,000 | - | 4,370,000 | - | 6,725,000 | - | - |
| 2.4 | Dredging (Clay/silts for disposal) | $ - | m3 | 9,644,000 | - | 13,030,000 | - | 6,500,000 | - | - |
| ***2.5*** | ***Sub-Total - Dredging (Excluded Provided by GHD)*** | | | | ***-*** | | ***-*** | | ***-*** | ***-*** |
| | **Earthworks/Groundworks** | | | | | | | | | |
| 3.0 | Land Reclamation (included in Dredging above) | | Note | | | | | | | |
| 3.1 | Land Reclamation Imported Fill | $ - | m3 | - | - | - | - | - | - | - |
| 3.2 | Ground Improvement Mobilisation | $ 350,000 | No. | 2 | 700,000 | 2 | 700,000 | 2 | 700,000 | 2,100,000 |
| 3.3 | Ground Improvement Type 1 - Vibro Compaction land based - 2m grid (+5 to -15m), 20m deep overall | $ 45 | m2 | 72,500 | 3,262,500 | 990,000 | 44,550,000 | 690,000 | 31,050,000 | 78,862,500 |
| 3.4 | Ground Improvement Type 2 - Vertical Wick Drains (Tyabb) - 1.2m grid x 20m deep | $ 42 | m2 | 797,500 | 33,391,657 | - | - | - | - | 33,391,657 |
| 3.5 | Safety bund at Esso | $ 15 | m3 | 360,000 | 5,400,000 | - | - | - | - | 5,400,000 |
| 3.6 | Temporary Surface stabilisation (Grass Unused land) | $ 2 | m2 | 870,000 | 1,740,000 | 990,000 | 1,980,000 | 690,000 | 1,380,000 | 5,100,000 |
| 3.7 | Temporary Stormwater Drainage (during Reclamation - Allowance 10No. Humeceptors incl. Connections/piping) | $ 2,000,000 | Item | 1 | 2,000,000 | 1 | 2,000,000 | 1 | 2,000,000 | 6,000,000 |
| 3.8 | Surcharge Earthworks (moving Material to the next phase) | $ 12 | m3 | 3,500,000 | 42,000,000 | - | - | - | - | 42,000,000 |
| 3.9 | Temporary Edge Protection Ground Mattress - 15m length x 0.35m thick | $ 5,260 | m | 600 | 3,156,000 | 600 | 3,156,000 | - | - | 6,312,000 |
| 3.10 | Rock Armour Type 1 - Southern/Northern Face | $ 110 | t | 50,000 | 5,500,000 | - | - | 55,000 | 6,050,000 | 11,550,000 |
| 3.11 | Rock Armour Type 2 - Landward Face | $ 100 | t | - | - | 63,000 | 6,300,000 | 50,000 | 5,000,000 | 11,300,000 |
| ***3.12*** | ***Sub-Total - Earthworks/Groundworks*** | | | | ***97,150,157*** | | ***58,686,000*** | | ***46,180,000*** | ***202,016,157*** |
| | | | | | 48% | | 29% | | 23% | |
| | **Wharf Construction/Terminal Construction** | | | | | | | | | |
| 4.0 | Wharf Structure Type 1 - (Open piled structure 40 m wide) | $ 259,956 | m | 1,450 | 376,936,380 | 1,650 | 428,927,605 | 1,150 | 298,949,543 | 1,104,813,529 |
| 4.1 | Wharf Structure Type 2 - Tubular Piles with infill sheet pile wall tug harbour | $ 87,206 | m | - | - | - | - | - | - | - |
| 4.2 | Container Stacking Pavements | $ 222 | m2 | 539,400 | 119,487,888 | 613,800 | 135,968,976 | 427,800 | 94,766,256 | 350,223,120 |
| 4.3 | Pavement Type 1 - Heavy Duty | $ 156 | m2 | 139,200 | 21,701,280 | 158,400 | 24,694,560 | 110,400 | 17,211,360 | 63,607,200 |
| 4.4 | Pavement Type 2 - Light Duty | $ 139 | m2 | 17,400 | 2,411,640 | 19,800 | 2,744,280 | 13,800 | 1,912,680 | 7,068,600 |
| 4.5 | Pavement Type 3 - Gravel over balance - allowed as 200mm Crushed Rock | $ 35 | m2 | 174,000 | 6,090,000 | 198,000 | 6,930,000 | 138,000 | 4,830,000 | 17,850,000 |
| 4.6 | Main Services distribution (per phase) | $ 5,000,000 | Item | 1 | 5,000,000 | 1 | 5,000,000 | 1 | 5,000,000 | 15,000,000 |
| 4.7 | Main Lighting distribution (per phase) - Light towers on 100m x 100m Grids @ $250K per light tower | $ 25 | m2 | 870,000 | 21,750,000 | 990,000 | 24,750,000 | 690,000 | 17,250,000 | 63,750,000 |
| 4.8 | Site Fencing | $ 120 | m | 2,650 | 318,000 | 2,850 | 342,000 | 2,300 | 276,000 | 936,000 |
| 4.9 | Berth Infrastructure (Fenders, Bollards, Services and Connections etc.) | $ 11,146 | m | 1,450 | 16,162,159 | 1,650 | 18,391,423 | 1,150 | 12,818,264 | 47,371,846 |
| 4.10 | Cathodic Protection to Piles & Sheet piles | $ 4,808 | m | 1,450 | 6,971,600 | 1,650 | 7,933,200 | 1,150 | 5,529,200 | 20,434,000 |
| ***4.11*** | ***Sub-Total - Wharf Construction/Terminal Construction*** | | | | ***576,828,947*** | | ***655,682,044*** | | ***458,543,303*** | ***1,691,054,294*** |
| | | | | | 34% | | 39% | | 27% | |
| | **Bridges** | | | | | | | | | |
| 5.0 | Bridge Type 1 - Marine Connection | $ 65,479 | m | 100 | 6,547,858 | | - | | - | 6,547,858 |
| 5.1 | Bridge Type 2 - Rail Grade Separation elevated | $ 20,000,000 | No. | 4 | 80,000,000 | | - | | - | 80,000,000 |
| 5.2 | Bridge Type 3 - Road Grade Separation elevated | $ 30,000,000 | No. | 3 | 90,000,000 | | - | | - | 90,000,000 |
| 5.3 | Bridge Type 4 - Grade Separation (under Road/Rail) | $ 80,000,000 | No. | | - | | - | | - | - |
| 5.4 | Marine Causeway (including reclamation, rock & services trench) | $ 44,318 | m | - | - | | - | | - | - |
| 5.5 | | | | | - | | - | | - | - |
| ***5.6*** | ***Sub-Total - Bridges*** | | | | ***176,547,858*** | | ***-*** | | ***-*** | ***176,547,858*** |
| | | | | | 100% | | 0% | | 0% | |
| | **Rail/Roading** | | | | | | | | | |
| 6.0 | Rail Lines Type 1 at Grade no electrics | $ 1,500 | m | 19,000 | 28,500,000 | 9,000 | 13,500,000 | | - | 42,000,000 |
| 6.1 | Rail Lines Type 2 Elevated no electrics - Assume 1No. Pile every 20m @ $25K + $3k/m Beam + $750 track (Allowance $5k per m) | $ 5,750 | m | - | - | | - | | - | - |
| 6.2 | Rail Marshalling Yard | $ 128 | m2 | 1,250,000 | 159,419,000 | | - | | - | 159,419,000 |
| 6.3 | Roading Primary | $ 222 | m2 | 310,000 | 68,736,118 | | - | | - | 68,736,118 |
| 6.4 | Road Earthworks | $ 45 | m3 | - | - | | - | | - | - |
| 6.5 | Roading Culverts - Minor Services/drainage crossing 2000 x 1500 x 6m long Box culverts | $ 33,000 | No. | | - | | - | | - | - |
| 6.6 | Roading Culverts - Major Services/drainage crossing Bridge | $ 65,479 | m | - | - | | - | | - | - |
| 6.7 | Roading Culverts - Major Services WAG Pipeline crossing - $2m allowance | $ 2,000,000 | No. | 2 | 4,000,000 | | - | | - | 4,000,000 |
| 6.8 | Roading Secondary (Port Precinct) | $ 210 | m2 | 50,000 | 10,485,000 | 50,000 | 10,485,000 | | - | 20,970,000 |
| 6.9 | Rail Signalling | $ 2,000,000 | No. | 7 | 14,000,000 | | - | | - | 14,000,000 |
| 6.10 | Fueling Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.11 | Locomotive Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.12 | Train Crew Administration office & Facilities | $ 5,000,000 | No. | 1 | 5,000,000 | | - | | - | 5,000,000 |
| 6.13 | Rail Gantries | $ 15,000,000 | No. | 4 | 60,000,000 | | - | | - | 60,000,000 |
| 6.14 | Crossovers outside Marshalling Yard | $ 200,000 | No. | 36 | 7,200,000 | | - | | - | 7,200,000 |
| 6.15 | Major services Alterations & Protection (Road & Rail) | $ 10,000,000 | Item | 1 | 10,000,000 | | - | | - | 10,000,000 |
| ***6.2*** | ***Sub-Total - Rail/Roading*** | | | | ***397,340,118*** | | ***23,985,000*** | | ***-*** | ***421,325,118*** |
| | | | | | 94% | | 6% | | 0% | |
| | **Common Costs** | | | | | | | | | |
| 7.0 | Site Clearance (Provisional Sum) | $ 2,500,000 | Item | 1 | 2,500,000 | 1 | 2,500,000 | 1 | 2,500,000 | 7,500,000 |
| 7.1 | Clearing of Dense Vegetation 10% | $ 31 | m2 | 87,000 | 2,697,000 | 99,000 | 3,069,000 | 69,000 | 2,139,000 | 7,905,000 |
| 7.2 | Clearing of Medium Vegetation 20% | $ 4 | m2 | 174,000 | 696,000 | 198,000 | 792,000 | 138,000 | 552,000 | 2,040,000 |
| 7.3 | Clearing of Light Vegetation 70% | $ 3 | m2 | 609,000 | 1,827,000 | 693,000 | 2,079,000 | 483,000 | 1,449,000 | 5,355,000 |
| 7.4 | Topsoil/Trimming | $ 14 | m2 | 870,000 | 11,745,000 | 990,000 | 13,365,000 | 690,000 | 9,315,000 | 34,425,000 |
| 7.5 | Port Offices Workshops & Facilities | $ 10,480,000 | Item | 1 | 10,480,000 | 1 | 10,480,000 | 1 | 10,480,000 | 31,440,000 |
| 7.6 | Port Offices & Facilities (Fit-Out Component) | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.7 | Services - Trunk Connection (Allowance) | $ 7,250,000 | Item | 1 | 7,250,000 | - | - | - | - | 7,250,000 |
| 7.8 | Gate Complex and Truck Marshalling | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.9 | Navigation Aids | $ 18,000,000 | Item | 1 | 18,000,000 | 0.2 | 3,600,000 | 0.2 | 3,600,000 | 25,200,000 |
| ***7.10*** | ***Sub-Total - Common Costs*** | | | | ***59,515,000*** | | ***40,205,000*** | | ***34,355,000*** | ***134,075,000*** |
| | | | | | 44% | | 30% | | 26% | |
| **8.0** | ***Sub-Total - Direct Construction Cost -*** | | | | **1,309,277,876** | | **783,481,568** | | **539,078,303** | **2,631,837,747** |
| | | | | | 1,307,382,080 | | | | | |
| | **Contractor Overheads:** | | | | | | | | | |
| 9.0 | Contractors Preliminaries | 20 | % | | 261,855,575 | | 156,696,314 | | 107,815,661 | 526,367,549 |
| 9.1 | Contractors Profit and Offsite O/H | 8 | % | | 125,690,676 | | 75,214,231 | | 51,751,517 | 252,656,424 |
| **9.3** | ***Sub-Total - Contractor Overheads:*** | | | | **387,546,251** | | **231,910,544** | | **159,567,178** | **779,023,973** |
| | | | | | 50% | | 30% | | 20% | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **10.0** | **Sub-Total Estimated Construction Cost** | | | | **1,696,824,128** | | **1,015,392,112** | | **698,645,481** | **3,410,861,720** |
| | | | | | 1,696,824,128 | | | | | |
| | **Escalation:** | | | | | | | | | |
| 11 | Escalation N/A (Excluded) | 0.00 | % | - | - | - | - | - | - | - |
| **11.1** | **Sub-Total Escalation** | | | | **-** | | **-** | | **-** | **-** |
| | | | | | | | | | | |
| **12.0** | **CONSTRUCTION COST AS AT DECEMBER 2016** | | | | **1,696,824,128** | | **1,015,392,112** | | **698,645,481** | **3,410,861,720** |
| | **Consultants Fees:** | | | | | | | | | |
| 13.1 | Design & Planning Fees | 8 | % | | 135,745,930 | | 81,231,369 | | 55,891,638 | 272,868,938 |
| 13.2 | Other Professional Fees | 2 | % | | 33,936,483 | | 20,307,842 | | 13,972,910 | 68,217,234 |
| 13.3 | Site Investigation | $ 25,000,000.00 | Item | 1 | 25,000,000 | | | | | 25,000,000 |
| **13.3** | **Sub-Total Consultants Fees** | | | | **194,682,413** | | **101,539,211** | | **69,864,548** | **366,086,172** |
| | | | | | 53% | | 28% | | 19% | |
| | **Contingencies:** | | | | | | | | | |
| 14.1 | Design Development Contingencies | 10 | % | | 169,682,413 | | 101,539,211 | | 69,864,548 | 341,086,172 |
| 14.2 | Construction Contingency | 10 | % | | 186,650,654 | | 111,693,132 | | 76,851,003 | 375,194,789 |
| **14.3** | **Sub-Total Contingencies** | | | | **356,333,067** | | **213,232,343** | | **146,715,551** | **716,280,961** |
| | | | | | 50% | | 30% | | 20% | |
| **15.0** | **Total Estimated Project Cost (Excl GST)** | | | | **2,247,839,607** | | **1,330,163,666** | | **915,225,580** | **4,493,228,854** |

