Part C

Addendum to the infrastructure and supply chain requirements assessment report

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Priority Port of Gladstone master planning

Addendum to the Infrastructure and Supply Chain Requirements Assessment

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1 Introduction

1.1 Background

The Queensland Government is currently advancing master planning for the priority ports of Gladstone, Abbot Point, Townsville, and Hay Point and Mackay in accordance with the *Sustainable Ports Development Act 2015* (Qld) (Ports Act).

Master planning for priority ports is one of the port-related actions of the Reef 2050 Long-Term Sustainability Plan (Reef 2050), and is mandated under the Ports Act.

Through port master planning, the Queensland Government seeks to effectively manage the land and marine areas needed for the efficient development and operation of each of the priority ports, while ensuring that the Outstanding Universal Value (OUV) of the Great Barrier Reef World Heritage Area (GBRWHA) is an intrinsic consideration in port development, management and governance.

Master planning for each of Queensland's priority ports is required to:

- Define a long term strategic vision, objectives and desired outcomes for each port master planned area
- Identify the state interests in relation to the priority ports and articulate how those interests are to be considered in all planning decisions made within each port master planned area
- Present an environmental management framework (EMF) that states priority management