**Bay West Estimate Detail - 18,000 TEU vessel** 4/01/2017 WT PARTNERSHIP

| Ref No. | Item | Rate | Unit | Phase 1 - 3m TEU Quantity | Phase 1 - 3m TEU Total $ excl GST | Phase 2 - 6m TEU Quantity | Phase 2 - 6m TEU Total $ excl GST | Phase 3 - 9m TEU Quantity | Phase 3 - 9m TEU Total $ excl GST | Total Total $ excl GST |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Construction Costs:** | | | | | | | | | |
| | ***Direct Construction Cost -*** | | | | | | | | | |
| | **Demolition & Relocation** | | | | | | | | | |
| 1.0 | | $ - | Item | - | - | | - | | - | - |
| 1.1 | | | | | | | - | | - | - |
| 1.2 | | | | | | | - | | - | - |
| 1.3 | | | | | | | - | | - | - |
| ***1.4*** | ***Sub-Total - Demolition & Relocation*** | | | | **-** | | **-** | | **-** | **-** |
| | **Dredging (Excluded Provided by GHD)** | | | | | | | | | |
| 2.0 | Dredging Clay Mobilisation/Demobilisation | $ - | Item | 1 | - | | - | | - | - |
| 2.1 | Dredging Sand Mobilisation/Demobilisation | $ - | Item | 1 | - | | - | | - | - |
| 2.2 | Environmental Monitoring | $ - | Item | 1 | - | | - | | - | - |
| 2.3 | Dredging (Sand) - Bunds/Permanent works | $ - | m3 | | - | | - | | - | - |
| 2.4 | Dredging (Sand) - Surcharge Material | $ - | m3 | | - | | - | | - | - |
| 2.5 | Dredging (Clay) | $ - | m3 | | - | | - | | - | - |
| ***2.6*** | ***Sub-Total - Dredging (Excluded Provided by GHD)*** | | | | **-** | | **-** | | **-** | **-** |
| | **Earthworks/Groundworks** | | | | | | | | | |
| 3.0 | Land Reclamation (included in Dredging above) | | Note | | | | | | | |
| 3.1 | Land Reclamation Imported Fill | $ - | m3 | - | - | - | - | - | - | - |
| 3.2 | Ground Improvement Mobilisation | $ 350,000 | No. | 2 | 700,000 | 2 | 700,000 | 2 | 700,000 | 2,100,000 |
| 3.3 | Ground Improvement Type 1 - Vibro Compaction land based - 2m grid (+5 to -15m), 20m deep overall | $ 45 | m2 | 170,000 | 7,650,000 | 135,000 | 6,075,000 | 155,000 | 6,975,000 | 20,700,000 |
| 3.4 | Ground Improvement Type 2 - Vertical Wick Drains - 1.2m grid x 20m deep | $ 42 | m2 | 700,000 | 29,309,292 | 675,000 | 28,262,531 | 625,000 | 26,169,010 | 83,740,833 |
| 3.5 | Temporary Surface stabilisation (Grass Unused land) | $ 2 | m2 | 870,000 | 1,740,000 | 810,000 | 1,620,000 | 780,000 | 1,560,000 | 4,920,000 |
| 3.6 | Temporary Stormwater Drainage (during Reclamation - Allowance 10No. Humeceptors incl. Connections/piping) | $ 2,000,000 | Item | 1 | 2,000,000 | 1 | 2,000,000 | 1 | 2,000,000 | 6,000,000 |
| 3.7 | Surcharge Earthworks (moving Material to the next phase) | $ 12 | m3 | - | - | 5,655,000 | 67,860,000 | 2,730,000 | 32,760,000 | 100,620,000 |
| 3.8 | Temporary Edge Protection Ground Mattress - 15m length x 0.35m thick | $ 5,260 | m | 2,650 | 13,939,000 | - | - | - | - | 13,939,000 |
| 3.9 | Rock Armour Type 1 - Western Face | $ 110 | t | 55,000 | 6,050,000 | - | - | - | - | 6,050,000 |
| 3.10 | Rock Armour Type 2 - Eastern Face | $ 110 | t | 55,000 | 6,050,000 | - | - | - | - | 6,050,000 |
| 3.11 | Rock Armour Type 1 - Northern Face | $ 100 | t | 190,000 | 19,000,000 | - | - | - | - | 19,000,000 |
| ***3.12*** | ***Sub-Total - Earthworks/Groundworks*** | | | | ***86,438,292*** | | ***106,517,531*** | | ***70,164,010*** | ***263,119,833*** |
| | | | | | 33% | | 40% | | 27% | |
| | **Wharf Construction/Terminal Construction** | | | | | | | | | |
| 4.0 | Wharf Structure Type 1 - (Open piled structure 40 m wide) | $ 259,956 | m | 1,450 | 376,936,380 | 1,350 | 350,940,768 | 1,300 | 337,942,962 | 1,065,820,110 |
| 4.1 | Wharf Structure Type 2 - Tubular Piles with infill sheet pile wall tug harbour | $ 87,206 | m | 100 | 8,720,601 | - | - | - | - | 8,720,601 |
| 4.2 | Container Stacking Pavements | $ 222 | m2 | 539,400 | 119,487,888 | 502,200 | 111,247,344 | 483,600 | 107,127,072 | 337,862,304 |
| 4.3 | Pavement Type 1 - Heavy Duty | $ 156 | m2 | 139,200 | 21,701,280 | 129,600 | 20,204,640 | 124,800 | 19,456,320 | 61,362,240 |
| 4.4 | Pavement Type 2 - Light Duty | $ 139 | m2 | 17,400 | 2,411,640 | 16,200 | 2,245,320 | 15,600 | 2,162,160 | 6,819,120 |
| 4.5 | Pavement Type 3 - Gravel over balance - allowed as 200mm Crushed Rock | $ 35 | m2 | 174,000 | 6,090,000 | 162,000 | 5,670,000 | 156,000 | 5,460,000 | 17,220,000 |
| 4.6 | Main Services distribution (per phase) | $ 5,000,000 | Item | 1 | 5,000,000 | 1 | 5,000,000 | 1 | 5,000,000 | 15,000,000 |
| 4.7 | Main Lighting distribution (per phase) - Light towers on 100m x 100m Grids @ $250K per light tower | $ 25 | m2 | 870,000 | 21,750,000 | 810,000 | 20,250,000 | 780,000 | 19,500,000 | 61,500,000 |
| 4.8 | Site Fencing | $ 120 | m | 2,650 | 318,000 | 2,250 | 270,000 | 2,500 | 300,000 | 888,000 |
| 4.9 | Berth Infrastructure (Fenders, Bollards, Services and Connections etc.) | $ 11,146 | m | 1,450 | 16,162,159 | 1,350 | 15,047,528 | 1,300 | 14,490,212 | 45,699,898 |
| 4.10 | Cathodic Protection to Piles & Sheet piles | $ 4,808 | m | 1,450 | 6,971,600 | 1,350 | 6,490,800 | 1,300 | 6,250,400 | 19,712,800 |
| ***4.11*** | ***Sub-Total - Wharf Construction/Terminal Construction*** | | | | ***585,549,548*** | | ***537,366,399*** | | ***517,689,125*** | ***1,640,605,073*** |
| | | | | | 35.7% | | 32.8% | | 31.6% | |
| | **Bridges** | | | | | | | | | |
| 5.0 | Bridge Type 1 - Marine Connection | $ 65,479 | m | 2,500 | 163,696,447 | | - | | - | 163,696,447 |
| 5.1 | Bridge Type 2 - Rail Grade Separation elevated | $ 20,000,000 | No. | 4 | 80,000,000 | | - | | - | 80,000,000 |
| 5.2 | Bridge Type 3 - Road Grade Separation elevated | $ 30,000,000 | No. | 1 | 30,000,000 | | - | | - | 30,000,000 |
| 5.3 | Bridge Type 4 - Grade Separation (under Road/Rail) | $ 80,000,000 | No. | 1 | 80,000,000 | | - | | - | 80,000,000 |
| 5.4 | Marine Causeway (including reclamation, rock & services trench) | $ 44,318 | m | 250 | 11,079,600 | | - | | - | 11,079,600 |
| 5.5 | | | | | - | | - | | - | - |
| 5.6 | | | | | - | | - | | - | - |
| ***5.7*** | ***Sub-Total - Bridges*** | | | | ***364,776,047*** | | **-** | | **-** | ***364,776,047*** |
| | | | | | 100% | | 0% | | 0% | |
| | **Rail/Roading** | | | | | | | | | |
| 6.0 | Rail Lines Type 1 at Grade no electrics | $ 1,500 | m | 9,000 | 13,500,000 | 9,000 | 13,500,000 | 5,000 | 7,500,000 | 34,500,000 |
| 6.1 | Rail Lines Type 2 Elevated no electrics - Assume 1No. Pile every 20m @ $25K + $3k/m Beam + $1500 track (Allowance $5k per m) | $ 5,750 | m | 13,300 | 76,475,000 | | - | | - | 76,475,000 |
| 6.2 | Rail Marshalling Yard | $ 128 | m2 | 750,000 | 95,651,400 | - | - | | - | 95,651,400 |
| 6.3 | Roading Primary | $ 222 | m2 | 600,000 | 133,037,647 | | - | | - | 133,037,647 |
| 6.4 | Road Earthworks | $ 45 | m3 | 678,900 | 30,550,500 | | - | | - | 30,550,500 |
| 6.5 | Roading Culverts - Minor Services/drainage crossing 2000 x 1500 x 6m long Box culverts | $ 33,000 | No. | 13 | 429,000 | | - | | - | 429,000 |
| 6.6 | Roading Culverts - Minor Services/drainage crossing 2000 x 1500 x 180m long Box culverts | $ 990,000 | | 7 | 6,930,000 | | - | | - | 6,930,000 |
| 6.7 | Roading Culverts - Major Services/drainage crossing Bridge | $ 65,479 | m | 130 | 8,512,215 | | - | | - | 8,512,215 |
| 6.8 | Roading Secondary (Port Precinct) | $ 210 | m2 | 50,000 | 10,485,000 | | - | | - | 10,485,000 |
| 6.9 | Rail Signalling | $ 2,000,000 | No. | 7 | 14,000,000 | | - | | - | 14,000,000 |
| 6.10 | Fueling Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.11 | Locomotive Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.12 | Train Crew Administration office & Facilities | $ 5,000,000 | No. | 1 | 5,000,000 | | - | | - | 5,000,000 |
| 6.13 | Crossovers outside Marshalling Yard | $ 200,000 | No. | 4 | 800,000 | | - | | - | 800,000 |
| 6.14 | Major services Alterations & Protections (Road & Rail) | $ 10,000,000 | Item | 1 | 10,000,000 | | - | | - | 10,000,000 |
| ***6.15*** | ***Sub-Total - Rail/Roading*** | | | | ***435,370,762*** | | ***13,500,000*** | | ***7,500,000*** | ***456,370,762*** |
| | | | | | 95% | | 3% | | 2% | |
| | **Common Costs** | | | | | | | | | |
| 7.0 | Site Clearance (Provisional Sum) | $ 2,500,000 | Item | 1 | 2,500,000 | 1 | 2,500,000 | 1 | 2,500,000 | 7,500,000 |
| 7.1 | Clearing of Dense Vegetation | $ 31 | m2 | - | - | - | - | - | - | - |
| 7.2 | Clearing of Medium Vegetation | $ 4 | m2 | - | - | - | - | - | - | - |
| 7.3 | Clearing of Light Vegetation | $ 3 | m2 | 1,200,000 | 3,600,000 | 870,000 | 2,610,000 | 810,000 | 2,430,000 | 8,640,000 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.4 | Topsoil/Trimming | $ 14 | m2 | 1,200,000 | 16,200,000 | - | - | - | - | 16,200,000 |
| 7.5 | Port Offices Workshops & Facilities | $ 10,480,000 | Item | 1 | 10,480,000 | 1 | 10,480,000 | 1 | 10,480,000 | 31,440,000 |
| 7.6 | Port Offices & Facilities (Fit-Out Component) | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.7 | Services - Trunk Connection (Allowance) | $ 7,250,000 | Item | 1 | 7,250,000 | - | - | - | - | 7,250,000 |
| 7.8 | Gate Complex and Truck Marshalling | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.9 | Navigation Aids | $ 18,000,000 | Item | 1 | 18,000,000 | 0.2 | 3,600,000 | 0.2 | 3,600,000 | 25,200,000 |
| ***7.10*** | ***Sub-Total - Common Costs*** | | | | ***62,350,000*** | | ***23,510,000*** | | ***23,330,000*** | ***109,190,000*** |
| | | | | | 57% | | 22% | | 21% | |
| **8.0** | ***Sub-Total - Direct Construction Cost -*** | | | | **1,534,484,650** | | **680,893,931** | | **618,683,136** | **2,834,061,716** |
| | **Contractor Overheads:** | | | | | | | | | |
| 9.0 | Contractors Preliminaries | 20% | % | | 306,896,930 | | 136,178,786 | | 123,736,627 | 566,812,343.19 |
| 9.1 | Contractors Profit and Offsite O/H | 8% | % | | 147,310,526.36 | | 65,365,817.34 | | 59,393,581.03 | 272,069,925 |
| **9.3** | ***Sub-Total - Contractor Overheads:*** | | | | **454,207,456** | | **201,544,603** | | **183,130,208** | **838,882,268** |
| | | | | | 54.1% | | 24.0% | | 21.8% | |
| **10.0** | **Sub-Total Estimated Construction Cost** | | | | **1,988,692,106** | | **882,438,534** | | **801,813,344** | **3,672,943,984** |
| | **Escalation:** | | | | | | | | | |
| 11 | Escalation N/A (Excluded) | 0.00 | % | - | - | - | - | - | - | - |
| **11.1** | **Sub-Total Escalation** | | | | **-** | | **-** | | **-** | **-** |
| **12.0** | **CONSTRUCTION COST AS AT DECEMBER 2016** | | | | **1,988,692,106** | | **882,438,534** | | **801,813,344** | **3,672,943,984** |
| | **Consultants Fees:** | | | | | | | | | |
| 13.1 | Design & Planning Fees | 8% | % | | 159,095,368.47 | | 70,595,082.73 | | 64,145,067.51 | 293,835,519 |
| 13.2 | Other Professional Fees | 2% | % | | 39,773,842.12 | | 17,648,770.68 | | 16,036,266.88 | 73,458,880 |
| 13.3 | Site Investigation | $ 25,000,000 | Item | 1 | 25,000,000 | | | | | 25,000,000 |
| **13.3** | **Sub-Total Consultants Fees** | | | | **223,869,211** | | **88,243,853** | | **80,181,334** | **392,294,398** |
| | | | | | 57% | | 22% | | 20% | |
| | **Contingencies:** | | | | | | | | | |
| 14.1 | Design Development Contingencies | 10% | % | | 198,869,210.58 | | 88,243,853.41 | | 80,181,334.39 | 367,294,398 |
| 14.2 | Construction Contingency | 10% | % | | 218,756,131.64 | | 97,068,238.75 | | 88,199,467.83 | 404,023,838 |
| **14.3** | **Sub-Total Contingencies** | | | | **417,625,342** | | **185,312,092** | | **168,380,802** | **771,318,237** |
| | | | | | 54% | | 24% | | 22% | |
| **15.0** | **Total Estimated Project Cost (Excl GST)** | | | | **2,630,186,659** | | **1,155,994,480** | | **1,050,375,481** | **4,836,556,619** |

***Bay West Estimate Detail - 14,000 TEU vessel*** 4/01/2017 WT PARTNERSHIP

| | | | | Phase 1 - 3m TEU | | Phase 2 - 6m TEU | | Phase 3 - 9m TEU | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ref No.** | **Item** | **Rate** | **Unit** | **Quantity** | **Total $ excl GST** | **Quantity** | **Total $ excl GST** | **Quantity** | **Total $ excl GST** | **Total $ excl GST** |
| | **Construction Costs:** | | | | | | | | | |
| | ***Direct Construction Cost -*** | | | | | | | | | |
| | **Demolition & Relocation** | | | | | | | | | |
| 1.0 | | $ - | Item | - | - | | - | | - | - |
| 1.1 | | | | | | | - | | - | - |
| 1.2 | | | | | | | - | | - | - |
| 1.3 | | | | | | | - | | - | - |
| ***1.4*** | ***Sub-Total - Demolition & Relocation*** | | | | **-** | | **-** | | **-** | **-** |
| | **Dredging (Excluded Provided by GHD)** | | | | | | | | | |
| 2.0 | Dredging Clay Mobilisation/Demobilisation | $ - | Item | 1 | - | | - | | - | - |
| 2.1 | Dredging Sand Mobilisation/Demobilisation | $ - | Item | 1 | - | | - | | - | - |
| 2.2 | Environmental Monitoring | $ - | Item | 1 | - | | - | | - | - |
| 2.3 | Dredging (Sand) - Bunds/Permanent works | $ - | m3 | 2,200,000 | - | | - | | - | - |
| 2.4 | Dredging (Sand) - Surcharge Material | $ - | m3 | 8,300,000 | - | | - | | - | - |
| 2.5 | Dredging (Clay) | $ - | m3 | 20,000,000 | - | | - | | - | - |
| ***2.6*** | ***Sub-Total - Dredging (Excluded Provided by GHD)*** | | | | **-** | | **-** | | **-** | **-** |
| | **Earthworks/Groundworks** | | | | | | | | | |
| 3.0 | Land Reclamation (included in Dredging above) | | Note | | | | | | | |
| 3.1 | Land Reclamation Imported Fill | $ - | m3 | - | - | - | - | - | - | - |
| 3.2 | Ground Improvement Mobilisation | $ 350,000 | No. | 2 | 700,000 | 2 | 700,000 | 2 | 700,000 | 2,100,000 |
| 3.3 | Ground Improvement Type 1 - Vibro Compaction land based - 2m grid (+5 to -15m), 20m deep overall | $ 45 | m2 | 170,000 | 7,650,000 | 135,000 | 6,075,000 | 155,000 | 6,975,000 | 20,700,000 |
| 3.4 | Ground Improvement Type 2 - Vertical Wick Drains - 1.2m grid x 20m deep | $ 42 | m2 | 700,000 | 29,309,292 | 675,000 | 28,262,531 | 625,000 | 26,169,010 | 83,740,833 |
| 3.5 | Temporary Surface stabilisation (Grass Unused land) | $ 2 | m2 | 870,000 | 1,740,000 | 810,000 | 1,620,000 | 780,000 | 1,560,000 | 4,920,000 |
| 3.6 | Temporary Stormwater Drainage (during Reclamation - Allowance 10No. Humeceptors incl. Connections/piping) | $ 2,000,000 | Item | 1 | 2,000,000 | 1 | 2,000,000 | 1 | 2,000,000 | 6,000,000 |
| 3.7 | Surcharge Earthworks (moving Material to the next phase) | $ 12 | m3 | - | - | 5,655,000 | 67,860,000 | 2,730,000 | 32,760,000 | 100,620,000 |
| 3.8 | Temporary Edge Protection Ground Mattress - 15m length x 0.35m thick | $ 5,260 | m | 2,650 | 13,939,000 | - | - | - | - | 13,939,000 |
| 3.9 | Rock Armour Type 1 - Western Face | $ 110 | t | 50,000 | 5,500,000 | - | - | - | - | 5,500,000 |
| 3.10 | Rock Armour Type 2 - Eastern Face | $ 110 | t | 50,000 | 5,500,000 | - | - | - | - | 5,500,000 |
| 3.11 | Rock Armour Type 1 - Northern Face | $ 100 | t | 175,000 | 17,500,000 | - | - | - | - | 17,500,000 |
| ***3.12*** | ***Sub-Total - Earthworks/Groundworks*** | | | | ***83,838,292*** | | ***106,517,531*** | | ***70,164,010*** | ***260,519,833*** |
| | | | | | 32% | | 41% | | 27% | |
| | **Wharf Construction/Terminal Construction** | | | | | | | | | |
| 4.0 | Wharf Structure Type 1 - (Open piled structure 40 m wide) | $ 259,956 | m | 1,450 | 376,936,380 | 1,350 | 350,940,768 | 1,300 | 337,942,962 | 1,065,820,110 |
| 4.1 | Wharf Structure Type 2 - Tubular Piles with infill sheet pile wall tug harbour | $ 87,206 | m | 100 | 8,720,601 | - | - | - | - | 8,720,601 |
| 4.2 | Container Stacking Pavements | $ 222 | m2 | 539,400 | 119,487,888 | 502,200 | 111,247,344 | 483,600 | 107,127,072 | 337,862,304 |
| 4.3 | Pavement Type 1 - Heavy Duty | $ 156 | m2 | 139,200 | 21,701,280 | 129,600 | 20,204,640 | 124,800 | 19,456,320 | 61,362,240 |
| 4.4 | Pavement Type 2 - Light Duty | $ 139 | m2 | 17,400 | 2,411,640 | 16,200 | 2,245,320 | 15,600 | 2,162,160 | 6,819,120 |
| 4.5 | Pavement Type 3 - Gravel over balance - allowed as 200mm Crushed Rock | $ 35 | m2 | 174,000 | 6,090,000 | 162,000 | 5,670,000 | 156,000 | 5,460,000 | 17,220,000 |
| 4.6 | Main Services distribution (per phase) | $ 5,000,000 | Item | 1 | 5,000,000 | 1 | 5,000,000 | 1 | 5,000,000 | 15,000,000 |
| 4.7 | Main Lighting distribution (per phase) - Light towers on 100m x 100m Grids @ $250K per light tower | $ 25 | m2 | 870,000 | 21,750,000 | 810,000 | 20,250,000 | 780,000 | 19,500,000 | 61,500,000 |
| 4.8 | Site Fencing | $ 120 | m | 2,650 | 318,000 | 2,250 | 270,000 | 2,500 | 300,000 | 888,000 |
| 4.9 | Berth Infrastructure (Fenders, Bollards, Services and Connections etc.) | $ 11,146 | m | 1,450 | 16,162,159 | 1,350 | 15,047,528 | 1,300 | 14,490,212 | 45,699,898 |
| 4.10 | Cathodic Protection to Piles & Sheet piles | $ 4,808 | m | 1,450 | 6,971,600 | 1,350 | 6,490,800 | 1,300 | 6,250,400 | 19,712,800 |
| ***4.11*** | ***Sub-Total - Wharf Construction/Terminal Construction*** | | | | ***585,549,548*** | | ***537,366,399*** | | ***517,689,125*** | ***1,640,605,073*** |
| | | | | | 35.7% | | 32.8% | | 31.6% | |
| | **Bridges** | | | | | | | | | |
| 5.0 | Bridge Type 1 - Marine Connection | $ 65,479 | m | 2,000 | 130,957,158 | | - | | - | 130,957,158 |
| 5.1 | Bridge Type 2 - Rail Grade Separation elevated | $ 20,000,000 | No. | 4 | 80,000,000 | | - | | - | 80,000,000 |
| 5.2 | Bridge Type 3 - Road Grade Separation elevated | $ 30,000,000 | No. | 1 | 30,000,000 | | - | | - | 30,000,000 |
| 5.3 | Bridge Type 4 - Grade Separation (under Road/Rail) | $ 80,000,000 | No. | 1 | 80,000,000 | | - | | - | 80,000,000 |
| 5.4 | Marine Causeway (including reclamation, rock & services trench) | $ 44,318 | m | 250 | 11,079,600 | | - | | - | 11,079,600 |
| 5.5 | | | | | - | | - | | - | - |
| 5.6 | | | | | - | | - | | - | - |
| ***5.7*** | ***Sub-Total - Bridges*** | | | | ***332,036,758*** | | **-** | | **-** | ***332,036,758*** |
| | | | | | 100% | | 0% | | 0% | |
| | **Rail/Roading** | | | | | | | | | |
| 6.0 | Rail Lines Type 1 at Grade no electrics | $ 1,500 | m | 9,000 | 13,500,000 | 9,000 | 13,500,000 | 5,000 | 7,500,000 | 34,500,000 |
| 6.1 | Rail Lines Type 2 Elevated no electrics - Assume 1No. Pile every 20m @ $25K + $3k/m Beam + $1500 track (Allowance $5k per m) | $ 5,750 | m | 13,300 | 76,475,000 | | - | | - | 76,475,000 |
| 6.2 | Rail Marshalling Yard | $ 128 | m2 | 750,000 | 95,651,400 | - | - | | - | 95,651,400 |
| 6.3 | Roading Primary | $ 222 | m2 | 600,000 | 133,037,647 | | - | | - | 133,037,647 |
| 6.4 | Road Earthworks | $ 45 | m3 | 678,900 | 30,550,500 | | - | | - | 30,550,500 |
| 6.5 | Roading Culverts - Minor Services/drainage crossing 2000 x 1500 x 6m long Box culverts | $ 33,000 | No. | 13 | 429,000 | | - | | - | 429,000 |
| 6.6 | Roading Culverts - Minor Services/drainage crossing 2000 x 1500 x 180m long Box culverts | $ 990,000 | | 7 | 6,930,000 | | - | | - | 6,930,000 |
| 6.7 | Roading Culverts - Major Services/drainage crossing Bridge | $ 65,479 | m | 130 | 8,512,215 | | - | | - | 8,512,215 |
| 6.8 | Roading Secondary (Port Precinct) | $ 210 | m2 | 50,000 | 10,485,000 | | - | | - | 10,485,000 |
| 6.9 | Rail Signalling | $ 2,000,000 | No. | 7 | 14,000,000 | | - | | - | 14,000,000 |
| 6.10 | Fueling Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.11 | Locomotive Facilities | $ 15,000,000 | No. | 1 | 15,000,000 | | - | | - | 15,000,000 |
| 6.12 | Train Crew Administration office & Facilities | $ 5,000,000 | No. | 1 | 5,000,000 | | - | | - | 5,000,000 |
| 6.13 | Crossovers outside Marshalling Yard | $ 200,000 | No. | 4 | 800,000 | | - | | - | 800,000 |
| 6.14 | Major services Alterations & Protections (Road & Rail) | $ 10,000,000 | Item | 1 | 10,000,000 | | - | | - | 10,000,000 |
| ***6.15*** | ***Sub-Total - Rail/Roading*** | | | | ***435,370,762*** | | ***13,500,000*** | | ***7,500,000*** | ***456,370,762*** |
| | | | | | 95% | | 3% | | 2% | |
| | **Common Costs** | | | | | | | | | |
| 7.0 | Site Clearance (Provisional Sum) | $ 2,500,000 | Item | 1 | 2,500,000 | 1 | 2,500,000 | 1 | 2,500,000 | 7,500,000 |
| 7.1 | Clearing of Dense Vegetation | $ 31 | m2 | - | - | - | - | - | - | - |
| 7.2 | Clearing of Medium Vegetation | $ 4 | m2 | - | - | - | - | - | - | - |
| 7.3 | Clearing of Light Vegetation | $ 3 | m2 | 1,200,000 | 3,600,000 | 870,000 | 2,610,000 | 810,000 | 2,430,000 | 8,640,000 |
| 7.4 | Topsoil/Trimming | $ 14 | m2 | 1,200,000 | 16,200,000 | - | - | - | - | 16,200,000 |
| 7.5 | Port Offices Workshops & Facilities | $ 10,480,000 | Item | 1 | 10,480,000 | 1 | 10,480,000 | 1 | 10,480,000 | 31,440,000 |
| 7.6 | Port Offices & Facilities (Fit-Out Component) | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.7 | Services - Trunk Connection (Allowance) | $ 7,250,000 | Item | 1 | 7,250,000 | - | - | - | - | 7,250,000 |
| 7.8 | Gate Complex and Truck Marshalling | $ 2,160,000 | Item | 1 | 2,160,000 | 1 | 2,160,000 | 1 | 2,160,000 | 6,480,000 |
| 7.9 | Navigation Aids | $ 18,000,000 | Item | 1 | 18,000,000 | 0.2 | 3,600,000 | 0.2 | 3,600,000 | 25,200,000 |
| ***7.10*** | ***Sub-Total - Common Costs*** | | | | ***62,350,000*** | | ***23,510,000*** | | ***23,330,000*** | ***109,190,000*** |
| | | | | | 57% | | 22% | | 21% | |
| **8.0** | ***Sub-Total - Direct Construction Cost -*** | | | | **1,499,145,360** | | **680,893,931** | | **618,683,136** | **2,798,722,427** |
| | **Contractor Overheads:** | | | | | | | | | |
| 9.0 | Contractors Preliminaries | 20% | % | | 299,829,072 | | 136,178,786 | | 123,736,627 | 559,744,485.30 |
| 9.1 | Contractors Profit and Offsite O/H | 8% | % | | 143,917,954.57 | | 65,365,817.34 | | 59,393,581.03 | 268,677,353 |
| **9.3** | ***Sub-Total - Contractor Overheads:*** | | | | **443,747,027** | | **201,544,603** | | **183,130,208** | **828,421,838** |
| | | | | | 53.6% | | 24.3% | | 22.1% | |
| **10.0** | **Sub-Total Estimated Construction Cost** | | | | **1,942,892,387** | | **882,438,534** | | **801,813,344** | **3,627,144,265** |
| | **Escalation:** | | | | | | | | | |
| 11 | Escalation N/A (Excluded) | 0.00 | % | - | - | - | - | - | - | - |
| **11.1** | **Sub-Total Escalation** | | | | **-** | | **-** | | **-** | **-** |
| **12.0** | **CONSTRUCTION COST AS AT DECEMBER 2016** | | | | **1,942,892,387** | | **882,438,534** | | **801,813,344** | **3,627,144,265** |
| | **Consultants Fees:** | | | | | | | | | |
| 13.1 | Design & Planning Fees | 8% | % | | 155,431,390.94 | | 70,595,082.73 | | 64,145,067.51 | 290,171,541 |
| 13.2 | Other Professional Fees | 2% | % | | 38,857,847.73 | | 17,648,770.68 | | 16,036,266.88 | 72,542,885 |
| 13.3 | Site Investigation | $ 25,000,000.00 | Item | 1 | 25,000,000 | | | | | 25,000,000 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **13.3** | **Sub-Total Consultants Fees** | | | | **219,289,239** | | **88,243,853** | | **80,181,334** | **387,714,426** |
| | | | | | 57% | | 23% | | 21% | |
| | **Contingencies:** | | | | | | | | | |
| 14.1 | Design Development Contingencies | 10% | % | | 194,289,238.67 | | 88,243,853.41 | | 80,181,334.39 | 362,714,426 |
| 14.2 | Construction Contingency | 10% | % | | 213,718,162.54 | | 97,068,238.75 | | 88,199,467.83 | 398,985,869 |
| **14.3** | **Sub-Total Contingencies** | | | | **408,007,401** | | **185,312,092** | | **168,380,802** | **761,700,296** |
| | | | | | 54% | | 24% | | 22% | |
| **15.0** | **Total Estimated Project Cost (Excl GST)** | | | | **2,570,189,027** | | **1,155,994,480** | | **1,050,375,481** | **4,776,558,987** |

# Infrastructure Victoria

## Second Container Port Advice

## Regional Rail East Cost Review

May 2017

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# Figure index



# Appendices

# 1. Introduction

Infrastructure Victoria has requested GHD undertake a review and reassessment of costs provided by Raylink Consulting based on high level planning of a freight rail link from the Dynon precinct west of Melbourne to Lyndhurst as part of future rail capacity for the proposed Port of Hastings. An additional new rail corridor between Lyndhurst and Hastings completes the total link to the port.

The initial planning and the scope of requirements for these new rail links was developed by Raylink Consulting (Raylink) for the Department of Economic Development Jobs Transport and Resources (DEDJTR) as part of development options for a Port of Hastings container port and became the South East Rail Link (SERL) Project.

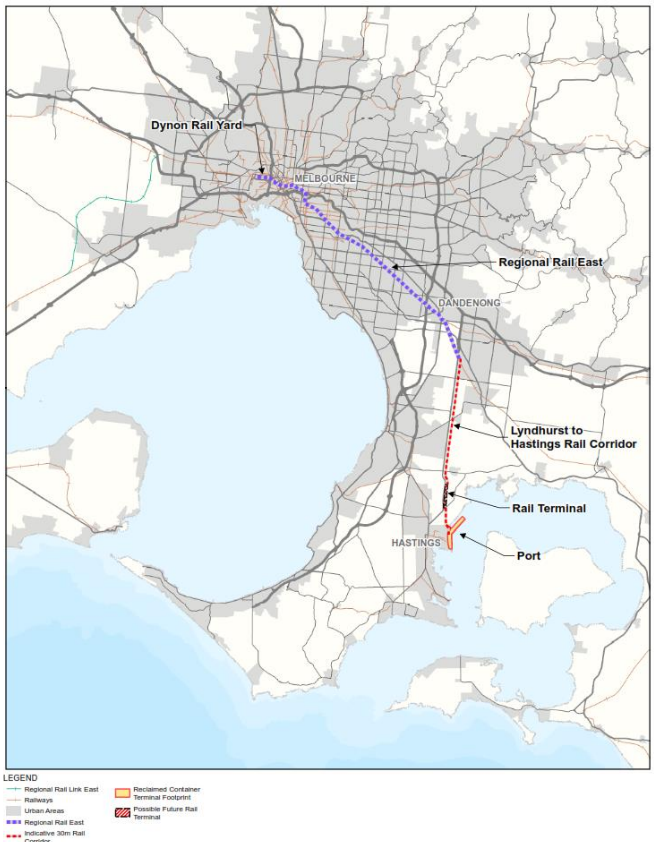
Indicative cost estimates were developed by Raylink in 2013 and a further update of costs based on the original scope with limited updates on changes to infrastructure was provided for Infrastructure Victoria in January 2017.

## 1.1 Purpose of this report

This report has been prepared in response to a request from Infrastructure Victoria to provide a review and reassessment of the Raylink costing details as part of overall options assessment for a second container port for Melbourne. The scope is to provide a review of a two track scenario based on Raylink estimates; representing the ultimate rail capacity requirement for the Port of Hastings.

The Project known originally as the SERL project is now referred to as Regional Rail East between South Dynon and Lyndhurst with an additional corridor from Lyndhurst to Hastings to complete the link. This report provides a review and comparison of RRE costs and utilises existing Raylink estimates for costs between Lyndhurst and Hastings. Figure 1 indicates the RRE area and the link to Hastings.

**Figure 1 RRE and the Lyndhurst/Hastings rail link**



The RRE project provides a broad scope and parameters to provide a dual gauge rail freight capacity from the west of Melbourne along the Dandenong Rail Corridor to service rail demand to the proposed Port of Hastings

The indicative scope and size of the project requirements are significant in perspective of the significant rail freight capacity through Melbourne and along the Dandenong Rail Corridor

## 1.2 Scope and limitations

GHD in conjunction with sub-consultant WT Partnership have utilised the Raylink scope and infrastructure to undertake a review of current Raylink costs and have provided comparative estimates within this report. Where clarification of information was required these items were discussed with Raylink to confirm the scope, general quantities and construction activities required.

We understand that the evaluations by Raylink are at a broad assessment level, and further detail may need to be progressed later in regard to current works, however they provide the best available information which has taken some time to develop, originally for SERL costs development and further for realignment and update for an RRE assessment. It is not practical to redo all this work, however reassessing the detail should provide some surety and a common cost basis through utilising WT inputs aligned to other project costs.

*This report: has been prepared by GHD for Infrastructure Victoria* and *may only be used and relied on by Infrastructure Victoria for the purpose agreed between GHD and the Infrastructure Victoira as set out in section 1 of this report.*

*GHD otherwise disclaims responsibility to any person other than Infrastructure Victoria arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.*

*The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report and assumptions required at this level of planning.  GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.*

*GHD has prepared this report and preliminary cost estimates set out in section 2 and the appendices of the report on the basis of information and assumptions provided by Infrastructure Victoria and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.*

*The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the* [works/project] *can or will be undertaken at a cost which is the same or less than the Cost Estimate.*

## 1.3 Assumptions and methodology

This report has been prepared as a review of costs utilising the existing planning scope and task requirements provided by Raylink  This scope of requirements is assumed to be the best information available for the planning task and costs have been reviewed based on this data. GHD has not independently verified the requirements but has discussed any apparent clarifications with RayLink Consulting.to provide an effective cost comparison.

WT Partnership as a sub Consultant to GHD assessed general scope and quantities presented in the Raylink calculations and applied current rates based on recent experience on major projects within Victoria and interstate.

In regard to recent planned changes on the Dandenong Rail Corridor where the Level Crossing Removal Works are being undertaken, available public information on proposed designs was utilised to provide an indicative scope for necessary works which were included in the revised costings. Discussion with Raylink Consulting resolved clarifications to eliminate relevant duplications.

# 2. Cost comparisons

## 2.1 Overall Comparison Summary

The cost comparisons for the Regional Rail East (RRE) were developed using the Raylink base data within eight separate sections of the rail corridor between the Dynon precinct west of Melbourne and Lyndhurst at the intersection of the Cranbourne rail corridor and the Western Port Highway.

Beyond this point costings had been provided in an additional corridor from Lyndhurst to Hastings and although these were not required to be included in the RRE costings the Raylink estimates were applied to complete the picture of overall costs to Hastings.

The Raylink January 2013 and January 2017 estimates are included in Figure 2 below with the reassessed WT Partnership estimates included for comparison.

While several adjustments were made throughout the eight line sections of the rail corridor to Lyndhurst, major differences and changes were applied within:

- the South Yarra to Caulfield Section;
- the Caulfield to Springvale; and
- Springvale to Dandenong sections.

Changes in other line sections were largely rate adjustments with some increases and decreases.

**The overall RRE cost from Dynon to Lyndhurst as indicated in Raylink costings was $4.695 bn. This compares to a reassessment estimate of $ 5.604 bn after adjustment of rates and some infrastructure changes on the corridor**

Inclusion of the Lyndhurst to Hastings corridor based on Raylink estimates resulted in a total corridor comparison of 6.239bn to 7.148bn  Figure 2 below provides and overview of the costs by Line section including an RRE total and total Dynon to Hastings comparison.

**Figure 2 Overall cost comparison by line section**

| Regional Rail East Cost Comparisons<br>Two Electrified Tracks | | | |
|---|---|---|---|
| Location | Estimated Cost RayLink Jan 2013 $m | Estimated Cost RayLink Jan 2017 $m | Estimated Cost WTP Jan 2017 $m |
| South Dynon - Southern Cross | 202 | 222 | 225 |
| Southern Cross - Flinders Street | 308 | 339 | 349 |
| Flinders Street - Richmond | 30 | 33 | 32 |
| Richmond - South Yarra | 117 | 128 | 130 |
| South Yarra - Caulfield | 2,017 | 2,219 | 2,065 |
| Caulfield - Springvale | 870 | 957 | 1,687 |
| Springvale - Dandenong | 355 | 391 | 733 |
| Dandenong - Lyndhurst | 368 | 405 | 383 |
| **REGIONAL RAIL EAST TOTAL** | **4,267** | **4,695** | **5,604** |
| Lyndhurst - Hastings | 1,404 | 1,544 | 1,544 |
| **SOUTH DYNON - HASTINGS TOTAL** | **5,671** | **6,239** | **7,148** |

## 2.2 Key areas of difference

Key areas of difference between the Raylink and updated estimate were:

**South Yarra to Caulfield**

Due to corridor constraints through this section the development of two tunnels for metropolitan traffic are required to enable freight and regional trains to operate above ground. (A possible

requirement for underground stations in this section was considered and further detail is provided at section 2.4) Major differences were within:

- Tunnelling rates and requirements – inclusion of separate rates for some items in the updated estimate result in an estimate reduction in this area.
- Variations in tunnel portal requirements and connections
- Construction and environmental costs
- An overall reduction of $154 m from the RayLink 2017 estimates was included in the reassessment

**Caulfield to Springvale**

This line section has been the subject of LXRA works in the Carnegie to Hughesdale area and the Clayton road /Centre road areas and information on specific infrastructure works was not available at the time of the Raylink estimate. Available public information has been utilised in this exercise to estimate elevated track structures and provide updated requirements with estimates applied.

Major cost variances were:

- The scope of elevated structures (as above) varied from the Raylink estimates and costs increased in the updated estimate;
- Realignment and redevelopment of station buildings
- Rates for signalling costs were also higher
- Overall changes to estimates in totalled an increase of $730 m in this line section

**Springvale to Dandenong**

This line section was also subject to LXRA changes through Corrigan Road, Noble Park and Chandler Road requiring adjustment to elevated tracks based on available public information.

Major cost variances were:

- The scope of elevated structure costs over Corrigan Road, through Noble Park and Chandler Road.
- Rates for signalling costs were higher
- Overall changes to estimates totalled an increase of $342 m in this section

Detailed costing comparisons per line section are included in Appendix 1

## 2.3 Further assumptions and clarifications

The assumptions made during the development of the RRE alignment by Raylink include:

### 2.3.1 Use of the RRE for Passenger services.

- Passenger and freight use of the RRE alignment which relates to the inclusion of electrification of the tracks so they can be used for passenger services where required.
- Use of the tracks by the regional diesel driven services including a need for a station interface at Clayton as a major passenger transfer point to Monash University.

These assumptions result in electrification costs (as updated and reassessed) of approximately $333 M and a further $36 m for Clayton station. These cost indications are not direct requirements of the port facility but provide for greater use and flexibility of network services on the RRE.

These costs are included in the original and updated RRE estimates.

### 2.3.2 The provision of underground stations between South Yarra and Caulfield.

We understand that the development of two tunnels extending from South Yarra to Caulfield for the relocation of metropolitan trains was generally considered in conjunction PTV on the basis that trains would run express between these locations without the need for stations underground.

This is a key interface to the potential project and this element is not resolved with certainty. It will rely on the operational requirements developed at a future stage of planning. In assessing costing requirements for this line section this element was the subject of some consideration with indicative underground station costs of approximately $1.3 bn for 4 stations assessed as a possible input.

To remain consistent with the scope and comparison of costs presented previously by Raylink the station costs <u>were not</u> included in the comparison.

# 3. Summary

Review and reassessment of costs for the Regional Rail East from South Dynon to Lyndhurst has been undertaken with a potential increase of 19.4 % on overall costs within this area.

The major cost differentiators relate to tunnelling and connection requirements from South Yarra to Dandenong and a change in corridor infrastructure between Caulfield and Dandenong requiring additional elevated tracks and associated works

Some of the information was not available at the time of Raylink costings and GHD has included some updated scope within the Caulfield to Dandenong section to ensure an updated view of requirements is available.

It should also be noted that the timing of cost updates included in this report was different to other reports submitted by GHD as part of second container port advice and these costs have not been included in earlier reports.

# Appendices

# **Appendix A** – Detailed Costing Comparison

**REGIONAL RAIL EAST**

**Two Tracks Electrified**

**Estimate Summary**

| Location | Estimated Cost Jan 2013 $m | Estimated Cost Jan 2017 $m | Estimated WTP Cost Jan 2017 $m | Comments |
|---|---|---|---|---|
| South Dynon - Southern Cross | 202 | 222 | 225 | Gauge convert/construct Dual Gauge tracks.<br>Connections to South Dynon port.<br>Track electrification. |
| Southern Cross - Flinders Street | 308 | 339 | 349 | Construct Dual Gauge tracks.<br>Extend viaduct to accommodate extra tracks.<br>Track electrification. |
| Flinders Street - Richmond | 30 | 33 | 32 | Convert existing Sandringham lines to Dual Gauge.<br>Remove redundant crossingwork.<br>Track electrification. |
| Richmond - South Yarra | 117 | 128 | 130 | Convert existing track to Dual Gauge.<br>Rail flyover between Yarra River and South Yarra Station.<br>Track electrification. |
| South Yarra - Caulfield | 2,017 | 2,219 | 2,065 | Construct Dual Gauge tracks. Re-align existing tracks to suit.<br>Two tunnels under for Dandenong metro trains<br><br>Track electrification. |
| Caulfield - Springvale | 870 | 957 | 1,687 | Gauge convert/construct Dual Gauge tracks. Re-align existing tracks to suit.<br>Rail underpass.<br>Raise tracks between Carnegie/ Murrumbeena/Hughesdale ; Clayton Road to Clayton Road.<br>Track electrification. |
| Springvale - Dandenong | 355 | 391 | 733 | Construct Dual Gauge tracks.<br>Rail tracks Corrigan Road to Chandler Road<br>Track electrification. |
| Dandenong - Lyndhurst | 368 | 405 | 383 | Construct Dual Gauge tracks.<br>Grade separate Webster Street.<br>Track electrification. |
| Lyndhurst - Hastings | 1,404 | 1,544 | 1,544 | Dual Gauge track in median of Western Port Highway.<br>2no crossing loops.<br>Track electrification. |
| **TOTAL** | 5,671 | 6,239 | 7,148 | |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** Preliminary Concept Diagram
**SCOPE:** R. Bartlett/J. Hearsch

**PROJECT:** Regional Rail East
South Dynon-Southern Cross
Two Electrified Tracks

**ORDER OF COST ESTIMATE**

Regional Rail East
South Dynon-Southern Cross
Two Electrified Tracks

**ORDER OF COST ESTIMATE - WT PARTNERSHIP**

**PROJECT:** Roundi

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY | | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY | | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | % | $ | | | | | | | % | $ | | |
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 100000 | 100000 | 30% | 30000 | $130,000 | $143,000 | Nominal allowance | 1 | 110000 | 110000 | 30% | 33,000 | Nominal allowance | $143,000 |
| Demolition | item | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | Nominal allowance to remove unspecified buildings, minor structures, fences, roads, etc. | 1 | 550000 | 550000 | 30% | 165,000 | Nominal allowance to remove unspecified buildings, minor structures, fences, roads, etc. | $715,000 |
| | | | | | | | $780,000 | $858,000 | | | | | | | | $858,000 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | 1 | 5500000 | 5500000 | 30% | 1,650,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | $7,150,000 |
| | | | | | | | $6,500,000 | $7,150,000 | | | | | | | | $7,150,000 |
| **SOUTH DYNON - SOUTHERN CROSS** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | 46050 | 0.5 | 23025 | 30% | 6907.5 | $29,933 | $32,926 | Clear site of vegetation; cart away | 60300 | 0.75 | 45,225 | 30% | 13,568 | Clear site of vegetation; cart away | $58,793 |
| Prepare Formation | cubm | 33770 | 30 | 1013100 | 30% | 303930 | $1,317,030 | $1,448,733 | Excavation and/or fill to assumed level | 44220 | 60 | 2,653,200 | 30% | 795,960 | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil | $3,449,160 |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | 6140 | 40 | 245,600 | 30% | 73,680 | Safe workin barriers required in the existing rail corridor | $319,280 |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | 33770 | 15 | 506550 | 30% | 151965 | $658,515 | $724,367 | 150mm. crushed rock layer in areas of new track. | 44220 | 17.25 | 762,795 | 30% | 228,839 | 150mm. crushed rock layer in areas of new track. | $991,634 |
| Convert to DG | metre | 3120 | 1260 | 3931200 | 30% | 1179360 | $5,110,560 | $5,621,616 | Remove existing BG; replace with DG. | 2120 | 1386 | 2,938,320 | 30% | 881,496 | Remove existing Broad Guage; replace with Dual Guage from Dudley Street Bridge to Southern Cross Station | $3,819,816 |
| New DG Track | metre | 3070 | 1160 | 3561200 | 30% | 1068360 | $4,629,560 | $5,092,516 | | 4020 | 1195 | 4,803,900 | 30% | 1,441,170 | 1,535m x 2 plus a third rail from South Dynon Maintenance Depot to RRL Bypass at Dudley Street Bridge | $6,245,070 |
| Track Slews | item | 2000 | 200 | 400000 | 30% | 120000 | $520,000 | $572,000 | Nominal sum. | 2000 | 210 | 420,000 | 30% | 126,000 | Accepted at face value | $546,000 |
| Turnouts | no | 12 | 500000 | 6000000 | 30% | 1800000 | $7,800,000 | $8,580,000 | Nominal number of turnouts replaced/relocated to | 12 | 375000 | 4,500,000 | 30% | 1,350,000 | Nominal number of turnouts replaced/relocated to suit new track. Allow for removal of existing and replace with new | $5,850,000 |
| Diamonds | no | 2 | 500000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | | 2 | 350000 | 700,000 | 30% | 210,000 | Allow for new Diamonds | $910,000 |
| Track Drainage - Cess Drainage | item | 1 | 614000 | 614000 | 30% | 184200 | $798,200 | $878,020 | | 4020 | 25 | 100,500 | 30% | 30,150 | Cess drainage only | $130,650 |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | 4020 | 615 | 2,472,300 | 30% | 741,690 | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | $3,213,990 |
| **Level Crossings** | no | | 50000 | | 30% | | | | | | 50000 | | 30% | | Allowance for Level Crossings | |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | 1 | 10000000 | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum. | 6140 | 1500 | 9,210,000 | 30% | 2,763,000 | Nominal sum. | $11,973,000 |
| | | | | | | | $35,163,798 | $38,680,177 | | | | | | | | $37,507,392 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | | | | | | | | | Nominal sum to re-arrange overhead wiring to suit new track layout. | | | | | | Nominal sum to re-arrange overhead wiring to suit new track layout. | |
| New Structures and Wiring | metre | 12380 | 800 | 9904000 | 30% | 2971200 | $12,875,200 | $14,162,720 | | 6140 | 880 | 5,403,200 | 30% | 1,620,960 | | $7,024,160 |
| Sundry Connections/Alterations | item | 2 | 500000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | | 2 | 550000 | 1,100,000 | 30% | 330,000 | | $1,430,000 |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | 1 | 6000000 | 6000000 | 30% | 1800000 | $7,800,000 | $8,580,000 | | 1 | 5900000 | 5,900,000 | 30% | 1,770,000 | | $7,670,000 |
| Tie Station | no | | 4000000 | | 30% | | | | | | 4000000 | | 30% | | | |
| | | | | | | | $21,975,200 | $24,172,720 | | | | | | | | $16,124,160 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | | | | | | | | | | | | | | | | |
| Moonee Ponds Creek | metre | 280 | 30000 | 8400000 | 30% | 2520000 | $10,920,000 | $12,012,000 | | 825 | 9000 | 7,425,000 | 30% | 2,227,500 | | $9,652,500 |
| Dudley Street | | | | | | | - | | Assume use of existing spans. | | | | | | Assume use of existing spans. | - |
| **Road Bridges** | | | | | | | | | | | | | | | | |
| **Miscellaneous** | item | 2 | 500000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for unspecified works, e.g. retaining walls etc. | 2 | 550000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified works, e.g. retaining | $1,430,000 |
| | | | | | | | | | | 1 | 10000000 | 10,000,000 | 30% | 3,000,000 | Relocate Signal Box and site restrictions at Southern Cross | $13,000,000 |
| **Compensation** | item | | | | 30% | | | | | | | | 30% | | | |
| | | | | | | | $12,220,000 | $13,442,000 | | | | | | | | $24,082,500 |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | $1,430,000 |
| Track Occupations | no | 10 | 100000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Weekend shutdown | 10 | 100000 | 1,000,000 | 30% | 300,000 | Weekend shutdown rate in Freight Area only | $1,300,000 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | $2,600,000 | $2,860,000 | | | | | | | | $2,730,000 |
| | | | | | | | | | | | | | | | | |
| **TOTAL CONSTRUCTION COST** | | | | 60953075 | 30% | 18285923 | $79,238,998 | $87,162,898 | | | | 68,040,040 | 30% | 20,412,012 | | $88,452,052 |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $18,285,923 | $20,114,515 | 30% (Nominal) | | | | | | 30% (Nominal) | $20,412,012 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $97,524,921 | $107,277,413 | | | | | | | | $108,864,064 |
| Land Acquisition | | | | 20000000 | 30% | 6000000 | $26,000,000 | $28,600,000 | Nominal sum for unspecified land purchases, compensation, etc. | | | 22,000,000 | 30% | 6,600,000 | Nominal sum for unspecified land purchases, compensation, etc. | $28,600,000 |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $123,524,921 | $135,877,413 | | | | | | | | $137,464,064 |
| Design | | | | | | | $9,752,492 | $10,727,741 | 10% (Nominal) | | | | | | 10% (Nominal) | $10,886,406 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $133,277,413 | $146,605,154 | | | | | | | | $148,350,470 |
| Principal Supplied Project Insurance | | | | | | | $751,917 | $827,109 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $839,342 |
| DoT Project Management (major role) | | | | | | | $12,352,492 | $13,587,741 | 10% (Nominal) | | | | | | 10% (Nominal) | $13,746,406.40 |
| Lessee/Operator PM (minor role) | | | | | | | $1,852,874 | $2,038,161 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $2,061,961 |
| Risk | | | | | | | $44,244,834 | $48,669,317 | 30% (Nominal) | | | | | | 30% (Nominal) | $49,247,651 |
| **TOTAL DIRECT COSTS** | | | | | | | $192,479,529 | $211,727,482 | | | | | | | | $214,245,831 |
| DOT Corporate Levy | | | | | | | $1,924,795 | $2,117,275 | 1% | | | | | | 1% | $2,142,458.31 |
| DOT Project Development Levy | | | | | | | $7,699,181 | $8,469,099 | 4% | | | | | | 4% | $8,569,833.24 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $202,103,506 | $222,313,856 | | | | | | | | $224,958,123 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $202,103,506 | $222,313,856 | | | | | | | | $224,958,123 |

| | | | |
|---|---|---|---|
| **PREPARED BY:** R. Bartlett | **PROJECT:** Regional Rail East | Regional Rail East | **PROJECT:** |
| **DATE:** 11/1/2017 | Southern Cross - Flinders Street | Southern Cross - Flinders Street | Roundi |
| **PLANS:** Preliminary Concept Diagram | Two Electrified Tracks | Two Electrified Tracks | |
| **SCOPE:** R. Bartlett/J. Hearsch **ORDER OF COST ESTIMATE** | | **ORDER OF COST ESTIMATE - WT PARTNERSHIP** | |

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 100000 | 100000 | 30% | 30000 | $130,000 | $143,000 | Nominal allowance | 1 | 110000 | 110000 | 30% | 33,000 | Nominal allowance | $143,000 |
| Demolition | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Nominal allowance to remove unspecified buildings, minor structures, fences, roads, etc. | 1 | 2200000 | 2200000 | 30% | 660,000 | Nominal allowance to remove unspecified buildings, minor structures, fences, roads, etc. | $2,860,000 |
| | | | | | | | $2,730,000 | $3,003,000 | | | | | | | | $3,003,000 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | 1 | 5500000 | 5500000 | 30% | 1,650,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | $7,150,000 |
| | | | | | | | $6,500,000 | $7,150,000 | | | | | | | | $7,150,000 |
| **SOUTHERN CROSS - FLINDERS STREET** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | | 0.5 | | 30% | | | | Clear site of vegetation; cart away | 35250 | 0.75 | 26,438 | 30% | 7,931 | Clear site of vegetation; cart away (deduct viaduct section) | $34,369 |
| Prepare Formation | cubm | | 30 | | 30% | | | | Excavation and/or fill to assumed level | 25850 | 60 | 1,551,000 | 30% | 465,300 | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil (deduct viaduct | $2,016,300 |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | 3100 | 40 | 124,000 | 30% | 37,200 | Safe workin barriers required in the existing rail corridor | $161,200 |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | 17820 | 15 | 267300 | 30% | 80190 | $347,490 | $382,239 | 150mm. crushed rock layer in areas of new track. | 25850 | 17.25 | 445,913 | 30% | 133,774 | 150mm. crushed rock layer in areas of new track (deduct viaduct section) | $579,686 |
| Convert to DG | metre | | 1260 | | 30% | | | | Remove existing BG; replace with DG. | | 1386 | | 30% | | Remove existing Broad Guage; replace with Dual Guage | |
| New DG Track | metre | 3240 | 1160 | 3758400 | 30% | 1127520 | $4,885,920 | $5,374,512 | | 3100 | 1195 | 3,704,500 | 30% | 1,111,350 | 1,550m x 2 plus a third rail from Southern Cross to Flinders Street | $4,815,850 |
| Track Slews (rearrange tracks) | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Accepted at face value | $1,430,000 |
| Turnouts | no | 6 | 500000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | Nominal number of turnouts replaced/relocated to | 6 | 375000 | 2,250,000 | 30% | 675,000 | Nominal number of turnouts replaced/relocated to suit new track. Allow for removal of existing and replace with new | $2,925,000 |
| Diamonds | no | | 500000 | | 30% | | | | | 2 | 350000 | 700,000 | 30% | 210,000 | Allow for new Diamonds | $910,000 |
| Track Drainage - Cess Drainage | item | 1 | 648000 | 648000 | 30% | 194400 | $842,400 | $926,640 | | 3100 | 25 | 77,500 | 30% | 23,250 | Cess drainage only | $100,750 |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | 3100 | 615 | 1,906,500 | 30% | 571,950 | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | $2,478,450 |
| **Level Crossings** | no | | 50000 | | 30% | | | | | | 50000 | | 30% | | Allowance for Level Crossings | |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | 1 | 10000000 | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum. | 3100 | 1500 | 4,650,000 | 30% | 1,395,000 | Nominal sum. | $6,045,000 |
| Relocation of Signalling Box/Relay Room | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Nominal sum. | $2,860,000 |
| | | | | | | | $26,875,810 | $29,563,391 | | | | | | | | $24,356,605 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | metre | 6400 | 800 | 5120000 | 30% | 1536000 | $6,656,000 | $7,321,600 | Nominal sum to re-arrange overhead wiring to suit new track layout. | 3100 | 880 | 2,728,000 | 30% | 818,400 | suit new track layout. | $3,546,400 |
| New Structures and Wiring | metre | 3240 | 800 | 2592000 | 30% | 777600 | $3,369,600 | $3,706,560 | | 3100 | 880 | 2,728,000 | 30% | 818,400 | | $3,546,400 |
| Sundry Connections/Alterations | item | 2 | 200000 | 400000 | 30% | 120000 | $520,000 | $572,000 | | 2 | 220000 | 440,000 | 30% | 132,000 | | $572,000 |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | 1 | 6000000 | 6000000 | 30% | 1800000 | $7,800,000 | $8,580,000 | | 1 | 5900000 | 5,900,000 | 30% | 1,770,000 | | $7,670,000 |
| Tie Station | no | | 4000000 | | 30% | | | | | | 4000000 | | 30% | | | |
| | | | | | | | $18,345,600 | $20,180,160 | | | | | | | | $15,334,800 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | | | | | | | | | | | | | | | | |
| Viaduct | metre | 830 | 67060 | 55660000 | 30% | 16698000 | $72,358,000 | $79,593,800 | | 9350 | 7500 | 70,125,000 | 30% | 21,037,500 | Assume elevated viaduct from Spencer Street to East of Williams S | $91,162,500 |
| Dudley Street | | | | | | | - | | Assume use of existing spans. | | | | | | Assume use of existing spans. | - |
| **Road Bridges** | | | | | | | | | | | | | | | | |
| **Miscellaneous** | item | 1 | 10000000 | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum for unspecified works, e.g. retaining walls, etc. | 1 | 11000000 | 11,000,000 | 30% | 3,300,000 | Nominal sum for unspecified works, e.g. retaining walls, etc. | $14,300,000 |
| | | | | | | | $85,358,000 | $93,893,800 | | | | | | | | $105,462,500 |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | $1,430,000 |
| Track Occupations | no | 20 | 100000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Weekend shutdown | 20 | 250000 | 5,000,000 | 30% | 1,500,000 | Weekend shutdown | $6,500,000 |
| Compensation | no | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Compensation | 1 | 5500000 | 5,500,000 | 30% | 1,650,000 | Weekend shutdown | $7,150,000 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | $10,400,000 | $11,440,000 | | | | | | | | $15,080,000 |
| | | | | | | | | | | | | | | | | |
| **TOTAL CONSTRUCTION COST** | | | | 115545700 | 30% | 34663710 | $150,209,410 | $165,230,351 | | | | 131,066,850 | 30% | 39,320,055 | | $170,386,905 |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $34,663,710 | $38,130,081 | 30% (Nominal) | | | | | | 30% (Nominal) | $39,320,055 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $184,873,120 | $203,360,432 | | | | | | | | $209,706,960 |
| Land Acquisition | | | | | 30% | | | | Nominal sum for unspecified land purchases, compensation, etc. | | | | 30% | | Nominal sum for unspecified land purchases, compensation, etc. | |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $184,873,120 | $203,360,432 | | | | | | | | $209,706,960 |
| Design | | | | | | | $18,487,312 | $20,336,043 | 10% (Nominal) | | | | | | 10% (Nominal) | $20,970,696 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $203,360,432 | $223,696,475 | | | | | | | | $230,677,656 |
| Principal Supplied Project Insurance | | | | | | | $1,425,372 | $1,567,909 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $1,616,841 |
| DoT Project Management (major role) | | | | | | | $18,487,312 | $20,336,043 | 10% (Nominal) | | | | | | 10% (Nominal) | $20,970,696.00 |
| Lessee/Operator PM (minor role) | | | | | | | $2,773,097 | $3,050,406 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $3,145,604 |
| Risk | | | | | | | $67,386,252 | $74,124,877 | 30% (Nominal) | | | | | | 30% (Nominal) | $76,438,187 |
| **TOTAL DIRECT COSTS** | | | | | | | $293,432,465 | $322,775,711 | | | | | | | | $332,848,984 |
| DOT Corporate Levy | | | | | | | $2,934,325 | $3,227,757 | 1% | | | | | | 1% | $3,328,489.84 |
| DOT Project Development Levy | | | | | | | $11,737,299 | $12,911,028 | 4% | | | | | | 4% | $13,313,959.36 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $308,104,088 | $338,914,497 | | | | | | | | $349,491,433 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $308,104,088 | $338,914,497 | | | | | | | | $349,491,433 |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** Preliminary Concept Diagram
**SCOPE:** R. Bartlett/J. Hearsch

**PROJECT:** Regional Rail East
Flinders Street - Richmond
Two Electrified Tracks

**ORDER OF COST ESTIMATE**

Regional Rail East
Flinders Street - Richmond
Two Electrified Tracks

**ORDER OF COST ESTIMATE - WT PARTNERSHIP**

**PROJECT:**

Roundi

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY | | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY | | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | % | $ | | | | | | | % | $ | | |
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 100000 | 100000 | 30% | 30000 | $130,000 | $143,000 | Nominal allowance | 1 | 110000 | 110000 | 30% | 33,000 | Nominal allowance | $143,000 |
| | | | | | | | $130,000 | $143,000 | | | | | | | | $143,000 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | | | | | | | | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | | 5500000 | | 30% | | Not required - coinversion of existing track only | |
| | | | | | | | | | | | | | | | | |
| **FLINDERS STREET - RICHMOND** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | | 0.5 | | 30% | | | | Clear site of vegetation; cart away | | 0.75 | | 30% | | Clear site of vegetation; cart away | |
| Prepare Formation | cubm | | 30 | | 30% | | | | Excavation and/or fill to assumed level | | 60 | | 30% | | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil | |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | 2100 | 40 | 84,000 | 30% | 25,200 | Safe workin barriers required in the existing rail corridor | $109,200 |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | | 15 | | 30% | | | | 150mm. crushed rock layer in areas of new track. | | 17.25 | | 30% | | 150mm. crushed rock layer in areas of new track (deduct viaduct section) | |
| Convert to DG | metre | 4080 | 1260 | 5140800 | 30% | 1542240 | $6,683,040 | $7,351,344 | Remove existing BG; replace with DG. | 2100 | 1386 | 2,910,600 | 30% | 873,180 | Remove existing Broad Guage; replace with Dual Guage | $3,783,780 |
| New DG Track | metre | | 1160 | | 30% | | | | | | 1195 | | 30% | | 1,550m x 2 plus a third rail from Southern Cross to Flinders Street | |
| Track Slews (rearrange tracks) | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Nominal sum. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Accepted at face value | $2,860,000 |
| Turnouts | no | | 500000 | | 30% | | | | Nominal number of turnouts replaced/relocated to | | 375000 | | 30% | | Nominal number of turnouts replaced/relocated to suit new track. Allow for removal of existing and replace with new | |
| Diamonds | no | | 500000 | | 30% | | | | | 2 | 350000 | 700,000 | 30% | 210,000 | Allow for new Diamonds | $910,000 |
| Track Drainage - Cess Drainage | item | 1 | | | 30% | | | | | | 25 | | 30% | | Cess drainage only | |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | | 615 | | 30% | | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | |
| **Level Crossings** | no | | 50000 | | 30% | | | | | | 50000 | | 30% | | Allowance for Level Crossings | |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | 1 | 3000000 | 2500000 | 30% | 750000 | $3,250,000 | $3,575,000 | Nominal sum. | 2100 | 1500 | 3,150,000 | 30% | 945,000 | Nominal sum. | $4,095,000 |
| | | | | | | | $12,533,040 | $13,786,344 | | | | | | | | $11,757,980 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum to re-arrange overhead wiring to suit new track layout. | 2100 | 880 | 1,848,000 | 30% | 554,400 | | $2,402,400 |
| New Structures and Wiring | metre | | 800 | | 30% | | | | Already electrified | | 880 | | 30% | | Already electrified | |
| Sundry Connections/Alterations | item | | 200000 | | 30% | | | | | | 220000 | | 30% | | | |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | | 6000000 | | 30% | | | | | | 5900000 | | 30% | | | |
| Tie Station | no | | 4000000 | | 30% | | | | | | 4000000 | | 30% | | | |
| | | | | | | | $1,300,000 | $1,430,000 | | | | | | | | $2,402,400 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | metre | | | | 30% | | | | | | 9000 | | 30% | | | - |
| **Road Bridges** | | | | | | | | | | | | | | | | |
| **Miscellaneous** | item | | | | 30% | | | | walls, etc. | | 550000 | | 30% | | Nominal sum for unspecified works, e.g. retaining walls, etc. | |
| **Compensation** | item | | | | 30% | | | | walls, etc. | | 550000 | | 30% | | Nominal sum for unspecified works, e.g. retaining walls, etc. | |
| | | | | | | | | | | | | | | | | |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | | 1000000 | | 30% | | | | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | | 1100000 | | 30% | | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | |
| Track Occupations | no | 4 | 150000 | 600000 | 30% | 180000 | $780,000 | $858,000 | Weekend shutdown | 4 | 250000 | 1,000,000 | 30% | 300,000 | Weekend shutdown | $1,300,000 |
| | | | | | | | $780,000 | $858,000 | | | | | | | | $1,300,000 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TOTAL CONSTRUCTION COST** | | | | 11340800 | 30% | 3402240 | $14,743,040 | $16,217,344 | | | | 12,002,600 | 30% | 3,600,780 | | $15,603,380 |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $3,402,240 | $3,742,464 | 30% (Nominal) | | | | | | 30% (Nominal) | $3,600,780 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $18,145,280 | $19,959,808 | | | | | | | | $19,204,160 |
| Land Acquisition | | | | | 30% | | | | Nominal sum for unspecified land purchases, compensation, etc. | | | | 30% | | Nominal sum for unspecified land purchases, compensation, etc. | |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $18,145,280 | $19,959,808 | | | | | | | | $19,204,160 |
| Design | | | | | | | $1,814,528 | $1,995,981 | 10% (Nominal) | | | | | | 10% (Nominal) | $1,920,416 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $19,959,808 | $21,955,789 | | | | | | | | $21,124,576 |
| Principal Supplied Project Insurance | | | | | | | $139,900 | $153,890 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $148,064 |
| DoT Project Management (major role) | | | | | | | $1,814,528 | $1,995,981 | 10% (Nominal) | | | | | | 10% (Nominal) | $1,920,416.00 |
| Lessee/Operator PM (minor role) | | | | | | | $272,179 | $299,397 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $288,062 |
| Risk | | | | | | | $6,613,955 | $7,275,350 | 30% (Nominal) | | | | | | 30% (Nominal) | $6,999,916 |
| **TOTAL DIRECT COSTS** | | | | | | | $28,800,370 | $31,680,407 | | | | | | | | $30,481,035 |
| DOT Corporate Levy | | | | | | | $288,004 | $316,804 | 1% | | | | | | 1% | $304,810.35 |
| DOT Project Development Levy | | | | | | | $1,152,015 | $1,267,216 | 4% | | | | | | 4% | $1,219,241.39 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $30,240,388 | $33,264,427 | | | | | | | | $32,005,087 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $30,240,388 | $33,264,427 | | | | | | | | $32,005,087 |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** Preliminary Concept Diagram
**SCOPE:** R. Bartlett/J. Hearsch

**PROJECT:** Regional Rail East
Richmond to South Yarra
Two Electrified Tracks

Regional Rail East
Richmond to South Yarra
Two Electrified Tracks

**PROJECT:** Roundi

**ORDER OF COST ESTIMATE** | **ORDER OF COST ESTIMATE - WT PARTNERSHIP**

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 50000 | 50000 | 30% | 15000 | $65,000 | $71,500 | Nominal allowance | 1 | 55000 | 55000 | 30% | 16,500 | Nominal allowance | $71,500 |
| Demolition - remove tracks | metre | 2230 | 100 | 223000 | 30% | 66900 | $289,900 | $318,890 | | 2230 | 110 | 245300 | 30% | 73,590 | Nominal allowance to remove unspecified buildings, minor structures, fences, roads, etc. | $318,890 |
| | | | | | | | $354,900 | $390,390 | | | | | | | | $390,390 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | 1 | 550000 | 550000 | 30% | 165,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | $715,000 |
| | | | | | | | $650,000 | $715,000 | | | | | | | | $715,000 |
| **RICHMOND - SOUTH YARRA** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | 2000 | 0.5 | 1000 | 30% | 300 | $1,300 | $1,430 | Clear site of vegetation; cart away | 13740 | 0.75 | 10,305 | 30% | 3,092 | Clear site of vegetation; cart away | $13,397 |
| Prepare Formation | cubm | | 30 | | 30% | | | | Excavation and/or fill to assumed level | 10076 | 60 | 604,560 | 30% | 181,368 | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil | $785,928 |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | 4508 | 40 | 180,320 | 30% | 54,096 | Safe workin barriers required in the existing rail corridor | $234,416 |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | 3300 | 15 | 49500 | 30% | 14850 | $64,350 | $70,785 | 150mm. crushed rock layer in areas of new track. | 10076 | 17.25 | 173,811 | 30% | 52,143 | 150mm. crushed rock layer in areas of new track. | $225,954 |
| Convert to DG | metre | 1200 | 900 | 1080000 | 30% | 324000 | $1,404,000 | $1,544,400 | | 3592 | 1386 | 4,978,512 | 30% | 1,493,554 | Remove existing and replace with Broad Guage | $6,472,066 |
| New DG Track | metre | 3050 | 1160 | 3538000 | 30% | 1061400 | $4,599,400 | $5,059,340 | | 916 | 1195 | 1,094,620 | 30% | 328,386 | | $1,423,006 |
| Track Slews/rearrange tracks | item | 1 | 3000000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | Nominal sum. | 1 | 3000000 | 3,000,000 | 30% | 900,000 | Accepted at face value | $3,900,000 |
| Turnouts | no | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | Nominal number of turnouts replaced/relocated to | 1 | 375000 | 375,000 | 30% | 112,500 | Nominal number of turnouts replaced/relocated to suit new track. Allow for removal of existing and replace with new | $487,500 |
| Diamonds | no | | 500000 | | 30% | | | | | | 350000 | | 30% | | Allow for new Diamonds | |
| Track Drainage - Cess Drainage | item | 1 | 240000 | 240000 | 30% | 72000 | $312,000 | $343,200 | | 916 | 25 | 22,900 | 30% | 6,870 | Cess drainage only | $29,770 |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | 916 | 615 | 563,340 | 30% | 169,002 | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | $732,342 |
| **Level Crossings** | no | | 50000 | | 30% | | | | | | 50000 | | 30% | | Allowance for Level Crossings | |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum. | 916 | 1500 | 1,374,000 | 30% | 412,200 | Assume signalling for new track only | $1,786,200 |
| | | | | | | | $17,431,050 | $19,174,155 | | | | | | | | $16,090,578 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | metre | 4800 | 800 | 3840000 | 30% | 1152000 | $4,992,000 | $5,491,200 | Nominal sum to re-arrange overhead wiring to suit new track layout. | 3592 | 880 | 3,160,960 | 30% | 948,288 | Nominal sum to re-arrange overhead wiring to suit new track layout. | $4,109,248 |
| New Structures and Wiring | metre | 300 | 800 | 240000 | 30% | 72000 | $312,000 | $343,200 | | 916 | 880 | 806,080 | 30% | 241,824 | | $1,047,904 |
| Sundry Connections/Alterations | item | 1 | 200000 | 200000 | 30% | 60000 | $260,000 | $286,000 | | 1 | 550000 | 550,000 | 30% | 165,000 | | $715,000 |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | 1 | 6000000 | 6000000 | 30% | 1800000 | $7,800,000 | $8,580,000 | | 1 | 5900000 | 5,900,000 | 30% | 1,770,000 | | $7,670,000 |
| Tie Station | no | | 4000000 | | 30% | | | | | | 4000000 | | 30% | | | |
| | | | | | | | $13,364,000 | $14,700,400 | | | | | | | | $13,542,152 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | | | | | | | | | | | | | | | | |
| Flyover | metre | 270 | 52963 | 14300000 | 30% | 4290000 | $18,590,000 | $20,449,000 | | 2970 | 6000 | 17,820,000 | 30% | 5,346,000 | Flyover required in this section | $23,166,000 |
| | | | | | | | - | #VALUE! | Assume use of existing spans. | | | | | | | - |
| **Road Bridges** | | | | | | | | | | | | | | | | |
| **Miscellaneous** Modify existing bridge | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Nominal sum for unspecified works, e.g. retaining | $2,860,000 |
| **Compensation** | item | | | | 30% | | | | | | | | 30% | | | |
| | | | | | | | $21,190,000 | $23,309,000 | | | | | | | | $26,026,000 |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | 1 | 50000 | 50000 | 30% | 15000 | $65,000 | $71,500 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | $1,430,000 |
| Track Occupations | no | 10 | 150000 | 1500000 | 30% | 450000 | $1,950,000 | $2,145,000 | Weekend shutdown | 10 | 250000 | 2,500,000 | 30% | 750,000 | Weekend shutdown | $3,250,000 |
| | | | | | | | $2,015,000 | $2,216,500 | | | | | | | | $4,680,000 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TOTAL CONSTRUCTION COST** | | | | 42311500 | 30% | 12693450 | $55,004,950 | $60,505,445 | | | | 47,264,708 | 30% | 14,179,412 | | $61,444,120 |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $12,693,450 | $13,962,795 | 30% (Nominal) | | | | | | 30% (Nominal) | $14,179,412 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $67,698,400 | $74,468,240 | | | | | | | | $75,623,532 |
| Land Acquisition | | | | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Nominal sum for unspecified land purchases, compensation, etc. | | | 2,000,000 | 30% | 600,000 | Nominal sum for unspecified land purchases, compensation, etc. | $2,600,000 |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $70,298,400 | $77,328,240 | | | | | | | | $78,223,532 |
| Design | | | | | | | $6,769,840 | $7,446,824 | 10% (Nominal) | | | | | | 10% (Nominal) | $7,562,353 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $77,068,240 | $84,775,064 | | | | | | | | $85,785,886 |
| Principal Supplied Project Insurance | | | | | | | $521,955 | $574,150 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $583,057 |
| DoT Project Management (major role) | | | | | | | $7,029,840 | $7,732,824 | 10% (Nominal) | | | | | | 10% (Nominal) | $7,822,353.24 |
| Lessee/Operator PM (minor role) | | | | | | | $1,054,476 | $1,159,924 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $1,173,353 |
| Risk | | | | | | | $25,545,767 | $28,100,343 | 30% (Nominal) | | | | | | 30% (Nominal) | $28,434,478 |
| **TOTAL DIRECT COSTS** | | | | | | | $111,220,277 | $122,342,305 | | | | | | | | $123,799,127 |
| DOT Corporate Levy | | | | | | | $1,112,203 | $1,223,423 | 1% | | | | | | 1% | $1,237,991.27 |
| DOT Project Development Levy | | | | | | | $4,448,811 | $4,893,692 | 4% | | | | | | 4% | $4,951,965.07 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $116,781,291 | $128,459,420 | | | | | | | | $129,989,083 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $116,781,291 | $128,459,420 | | | | | | | | $129,989,083 |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** Preliminary Concept Diagram
**SCOPE:** R. Bartlett/J. Hearsch

**ORDER OF COST ESTIMATE**

**PROJECT:** Regional Rail East
South Yarra to Caulfield
Two Electrified Tracks

Regional Rail East
South Yarra to Caulfield
Two Electrified Tracks

**ORDER OF COST ESTIMATE - WT PARTNERSHIP**

**PROJECT:**

Roundi

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 100000 | 100000 | 30% | 30000 | $130,000 | $143,000 | Nominal allowance | 1 | 110000 | 110000 | 30% | 33,000 | Nominal allowance | $143,000 |
| | | | | | | | $130,000 | $143,000 | | | | | | | | $143,000 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 10000000 | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | 1 | 11000000 | 11000000 | 30% | 3,300,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | $14,300,000 |
| | | | | | | | $13,000,000 | $14,300,000 | | | | | | | | $14,300,000 |
| **SOUTH YARRA - CAULFIELD** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | | 0.5 | | 30% | | | | Clear site of vegetation; cart away | | 0.75 | | 30% | | Clear site of vegetation; cart away | |
| Prepare Formation | cubm | | 30 | | 30% | | | | Excavation and/or fill to assumed level | | 60 | | 30% | | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil | |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | | 40 | | 30% | | Safe working barriers required in the existing rail corridor | |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | | 15 | | 30% | | | | 150mm. crushed rock layer in areas of new track. | | 17.25 | | 30% | | | |
| Convert to DG | metre | | 1260 | | 30% | | | | Remove existing BG; replace with DG. | | 1386 | | 30% | | | |
| New DG Track | metre | | 1160 | | 30% | | | | | | 1195 | | 30% | | 1,535m x 2 plus a third rail from South Dynon Maintenance Depot to RRL Bypass at Dudley Street Bridge | |
| Track Slews | item | | 200 | | 30% | | | | Nominal sum. | | 210 | | 30% | | Accepted at face value | |
| Turnouts | no | | 500000 | | 30% | | | | Nominal number of turnouts replaced/relocated to | | 375000 | | 30% | | Nominal number of turnouts replaced/relocated to suit new track. Allow for removal of existing and replace with new | |
| Diamonds | no | | 500000 | | 30% | | | | | | 350000 | | 30% | | Allow for new Diamonds | |
| Track Drainage - Cess Drainage | item | | | | 30% | | | | | | 25 | | 30% | | Cess drainage only | |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | | 615 | | 30% | | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | |
| **Level Crossings** | no | | 50000 | | 30% | | | | | | 50000 | | 30% | | Allowance for Level Crossings | |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | | 10000000 | | 30% | | | | Included in tunnel costs | | 1500 | | 30% | | Nominal sum. | |
| **Bored Twin Tunnels including track, signalling OHLE etc.** | | | | | | | | | | | | | | | | |
| Bored Twin Rail Tunnels | Lin/m | 6300 | 100000 | 630000000 | 30% | 189000000 | $819,000,000 | $900,900,000 | | 5980 | 100034 | 598,204,337 | 30% | 179,461,301 | Nominal sum. | $777,665,638 |
| Ramp structure both sides | Lin/m | 600 | | | 30% | | | | | 1000 | 66454 | 66,453,543 | 30% | 19,936,063 | | $86,389,606 |
| Draught Relief Shafts | | | | | | | | | | 8 | 2000000 | 16,000,000 | 30% | 4,800,000 | | $20,800,000 |
| | | | | | | | $819,000,000 | $900,900,000 | | | | | | | | $884,855,244 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | | | | | | | | | | | | | | | | |
| New Structures and Wiring | metre | | 800 | | 30% | | | | All electrification costs are deemed to be included in the Tunnel co | | 880 | | 30% | | All electrification costs are deemed to be included in the Tunnel costs | |
| Sundry Connections/Alterations | item | | 500000 | | 30% | | | | | | 550000 | | 30% | | | |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | | 6000000 | | 30% | | | | | | 5900000 | | 30% | | | |
| Tie Station | no | | 4000000 | | 30% | | | | | | 4000000 | | 30% | | | |
| | | | | | | | | | | | | | | | | |
| **STATION WORKS** | | | | | | | | | | | | | | | | |
| **South Yarra Station Track Junction** | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum to re-arrange junction to suit MM1 | 1 | 5500000 | 5,500,000 | 30% | 1,650,000 | Nominal sum to rebuild station. | $7,150,000 |
| **Hawksburn Station** | item | | 2000000 | | 30% | | | | See separate estimate for alterations to platforms and Station C | | 125000000 | | 30% | | New Underground Station EXCLUDED | |
| **Toorak Station** | item | | 2000000 | | 30% | | | | See separate estimate for alterations to platforms and Station C | | 125000000 | | 30% | | New Underground Station EXCLUDED | |
| **Armadale Station** | item | | 2000000 | | 30% | | | | See separate estimate for alterations to platforms and Station C | | 125000000 | | 30% | | New Underground Station EXCLUDED | |
| **Malvern Station** | item | | 2000000 | | 30% | | | | See separate estimate for alterations to platforms and Station C | | 125000000 | | 30% | | New Underground Station EXCLUDED | |
| **Caulfield Station Track Junction** | item | 1 | 100000000 | 100000000 | 30% | 30000000 | $130,000,000 | $143,000,000 | Yard rearrangement and portal works | 1 | 63,546,457 | 63,546,457 | 30% | 19,063,937 | Yard re-arrangement works only - portal works included above | $82,610,394 |
| | | | | | | | $136,500,000 | $150,150,000 | | | | | | | | $89,760,394 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | | | | | | | | | | | | | | | | |
| Surrey Road | metre | 21 | | | 30% | | | | | | 4800 | | 30% | | | |
| Dandenong Road | metre | 28 | | | 30% | | | | Nominal sum for "typical" single track | | 4800 | | 30% | | | |
| Finlayson Street | metre | 13 | | | 30% | | | | rail bridges. | | 4800 | | 30% | | | |
| Smith Street | metre | 25 | | | 30% | | | | | | 4800 | | 30% | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Road Bridges** | | | | | | | | | | | | | | | | |
| William Street | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| Chapel Street | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| Cromwell Road | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| Williams Road | item | 1 | | | 30% | | | | Nominal sum for unspecified alterations to allow additional track. | | 4800 | | 30% | | | |
| Mathoura Road | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| Orrong/Malvern Road | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| High Street | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| Kooyong Road | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| Wattletree Road | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| Glenferrie Road | item | 1 | | | 30% | | | | | | 4800 | | 30% | | | |
| **Miscellaneous** | | | | | | | | | | | | | | | | |
| Retaining Walls | meter | 4200 | | | 30% | | | | Assume retaining walls required for approx 90% of distance from South Yarra to Malvern. | | | | 30% | | | |
| Footbridges/Subways | item | 1 | | | 30% | | | | Nominal sum for unspecified alterations to Canterbury Road footbridge, Alleyne Avenue footbridge, Dandenong Road subway and Tooronga Road subway. | | | | 30% | | | |
| | | | | | | | | | | | | | | | | |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | $1,430,000 |
| Track Occupations | no | 20 | 150000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | Weekend shutdown | 20 | 250000 | 5,000,000 | 30% | 1,500,000 | Weekend shutdown | $6,500,000 |
| Roadworks - Surrey Road | item | 1 | | | 30% | | | | Nominal sum to regrade. | | | | | | | |
| | | | | | | | $5,200,000 | $5,720,000 | | | | | | | | $7,930,000 |
| | | | | | | | | | | | | | | | | |
| **TOTAL CONSTRUCTION COST** | | | | 749100000 | 30% | 224730000 | $973,830,000 | $1,071,213,000 | | | | 766,914,337 | 30% | 230,074,301 | | $996,988,638 |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $224,730,000 | $247,203,000 | 30% (Nominal) | | | | | | 30% (Nominal) | $230,074,301 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $1,198,560,000 | $1,318,416,000 | | | | | | | | $1,227,062,939 |
| Land Acquisition | | | | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum for unspecified land purchases, compensation, etc. | | | 10,000,000 | 30% | 3,000,000 | Nominal sum for unspecified land purchases, compensation, etc. | $13,000,000 |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $1,211,560,000 | $1,332,716,000 | | | | | | | | $1,240,062,939 |
| Design | | | | | | | $119,856,000 | $131,841,600 | 10% (Nominal) | | | | | | 10% (Nominal) | $122,706,294 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $1,331,416,000 | $1,464,557,600 | | | | | | | | $1,362,769,233 |
| Principal Supplied Project Insurance | | | | | | | $9,240,898 | $10,164,987 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $9,460,655 |
| DoT Project Management (major role) | | | | | | | $121,156,000 | $133,271,600 | 10% (Nominal) | | | | | | 10% (Nominal) | $124,006,293.91 |
| Lessee/Operator PM (minor role) | | | | | | | $18,173,400 | $19,990,740 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $18,600,944 |
| Risk | | | | | | | $441,223,620 | $485,345,982 | 30% (Nominal) | | | | | | 30% (Nominal) | $451,612,941 |
| **TOTAL DIRECT COSTS** | | | | | | | $1,921,209,918 | $2,113,330,909 | | | | | | | | $1,966,450,068 |
| DOT Corporate Levy | | | | | | | $19,212,099 | $21,133,309 | 1% | | | | | | 1% | $19,664,500.68 |
| DOT Project Development Levy | | | | | | | $76,848,397 | $84,533,236 | 4% | | | | | | 4% | $78,658,002.70 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $2,017,270,413 | $2,218,997,455 | | | | | | | | $2,064,772,571 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $2,017,270,413 | $2,218,997,455 | | | | | | | | $2,064,772,571 |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** Preliminary Concept Diagram
**SCOPE:** R. Bartlett/J. Hearsch

**PROJECT:** Regional Rail East
Caulfield to Springvale
Two Electrified Tracks

**ORDER OF COST ESTIMATE**

**PROJECT:** Regional Rail East
Caulfield to Springvale
Two Electrified Tracks

**ORDER OF COST ESTIMATE - WT PARTNERSHIP**

Roundi

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 100000 | 100000 | 30% | 30000 | $130,000 | $143,000 | Nominal allowance | 1 | 110000 | 110000 | 30% | 33,000 | Nominal allowance | $143,000 |
| Demolition | item | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | Nominal allowance to remove unspecified buildings, minor structures, fences, roads, etc. | 1 | 550000 | 550000 | 30% | 165,000 | Nominal allowance to remove unspecified buildings, minor structures, fences, roads, etc. | $715,000 |
| | | | | | | | $780,000 | $858,000 | | | | | | | | $858,000 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 10000000 | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | 1 | 11000000 3 | 11000000 | 30% | 3,300,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | $14,300,000 |
| | | | | | | | $13,000,000 | $14,300,000 | | | | | | | | $14,300,000 |
| **SOUTH DYNON - SOUTHERN CROSS** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | 190500 | 0.5 | 95250 | 30% | 28575 | $123,825 | $136,208 | Clear site of vegetation; cart away | 18960 | 0.75 | 14,220 | 30% | 4,266 | Clear site of vegetation; cart away | $18,486 |
| Prepare Formation | cubm | 139700 | 30 | 4191000 | 30% | 1257300 | $5,448,300 | $5,993,130 | Excavation and/or fill to assumed level | 13904 | 60 | 834,240 | 30% | 250,272 | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil | $1,084,512 |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | 11748 | 40 | 469,920 | 30% | 140,976 | Safe workin barriers required in the existing rail corridor | $610,896 |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | 139700 | 15 | 2095500 | 30% | 628650 | $2,724,150 | $2,996,565 | 150mm. crushed rock layer in areas of new track. | 9504 | 17.25 | 163,944 | 30% | 49,183 | 150mm. crushed rock layer in areas of new track. | $213,127 |
| New BG Platform Roads Track | metre | 800 | 900 | 720000 | 30% | 216000 | $936,000 | $1,029,600 | New platform roads at Hughesdale and Huntingdale due to platform cutbacks and/or realigments. | 800 | 1386 | 1,108,800 | 30% | 332,640 | New platform roads at Hughesdale and Huntingdale due to platform cutbacks and/or realigments. | $1,441,440 |
| New DG Track at Grade | metre | 25400 | 1160 | 29464000 | 30% | 8839200 | $38,303,200 | $42,133,520 | | 1728 | 1195 | 2,064,960 | 30% | 619,488 | | $2,684,448 |
| New DG Track - Elevated from Carnegie Grange to Hughesdale | | | | | | | | | | 6500 | 30000 | 195,000,000 | 30% | 58,500,000 | $6,000/m2 for elevated structure including trackwork | $253,500,000 |
| New DG Track - Clyton Road/Centre Road Elevated | | | | | | | | | | 3800 | 30000 | 114,000,000 | 30% | 34,200,000 | $6,000/m2 for elevated structure including trackwork | $148,200,000 |
| New DG Track - Corrigan Road to Noble Park Elevated | | | | | | | | | | 4940 | 30000 | 148,200,000 | 30% | 44,460,000 | $6,000/m2 for elevated structure including trackwork | $192,660,000 |
| New DG Track - Corrigan Road to Noble Park Elevated - CREDIT (Moved to Springfield - | | | | | | | | | | -4940 | 30000 | -148,200,000 | 30% | -44,460,000 | $6,000/m2 for elevated structure including trackwork | ($192,660,000) |
| Convert to DG | metre | | | | 30% | | | | Remove existing BG; replace with DG. | 9220 | 1386 | 12,778,920 | 30% | 3,833,676 | Remove existing Broad Guage; replace with Dual Guage | $16,612,596 |
| Track Slews | item | 2000 | 200 | 400000 | 30% | 120000 | $520,000 | $572,000 | Nominal sum. | 2000 | 210 | 420,000 | 30% | 126,000 | Accepted at face value | $546,000 |
| Turnouts | no | 6 | 500000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | Nominal number of turnouts replaced/relocated to | 6 | 375000 | 2,250,000 | 30% | 675,000 | Nominal number of turnouts replaced/relocated to suit new track. | $2,925,000 |
| Diamonds | no | | 500000 | | 30% | | | | | | 350000 | | 30% | | Allow for new Diamonds | |
| Track Drainage - Cess Drainage | item | | 5080000 | | 30% | | | | | 17768 | 25 | 444,200 | 30% | 133,260 | Cess drainage only | $577,460 |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | 17768 | 615 | 10,927,320 | 30% | 3,278,196 | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | $14,205,516 |
| **Level Crossings (Pedestrian)** | no | 3 | 20000 | 60000 | 30% | 18000 | $78,000 | $85,800 | | 3 | 22000 | 66,000 | 30% | 19,800 | Allowance for Level Crossings | $85,800 |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | 1 | 10000000 | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum. | 17768 | 1500 | 26,652,000 | 30% | 7,995,600 | | $34,647,600 |
| | | | | | | | $65,033,475 | $71,536,823 | | | | | | | | $477,352,881 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 10160000 | 10160000 | 30% | 3048000 | $13,208,000 | $14,528,800 | Nominal sum to re-arrange overhead wiring to suit new track layout. | 1 | 11176000 | 11,176,000 | 30% | 3,352,800 | Nominal sum to re-arrange overhead wiring to suit new track layout. | $14,528,800 |
| New Structures and Wiring | metre | 25400 | 800 | 20320000 | 30% | 6096000 | $26,416,000 | $29,057,600 | | 17768 | 880 | 15,635,840 | 30% | 4,690,752 | | $20,326,592 |
| Sundry Connections/Alterations | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | | 1 | 1100000 | 1,100,000 | 30% | 330,000 | | $1,430,000 |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | 1 | 6000000 | 6000000 | 30% | 1800000 | $7,800,000 | $8,580,000 | | 1 | 5900000 | 5,900,000 | 30% | 1,770,000 | | $7,670,000 |
| Tie Station | no | 1 | 4000000 | 4000000 | 30% | 1200000 | $5,200,000 | $5,720,000 | | 1 | 4000000 | 4,000,000 | 30% | 1,200,000 | | $5,200,000 |
| | | | | | | | $53,924,000 | $59,316,400 | | | | | | | | $49,155,392 |
| **STATION WORKS** | | | | | | | | | | | | | | | | |
| **Carnegie Station** | item | 1 | 15000000 | 15000000 | 50% | 7500000 | $22,500,000 | $24,750,000 | Nominal sum to rebuild station. | 1 | 16500000 | 16,500,000 | 50% | 8,250,000 | Nominal sum to rebuild station. | $24,750,000 |
| **Murrumbeena Station** | item | 1 | 15000000 | 15000000 | 50% | 7500000 | $22,500,000 | $24,750,000 | Nominal sum to rebuild station. | 1 | 16500000 | 16,500,000 | 50% | 8,250,000 | Nominal sum to rebuild station. | $24,750,000 |
| **Hughesdale Station** | item | 1 | 15000000 | 15000000 | 50% | 7500000 | $22,500,000 | $24,750,000 | Nominal sum to rebuild station. | 1 | 16500000 | 16,500,000 | 50% | 8,250,000 | Nominal sum to rebuild station. | $24,750,000 |
| Slew Tracks | metre | 400 | 200 | 80000 | 150% | 120000 | $200,000 | $220,000 | | 400 | 210 | 84,000 | 150% | 126,000 | | $210,000 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Oakleigh** | item | | 15000000 | | 50% | | | | Assume no work required | | 16500000 | | 50% | | Assume no work required | |
| **Huntingdale Station** | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum to re-align platform faces; provide new station building and facilities; car parking. | 1 | 5500000 | 5,500,000 | 30% | 1,650,000 | Nominal sum to re-align platform faces; provide new station building and facilities; car parking. | $7,150,000 |
| **Clayton Station** | item | 1 | 3700000 | 3700000 | 30% | 1110000 | $4,810,000 | $5,291,000 | Nominal sum to rebuild station. | 1 | 16500000 | 16,500,000 | 30% | 4,950,000 | Nominal sum to re-align platform faces; provide new station building and facilities; car parking. | $21,450,000 |
| **Westall Station** | item | | 15000000 | | 50% | | | | Assume no work required | | 16500000 | | 50% | | Assume no work required | |
| **Springvale Station** | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Nominal sum to re-align platform faces; provide new station building and facilities; car parking. (Assume station reconstructed by others, at lower level, as part of future grade separation). | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Nominal sum to re-align platform faces; provide new station building and facilities; car parking. (Assume station reconstructed by others, at lower level, as part of future grade separation). | $2,860,000 |
| | | | | | | | $81,610,000 | $89,771,000 | | | | | | | | $105,920,000 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | | | | | | | | | | | | | | | | |
| Queens Avenue | metre | 26 | 60000 | 1560000 | 30% | 468000 | $2,028,000 | $2,230,800 | | 286 | 6000 | 1,716,000 | 30% | 514,800 | | $2,230,800 |
| **Road Bridges** | | | | | | | | | | | | | | | | |
| Warrigal Road | | | | | | | | | Assume no work required | | | | | | Assume no work required | |
| Hanover Street | | | | | | | | | Assume no work required | | | | | | Assume no work required | |
| North Road | | 1 | 4000000 | 4000000 | 30% | 1200000 | $5,200,000 | $5,720,000 | Nominal sum for unspecified alterations to accommodate extra | 1 | 4400000 | 4,400,000 | 30% | 1,320,000 | Nominal sum for unspecified alterations to accommodate extra tra | $5,720,000 |
| Westall Road | | | | | 30% | | | | Assume no work required | | | | | | Assume no work required | |
| **Miscellaneous (Footbridges/Subways)** | item | 1 | 20000000 | 20000000 | 30% | 6000000 | $26,000,000 | $28,600,000 | Nominal sum for unspecified alterations at Koornang Road, Murrumbeena, Huntingdale, Wordsworth Avenue, Moore Avenue and Lewis Street. | 1 | 22000000 | 22,000,000 | 30% 30% | 6,600,000 | Nominal sum for unspecified alterations at Koornang Road, Murrumbeena, Huntingdale, Wordsworth Avenue, Moore Avenue and Lewis Street. | $28,600,000 |
| **Grade Separations** | | | | | | | | | | | | | | | | |
| Underpass | item | 1 | 22800000 | 22800000 | 50% | 11400000 | $34,200,000 | $37,620,000 | Single track underpass - see separate estimate. | 1 | 45000000 | 45,000,000 | 50% | 22,500,000 | Single track underpass - see separate estimate. | $67,500,000 |
| Springvale Road | item | 1 | 26000000 | 26000000 | 50% | 13000000 | $39,000,000 | $42,900,000 | Provide for 2no additional tracks at lowered level. | 1 | 45000000 | 45,000,000 | 50% | 22,500,000 | Provide for 2no additional tracks at lowered level. | $67,500,000 |
| Carnegie - Murrumbeena | item | 1 | 35000000 | 35000000 | 50% | 17500000 | $52,500,000 | $57,750,000 | Lower Tracks | 1 | | | 50% | | Lower Tracks | |
| Centre Road - Clayton Road | item | 1 | 34000000 | 34000000 | 50% | 17000000 | $51,000,000 | $56,100,000 | Lower Tracks | 1 | | | 50% | | Lower Tracks | |
| | | | | | | | $209,928,000 | $230,920,800 | | | | | | | | $171,550,800 |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | $1,430,000 |
| Roadworks | item | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | Nominal sum for road re-grading works associated with level crossing upgrades. | 1 | 550000 | 550,000 | 30% | 165,000 | Nominal sum for road re-grading works associated with level crossing upgrades. | $715,000 |
| Track Occupations | no | 20 | 150000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | Weekend shutdown | 20 | 250000 | 5,000,000 | 30% | 1,500,000 | Weekend shutdown | $6,500,000 |
| | | | | | | | $5,850,000 | $6,435,000 | | | | | | | | $8,645,000 |
| **TOTAL CONSTRUCTION COST** | | | | 305745750 | 41% | 124379725 | $430,125,475 | $473,138,023 | | | | 615,216,364 | 35% | 212,565,709 | | $827,782,073 |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $91,747,725 | $100,922,498 | 30% (Nominal) | | | | | | 30% (Nominal) | $184,564,909 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $521,873,200 | $574,060,520 | | | | | | | | $1,012,346,982 |
| Land Acquisition | | | | | 30% | | | | Nominal sum for unspecified land purchases, compensation, etc. | | | | 30% | | Nominal sum for unspecified land purchases, compensation, etc. | |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $521,873,200 | $574,060,520 | | | | | | | | $1,012,346,982 |
| Design | | | | | | | $52,187,320 | $57,406,052 | 10% (Nominal) | | | | | | 10% (Nominal) | $101,234,698 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $574,060,520 | $631,466,572 | | | | | | | | $1,113,581,680 |
| Principal Supplied Project Insurance | | | | | | | $4,023,642 | $4,426,007 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $7,805,195 |
| DoT Project Management (major role) | | | | | | | $52,187,320 | $57,406,052 | 10% (Nominal) | | | | | | 10% (Nominal) | $101,234,698.22 |
| Lessee/Operator PM (minor role) | | | | | | | $7,828,098 | $8,610,908 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $15,185,205 |
| Risk | | | | | | | $190,222,781 | $209,245,060 | 30% (Nominal) | | | | | | 30% (Nominal) | $369,000,475 |
| **TOTAL DIRECT COSTS** | | | | | | | $828,322,362 | $911,154,598 | | | | | | | | $1,606,807,254 |
| DOT Corporate Levy | | | | | | | $8,283,224 | $9,111,546 | 1% | | | | | | 1% | $16,068,072.54 |
| DOT Project Development Levy | | | | | | | $33,132,894 | $36,446,184 | 4% | | | | | | 4% | $64,272,290.14 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $869,738,480 | $956,712,328 | | | | | | | | $1,687,147,616 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $869,738,480 | $956,712,328 | | | | | | | | $1,687,147,616 |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** Preliminary Concept Diagram
**SCOPE:** R. Bartlett/J. Hearsch

**PROJECT:** Regional Rail East
Springvale to Dandenong
Two Electrified Tracks

**ORDER OF COST ESTIMATE**

Regional Rail East
Springvale to Dandenong
Two Electrified Tracks

**ORDER OF COST ESTIMATE - WT PARTNERSHIP**

**PROJECT:**

Roundi

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 100000 | 100000 | 30% | 30000 | $130,000 | $143,000 | Nominal allowance | 1 | 110000 | 110000 | 30% | 33,000 | Nominal allowance | $143,000 |
| | | | | | | | $130,000 | $143,000 | | | | | | | | $143,000 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 10000000 | 10000000 | 30% | 3000000 | $13,000,000 | $14,300,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | 1 | 11000000 | 11000000 | 30% | 3,300,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | $14,300,000 |
| | | | | | | | $13,000,000 | $14,300,000 | | | | | | | | $14,300,000 |
| **SOUTH DYNON - SOUTHERN CROSS** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | 100500 | 0.5 | 50250 | 30% | 15075 | $65,325 | $71,858 | Clear site of vegetation; cart away | 88170 | 0.75 | 66,128 | 30% | 19,838 | Clear site of vegetation; cart away | $85,966 |
| Prepare Formation | cubm | 73700 | 30 | 2211000 | 30% | 663300 | $2,874,300 | $3,161,730 | Excavation and/or fill to assumed level | 64658 | 60 | 3,879,480 | 30% | 1,163,844 | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil | $5,043,324 |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | 13386 | 40 | 535,440 | 30% | 160,632 | Safe workin barriers required in the existing rail corridor | $696,072 |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | 73700 | 15 | 1105500 | 30% | 331650 | $1,437,150 | $1,580,865 | 150mm. crushed rock layer in areas of new track. | 129316 | 17.25 | 2,230,701 | 30% | 669,210 | 150mm. crushed rock layer in areas of new track. | $2,899,911 |
| New BG Platform Roads Track | metre | 400 | 900 | 360000 | 30% | 108000 | $468,000 | $514,800 | New platform roads at Hughesdale and Huntingdale due to platform cutbacks and/or realigments. | 400 | 1386 | 554,400 | 30% | 166,320 | New platform roads at Hughesdale and Huntingdale due to platform cutbacks and/or realigments. | $720,720 |
| New DG Track | metre | 13400 | 1160 | 15544000 | 30% | 4663200 | $20,207,200 | $22,227,920 | | 11356 | 1195 | 13,570,420 | 30% | 4,071,126 | | $17,641,546 |
| Convert to DG | metre | | | | 30% | | | | Remove existing BG; replace with DG. | 1630 | 1386 | 2,259,180 | 30% | 677,754 | Remove existing Broad Guage; replace with Dual Guage | $2,936,934 |
| Track Slews | item | 1000 | 200 | 200000 | 30% | 60000 | $260,000 | $286,000 | Nominal sum. | 1000 | 210 | 210,000 | 30% | 63,000 | Accepted at face value | $273,000 |
| New DG Track - Corrigan Road to Noble Park Elevated | | | | | | | | | | 4940 | 30000 | 148,200,000 | 30% | 44,460,000 | $6,000/m2 for elevated structure including trackwork | $192,660,000 |
| Turnouts | no | 2 | 500000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal number of turnouts replaced/relocated to | 2 | 375000 | 750,000 | 30% | 225,000 | Nominal number of turnouts replaced/relocated to suit new track. | $975,000 |
| Diamonds | no | | 500000 | | 30% | | | | | | 350000 | | 30% | | Allow for new Diamonds | |
| Track Drainage - Cess Drainage | item | 1 | 2680000 | 2680000 | 30% | 804000 | $3,484,000 | $3,832,400 | | 11756 | 25 | 293,900 | 30% | 88,170 | Cess drainage only | $382,070 |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | 11756 | 615 | 7,229,940 | 30% | 2,168,982 | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | $9,398,922 |
| **Level Crossings (Pedestrian)** | no | 1 | 20000 | 20000 | 30% | 6000 | $26,000 | $28,600 | | 1 | 22000 | 22,000 | 30% | 6,600 | Nominal sum for extra works at stabling siding,, | $28,600 |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum. | 11756 | 1500 | 17,634,000 | 30% | 5,290,200 | Nominal sum. | $22,924,200 |
| | | | | | | | $36,621,975 | $40,284,173 | | | | | | | | $256,666,265 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 2680000 | 2680000 | 30% | 804000 | $3,484,000 | $3,832,400 | Nominal sum to re-arrange overhead wiring to suit new track layout. | 1 | 2948000 | 2,948,000 | 30% | 884,400 | Nominal sum to re-arrange overhead wiring to suit new track layout. | $3,832,400 |
| New Structures and Wiring | metre | 13400 | 800 | 10720000 | 30% | 3216000 | $13,936,000 | $15,329,600 | | 11756 | 880 | 10,345,280 | 30% | 3,103,584 | | $13,448,864 |
| Sundry Connections/Alterations | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | | 1 | 1100000 | 1,100,000 | 30% | 330,000 | | $1,430,000 |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | 1 | 6000000 | 6000000 | 30% | 1800000 | $7,800,000 | $8,580,000 | | 1 | 5900000 | 5,900,000 | 30% | 1,770,000 | | $7,670,000 |
| Tie Station | no | 1 | 4000000 | 4000000 | 30% | 1200000 | $5,200,000 | $5,720,000 | | 1 | 4000000 | 4,000,000 | 30% | 1,200,000 | | $5,200,000 |
| | | | | | | | $31,720,000 | $34,892,000 | | | | | | | | $31,581,264 |
| **STATION WORKS** | | | | | | | | | | | | | | | | |
| **Sandown Park Station** | | | | | | | | | Assume no work required | | | | | | Assume no work required | |
| **Noble Park Station** | item | 1 | 150000 | 150000 | 30% | 45000 | $195,000 | $214,500 | Nominal sum to replace car spaces lost a/c new track construction. | 1 | 165000 | 165,000 | 30% | 49,500 | Nominal sum to replace car spaces lost a/c new track construction. | $214,500 |
| **Yarraman Station** | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Re-align platform faces; new building. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Re-align platform faces; new building. | $2,860,000 |
| **Dandenong Station** | item | 1 | 200000 | 200000 | 30% | 60000 | $260,000 | $286,000 | Nominal sum for unspecified alterations to existing. | 1 | 220000 | 220,000 | 30% | 66,000 | Nominal sum for unspecified alterations to existing. | $286,000 |
| **Dandenong Yard Re-arrangement** | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum to re-arrange yard to suit new track layout. | 1 | 5500000 | 5,500,000 | 30% | 1,650,000 | Nominal sum to re-arrange yard to suit new track layout. | $7,150,000 |
| | | | | | | | $9,555,000 | $10,510,500 | | | | | | | | $10,510,500 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | | | | | | | | | | | | | | | | |
| Mile Creek | metre | 35 | 60000 | 2100000 | 30% | 630000 | $2,730,000 | $3,003,000 | | 385 | 6000 | 2,310,000 | 30% | 693,000 | | $3,003,000 |
| Yarraman Creek | metre | 6 | 60000 | 360000 | 30% | 108000 | $468,000 | $514,800 | | 66 | 6000 | 396,000 | 30% | 118,800 | | $514,800 |
| **Road Bridges** | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jones Road | item | 1 | 12000000 | 12000000 | 30% | 3600000 | $15,600,000 | $17,160,000 | Partial reconstruction to allow extra track | 1 | 13200000 | 13,200,000 | 30% | 3,960,000 | Partial reconstruction to allow extra track | $17,160,000 |
| **Miscellaneous (Sundry)** | | | | | | | | | | | | | | | | |
| Sandown Park Former Subway | item | | 2000000 | | 30% | | | | Assume no work required. | | 2200000 | | 30% | | Assume no work required. | |
| Sandown Park Subway | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Extend subway; re-arrange ramp. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Extend subway; re-arrange ramp. | $2,860,000 |
| Noble Park Subway | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Extend subway; re-arrange ramp. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Extend subway; re-arrange ramp. | $2,860,000 |
| Callaghan Street Subway | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Extend subway; re-arrange ramp. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Extend subway; re-arrange ramp. | $2,860,000 |
| Yarraman Footbridge | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Extend bridge. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Extend bridge. | $2,860,000 |
| Pickett Street Subway | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Extend subway; re-arrange ramp. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Extend subway; re-arrange ramp. | $2,860,000 |
| Dandenong Footbridge | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Extend bridge. | 1 | 2200000 | 2,200,000 | 30% | 660,000 | Extend bridge. | $2,860,000 |
| **Grade Separations** | | | | | | | | | | | | | | | | |
| Noble Park | item | 1 | 12000000 | 12000000 | 50% | 6000000 | $18,000,000 | $19,800,000 | Nominal sum | | | | 50% | | Included in Elevated Rail Above | |
| | | | | | | | $52,398,000 | $57,637,800 | | | | | | | | $37,837,800 |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | $1,430,000 |
| Roadworks | item | 2 | 500000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for road re-grading works associated with level crossing upgrades. | 2 | 550000 | 1,100,000 | 30% | 330,000 | Nominal sum for road re-grading works associated with level crossing upgrades. | $1,430,000 |
| Track Occupations | no | 10 | 150000 | 1500000 | 30% | 450000 | $1,950,000 | $2,145,000 | Weekend shutdown | 10 | 250000 | 2,500,000 | 30% | 750,000 | Weekend shutdown | $3,250,000 |
| | | | | | | | $4,550,000 | $5,005,000 | | | | | | | | $6,110,000 |
| | | | | | | | | | | | | | | | | |
| **TOTAL CONSTRUCTION COST** | | | | 111980750 | 32% | 35994225 | $179,694,975 | $197,664,473 | | | | 274,729,869 | 30% | 82,418,961 | | $357,148,829 |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $33,594,225 | $36,953,648 | 30% (Nominal) | | | | | | 30% (Nominal) | $82,418,961 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $213,289,200 | $234,618,120 | | | | | | | | $439,567,790 |
| Land Acquisition | | | | | 30% | | | | Nominal sum for unspecified land purchases, compensation, etc. | | | | 30% | | Nominal sum for unspecified land purchases, compensation, etc. | |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $213,289,200 | $234,618,120 | | | | | | | | $439,567,790 |
| Design | | | | | | | $21,328,920 | $23,461,812 | 10% (Nominal) | | | | | | 10% (Nominal) | $43,956,779 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $234,618,120 | $258,079,932 | | | | | | | | $483,524,569 |
| Principal Supplied Project Insurance | | | | | | | $1,644,460 | $1,808,906 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $3,389,068 |
| DoT Project Management (major role) | | | | | | | $21,328,920 | $23,461,812 | 10% (Nominal) | | | | | | 10% (Nominal) | $43,956,778.97 |
| Lessee/Operator PM (minor role) | | | | | | | $3,199,338 | $3,519,272 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $6,593,517 |
| Risk | | | | | | | $77,743,913 | $85,518,305 | 30% (Nominal) | | | | | | 30% (Nominal) | $160,222,459 |
| **TOTAL DIRECT COSTS** | | | | | | | $338,534,751 | $372,388,226 | | | | | | | | $697,686,391 |
| DOT Corporate Levy | | | | | | | $3,385,348 | $3,723,882 | 1% | | | | | | 1% | $6,976,863.91 |
| DOT Project Development Levy | | | | | | | $13,541,390 | $14,895,529 | 4% | | | | | | 4% | $27,907,455.66 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $355,461,489 | $391,007,638 | | | | | | | | $732,570,711 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $355,461,489 | $391,007,638 | | | | | | | | $732,570,711 |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** Preliminary Concept Diagram
**SCOPE:** R. Bartlett/J. Hearsch

**PROJECT:** Regional Rail East
Dandenong to Lyndhurst
Two Electrified Tracks

**ORDER OF COST ESTIMATE**

Regional Rail East
Dandenong to Lyndhurst
Two Electrified Tracks

**ORDER OF COST ESTIMATE - WT PARTNERSHIP**

**PROJECT:**

Roundi

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY | | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS | QUANTITY | RATE | ITEM COST | CONTINGENCY | | COMMENTS | TOTAL ITEM COST (2017) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | % | $ | | | | | | | % | $ | | |
| **PRELIMINARIES** | | | | | | | | | | | | | | | | |
| Mobilisation | item | 1 | 100000 | 100000 | 30% | 30000 | $130,000 | $143,000 | Nominal allowance | 1 | 110000 | 110000 | 30% | 33,000 | Nominal allowance | $143,000 |
| | | | | | | | $130,000 | $143,000 | | | | | | | | $143,000 |
| **SERVICES** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | 1 | 2200000 | 2200000 | 30% | 660,000 | Nominal sum for unspecified alteration/relocation of existing services, e.g. power, water, gas, etc. | $2,860,000 |
| | | | | | | | $2,600,000 | $2,860,000 | | | | | | | | $2,860,000 |
| **SOUTH DYNON - SOUTHERN CROSS** | | | | | | | | | | | | | | | | |
| **Earthworks** | | | | | | | | | | | | | | | | |
| Site Preparation | sqm | 105000 | 0.5 | 52500 | 30% | 15750 | $68,250 | $75,075 | Clear site of vegetation; cart away | 112785 | 0.75 | 84,589 | 30% | 25,377 | Clear site of vegetation; cart away | $109,965 |
| Prepare Formation | cubm | 49000 | 30 | 1470000 | 30% | 441000 | $1,911,000 | $2,102,100 | Excavation and/or fill to assumed level | 82709 | 60 | 4,962,540 | 30% | 1,488,762 | Excavation and/or fill to assumed level including remediation of soft spots and disposal of contaminated spoil | $6,451,302 |
| Safe working barrier along the route - temp barrier | lin/m | | | | | | | | Safe working barrier along the route - temp barrier | 15038 | 40 | 601,520 | 30% | 180,456 | Safe workin barriers required in the existing rail corridor | $781,976 |
| **Trackwork** | | | | | | | | | | | | | | | | |
| Formation Capping | sqm. | 77000 | 15 | 1155000 | 30% | 346500 | $1,501,500 | $1,651,650 | 150mm. crushed rock layer in areas of new track. | 165418 | 17.25 | 2,853,461 | 30% | 856,038 | 150mm. crushed rock layer in areas of new track. | $3,709,499 |
| New DG Track | metre | 14000 | 1160 | 16240000 | 30% | 4872000 | $21,112,000 | $23,223,200 | | 8928 | 1195 | 10,668,960 | 30% | 3,200,688 | | $13,869,648 |
| Convert to DG | metre | | | | 30% | | | | Remove existing BG; replace with DG. | 6110 | 1386 | 8,468,460 | 30% | 2,540,538 | Remove existing Broad Guage; replace with Dual Guage | $11,008,998 |
| Track Slews | item | 2000 | 200 | 400000 | 30% | 120000 | $520,000 | $572,000 | Nominal sum. | 2000 | 210 | 420,000 | 30% | 126,000 | Accepted at face value | $546,000 |
| Turnouts | no | 6 | 500000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | Nominal number of turnouts replaced/relocated to | 6 | 375000 | 2,250,000 | 30% | 675,000 | Nominal number of turnouts replaced/relocated to suit new track. | $2,925,000 |
| Diamonds | no | | 500000 | | 30% | | | | | | 350000 | | 30% | | Allow for new Diamonds | |
| Track Drainage - Cess Drainage | item | 1 | 2800000 | 2800000 | 30% | 840000 | $3,640,000 | $4,004,000 | | 8928 | 25 | 223,200 | 30% | 66,960 | Cess drainage only | $290,160 |
| Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | Lin/m | | | | 30% | | | | | 8928 | 615 | 5,490,720 | 30% | 1,647,216 | Drainage pipes and pits, in various sections of the route - allow 20% of the route, $250/m plus swales at 15% at $75/m, plus an allowance for temporary works during construction. | $7,137,936 |
| **Level Crossings (Pedestrian)** | no | | 20000 | | 30% | | | | | 1 | 22000 | 22,000 | 30% | 6,600 | Nominal sum for extra works at stabling siding,, | $28,600 |
| **Signals** | | | | | | | | | | | | | | | | |
| Signalling | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum. | 8928 | 1200 | 10,713,600 | 30% | 3,214,080 | Nominal sum. | $13,927,680 |
| | | | | | | | $39,152,750 | $43,068,025 | | | | | | | | $60,786,764 |
| **ELECTRIFICATION** | | | | | | | | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | | | | | | | | |
| Existing | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum to re-arrange overhead wiring to suit new track layout. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum to re-arrange overhead wiring to suit new track layout. | $1,430,000 |
| New Structures and Wiring | metre | 14000 | 800 | 11200000 | 30% | 3360000 | $14,560,000 | $16,016,000 | | 8928 | 880 | 7,856,640 | 30% | 2,356,992 | | $10,213,632 |
| Sundry Connections/Alterations | item | 2 | 500000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | | 2 | 550000 | 1,100,000 | 30% | 330,000 | | $1,430,000 |
| **Power Supply** | | | | | | | | | | | | | | | | |
| Substation | no | 1 | 6000000 | 6000000 | 30% | 1800000 | $7,800,000 | $8,580,000 | | 1 | 5900000 | 5,900,000 | 30% | 1,770,000 | | $7,670,000 |
| Tie Station | no | 1 | 4000000 | 4000000 | 30% | 1200000 | $5,200,000 | $5,720,000 | | 1 | 4000000 | 4,000,000 | 30% | 1,200,000 | | $5,200,000 |
| | | | | | | | $30,160,000 | $33,176,000 | | | | | | | | $25,943,632 |
| **STRUCTURAL WORKS** | | | | | | | | | | | | | | | | |
| **Rail Bridges** | | | | | | | | | | | | | | | | |
| Cheltenham Road | metre | 22 | 60000 | 1320000 | 30% | 396000 | $1,716,000 | $1,887,600 | | 242 | 6000 | 1,452,000 | 30% | 435,600 | | $1,887,600 |
| Eumemmering Creek | metre | 60 | 60000 | 3600000 | 30% | 1080000 | $4,680,000 | $5,148,000 | | 660 | 6000 | 3,960,000 | 30% | 1,188,000 | | $5,148,000 |
| Dandenong Creek Overflow | metre | 10 | 60000 | 600000 | 30% | 180000 | $780,000 | $858,000 | | 110 | 6000 | 660,000 | 30% | 198,000 | | $858,000 |
| Dandenong Creek | metre | 50 | 60000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | | 550 | 6000 | 3,300,000 | 30% | 990,000 | | $4,290,000 |
| **Miscellaneous (Sundry)** | | | | | | | | | | | | | | | | |
| Sundry items, minor structures, culverts etc. | item | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | | 1 | 550000 | 550,000 | 30% | 165,000 | Sundry items, minor structures, culverts etc. | $715,000 |
| **Grade Separations** | | | | | | | | | | | | | | | | |
| Webster Street | item | 1 | 50000000 | 50000000 | 30% | 15000000 | $65,000,000 | $71,500,000 | Nominal sum | 1 | 51000000 | 51,000,000 | 50% | 25,500,000 | Nominal sum | $76,500,000 |
| | | | | | | | $76,726,000 | $84,398,600 | | | | | | | | $89,398,600 |
| **MISCELLANEOUS** | | | | | | | | | | | | | | | | |
| Environmental | item | 1 | 1000000 | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | 1 | 1100000 | 1,100,000 | 30% | 330,000 | Nominal sum for unspecified environmental management during construction; remediation; vegetation offsets; etc. | $1,430,000 |
| Track Occupations | no | 10 | 150000 | 1500000 | 30% | 450000 | $1,950,000 | $2,145,000 | Weekend shutdown | 10 | 250000 | 2,500,000 | 30% | 750,000 | Weekend shutdown | $3,250,000 |
| | | | | | | | $3,250,000 | $3,575,000 | | | | | | | | $4,680,000 |
| **TOTAL CONSTRUCTION COST** | | | | 116937500 | 30% | 35081250 | $179,694,975 | $197,664,473 | | | | 133,547,689 | 38% | 50,264,307 | | $183,811,996 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contractor Preliminaries, Overheads & Margin | | | | | | | $35,081,250 | $38,589,375 | 30% (Nominal) | | | | | | 30% (Nominal) | $40,064,307 |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $214,776,225 | $236,253,848 | | | | | | | | $223,876,303 |
| Land Acquisition | | | | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum for unspecified land purchases, compensation, etc. | | | 5,000,000 | 30% | 1,500,000 | Nominal sum for unspecified land purchases, compensation, etc. | $6,500,000 |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $221,276,225 | $243,403,848 | | | | | | | | $230,376,303 |
| Design | | | | | | | $21,477,623 | $23,625,385 | 10% (Nominal) | | | | | | 10% (Nominal) | $22,387,630 |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $242,753,848 | $267,029,232 | | | | | | | | $252,763,933 |
| Principal Supplied Project Insurance | | | | | | | $1,655,925 | $1,821,517 | 0.77% (Nominal) | | | | | | 0.77% (Nominal) | $1,726,086 |
| DoT Project Management (major role) | | | | | | | $22,127,623 | $24,340,385 | 10% (Nominal) | | | | | | 10% (Nominal) | $23,037,630.27 |
| Lessee/Operator PM (minor role) | | | | | | | $3,319,143 | $3,651,058 | 1.5% (Nominal) | | | | | | 1.5% (Nominal) | $3,455,645 |
| Risk | | | | | | | $80,460,184 | $88,506,202 | 30% (Nominal) | | | | | | 30% (Nominal) | $83,777,162 |
| **TOTAL DIRECT COSTS** | | | | | | | $350,316,722 | $385,348,394 | | | | | | | | $364,760,456 |
| DOT Corporate Levy | | | | | | | $3,503,167 | $3,853,484 | 1% | | | | | | 1% | $3,647,604.56 |
| DOT Project Development Levy | | | | | | | $14,012,669 | $15,413,936 | 4% | | | | | | 4% | $14,590,418.26 |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $367,832,558 | $404,615,814 | | | | | | | | $382,998,479 |
| Escalation | | | | | | | | | 10% | | | | | | | |
| **TEI** | | | | | | | $367,832,558 | $404,615,814 | | | | | | | | $382,998,479 |

**PREPARED BY:** R. Bartlett
**DATE:** 11/1/2017
**PLANS:** AECOM Plans/Sections
VicRoads Plans
**SCOPE:** R. Bartlett

**NO COST COMPARISON OF THIS LINE SECTION REQUIRED FOR RRE**

**ORDER OF COST ESTIMATE**

**PROJECT:** South Gippsland Highway to Port of Hastings
Western Port Highway
Heavy Rail Link - Single Track with loops
Dual Gauge Electrified
Rail Overpass at Glasscocks Road
Altered arrangement at Browns Road

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY | | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | % | $ | | | |
| **PRELIMINARIES** | | | | | | | | | |
| Mobilisation/demobilisation | item | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | |
| Site Office and facility | no | 2 | 1000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | |
| Project office and facility | no | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | |
| Temporary storage yard | no | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | |
| | | | | | | | $6,500,000 | $7,150,000 | |
| **SERVICES** | item | 1 | 2000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | Nominal sum for unspecified alteration/relocation of existing services. |
| | | | | | | | $2,600,000 | $2,860,000 | |
| **EARTHWORKS** | | | | | | | | | |
| Subgrade stripping and preparation | sqm | 405000 | 10 | 4050000 | 30% | 1215000 | $5,265,000 | $5,791,500 | In existing Freeway median |
| Cut | cubm | 124800 | 30 | 3744000 | 30% | 1123200 | $4,867,200 | $5,353,920 | Tunnel approaches; lowering at grade separations; tracks outside of freeway median. |
| Fill | cubm | 111600 | 30 | 3348000 | 30% | 1004400 | $4,352,400 | $4,787,640 | Approaches to overpasses. |
| | | | | | | | $14,484,600 | $15,933,060 | |
| **TRACKWORK** | | | | | | | | | |
| Formation Capping | sqm. | 305800 | 40 | 12232000 | 30% | 3669600 | $15,901,600 | $17,491,760 | 150mm. crushed rock layer in areas of new track. High rate due to site constraints. |
| New Single DG Track | metre | 55600 | 1160 | 64496000 | 30% | 19348800 | $83,844,800 | $92,229,280 | |
| Crossing Loops | metre | | 1160 | | 30% | | | | |
| Track Drainage | metre | 30000 | 400 | 12000000 | 30% | 3600000 | $15,600,000 | $17,160,000 | |
| Grated pits | no | 30 | 1000 | 30000 | 30% | 9000 | $39,000 | $42,900 | |
| Turnouts | no | 4 | 500000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | |
| Diamonds | no | | 350000 | | 30% | | | | |
| | | | | | | | $117,985,400 | $129,783,940 | |
| **ELECTRIFICATION** | | | | | | | | | |
| **Overhead Wiring** | | | | | | | | | |
| Existing | item | | | | | | | | Nominal sum to re-arrange overhead wiring to suit new track layout. |
| New Structures and Wiring | metre | 55600 | 800 | 44480000 | 30% | 13344000 | $57,824,000 | $63,606,400 | |
| Sundry Connections/Alterations | item | 2 | 1000000 | 2000000 | 30% | 600000 | $2,600,000 | $2,860,000 | |
| **Power Supply** | | | | | | | | | |
| Substation | no | 3 | 6000000 | 18000000 | 30% | 5400000 | $23,400,000 | $25,740,000 | |
| Tie Station | no | 3 | 4000000 | 12000000 | 30% | 3600000 | $15,600,000 | $17,160,000 | |
| | | | | | | | $99,424,000 | $109,366,400 | |
| **CIVIL WORKS** | | | | | | | | | |
| **Tunnels** | | | | | | | | | |
| Portal | no | 2 | 130000 | 260000 | 30% | 78000 | $338,000 | $371,800 | Headwall structure |
| Tunnel Structure | metre | 500 | 105000 | 52500000 | 50% | 26250000 | $78,750,000 | $86,625,000 | Under southbound carriageway and Denham Road |
| **"Deep Trench" - Browns Road** | | | | | | | | | Under steep grade south of Cranbourne-Frankston Road. Continues under Browns Road. Tracks in deep cutting supported by propped secant pile walls |
| Mobilisation | no | 1 | 30000 | 30000 | 50% | 15000 | $45,000 | $49,500 | Piling:- set up and dismantle |
| Secant Walls | sqm | 48000 | 900 | 43200000 | 50% | 21600000 | $64,800,000 | $71,280,000 | Assume 900mm dia concrete piles. |
| Excavation | cubm | 216000 | 30 | 6480000 | 50% | 3240000 | $9,720,000 | $10,692,000 | |
| Longitudinal Beams | cubm | 1152 | 2000 | 2304000 | 50% | 1152000 | $3,456,000 | $3,801,600 | 2 rows of concrete beams. |
| Transverse Beams | cubm | 3600 | 2000 | 7200000 | 50% | 3600000 | $10,800,000 | $11,880,000 | Concrete beams, in pairs, spanning the cutting at 6m centres |
| **Freeway Drainage** | metre | 30000 | 400 | 12000000 | 30% | 3600000 | $15,600,000 | $17,160,000 | Nominal sum for unspecified alterations. |
| **Bridges** | | | | | | | | | |

| DESCRIPTION | UNIT | QUANTITY | RATE | ITEM COST | CONTINGENCY % | CONTINGENCY $ | TOTAL ITEM COST | ESCALATED 2017 TOTAL ITEM COST | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| Road Bridges | no | | | | | | - | | Assume grade separations complete prior to rail construction |
| Pier Strengthening | no | 7 | 500000 | 3500000 | 30% | 1050000 | $4,550,000 | $5,005,000 | Nominal sum for unspecified works at road overpasses:- Wedge Road, Hall Road, Ballarto Road, Cranbourne-Frankston Road, Robinsons Road, Baxter-Tooradin Road, Bungower Road |
| Rail Bridges: Glasscocks Road | metre | 30 | 60000 | 1800000 | 30% | 540000 | $2,340,000 | $2,574,000 | |
| Northbound carriageway | metre | 120 | 60000 | 7200000 | 30% | 2160000 | $9,360,000 | $10,296,000 | |
| Thompsons Road | metre | 60 | 60000 | 3600000 | 30% | 1080000 | $4,680,000 | $5,148,000 | |
| North Road | metre | 40 | 60000 | 2400000 | 30% | 720000 | $3,120,000 | $3,432,000 | |
| **Retaining Walls** | metre | 6700 | 7560 | 50652000 | 30% | 15195600 | $65,847,600 | $72,432,360 | Ramped approaches to tunnels; embankments. |
| **Barriers** | metre | 21350 | 5500 | 117425000 | 30% | 35227500 | $152,652,500 | $167,917,750 | Retaining structure placed on bored piers at 3m spacing. |
| **Freeway Structures** | item | 1 | 500000 | 500000 | 30% | 150000 | $650,000 | $715,000 | Nominal sum for unspecified alterations to barriers, gantries, signs, etc. |
| | | | | | | | $625,557,100 | $688,112,810 | |
| **SIGNALS** | | | | | | | | | |
| Signalling | item | 1 | 5000000 | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum |
| | | | | | | | $6,500,000 | $7,150,000 | |
| **MISCELLANEOUS** | | | | | | | | | |
| Landscaping/Furniture | item | | | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum |
| Environmental | item | | | 1000000 | 30% | 300000 | $1,300,000 | $1,430,000 | Nominal sum |
| Traffic Mitigation | item | 1 | 3000000 | 3000000 | 30% | 900000 | $3,900,000 | $4,290,000 | Nominal sum |
| Temporary protection | metre | 10000 | 350 | 3500000 | 30% | 1050000 | $4,550,000 | $5,005,000 | Concrete barrier |
| Safety Fence | metre | 10000 | 120 | 1200000 | 30% | 360000 | $1,560,000 | $1,716,000 | |
| | | | | | | | $17,810,000 | $19,591,000 | |
| | | | | | | | | | |
| **TOTAL CONSTRUCTION COST** | | | | 515100000 | 34% | 176882100 | $791,437,100 | $870,580,810 | |
| Contractor Preliminaries, Overheads & Margin | | | | | | | $103,020,000 | $113,322,000 | 20% (Nominal) |
| **TOTAL CONSTRUCTION COST INCL PRELIMS, OVERHEADS & MARGIN** | | | | | | | $894,457,100 | $983,902,810 | |
| Land Acquisition | | | | 5000000 | 30% | 1500000 | $6,500,000 | $7,150,000 | Nominal sum for unspecified land purchases, compensation , etc. |
| **TOTAL CONSTRUCTION COST INCL LAND ACQUISITION** | | | | | | | $900,957,100 | $991,052,810 | |
| Design | | | | | | | $89,445,710 | $98,390,281 | 10% (Nominal) |
| **TOTAL CONSTRUCTION COST INCL DESIGN** | | | | | | | $990,402,810 | $1,089,443,091 | |
| Principal Supplied Project Insurance | | | | | | | $6,896,264 | $7,585,891 | 0.77% (Nominal) |
| DoT Project Management (major role) | | | | | | | $90,095,710 | $99,105,281 | 10% (Nominal) |
| Lessee/Operator PM (minor role) | | | | | | | $13,514,357 | $14,865,792 | 1.5% (Nominal) |
| Other Authority/Agency Consultee charges | | | | | | | $13,514,357 | $14,865,792 | 1.5% (Nominal) |
| Risk | | | | | | | $221,505,447 | $243,655,991 | 20.0% (Nominal) |
| **TOTAL DIRECT COSTS** | | | | | | | $1,335,928,944 | $1,469,521,838 | |
| DOT Corporate Levy | | | | | | | $13,359,289 | $14,695,218 | 1% |
| DOT Project Development Levy | | | | | | | $53,437,158 | $58,780,874 | 4% |
| **TOTAL PROJECT COST ($REAL)** | | | | | | | $1,402,725,391 | $1,542,997,930 | |
| Escalation | | | | | | | $1,335,929 | $1,469,522 | 10% |
| **TEI** | | | | | | | $1,404,061,320 | $1,544,467,452 | |

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Document Status

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|---|---|---|---|---|---|---|
| | | Name | Signature | Name | Signature | Date |
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| | | | | | | |
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# **Appendix F** - References


Preliminary Siltation Analysis Report (HAS-CEP0-HY-REP-0016-B )

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Document Status

| Revision | Author | Reviewer | | Approved for Issue | | |
|---|---|---|---|---|---|---|
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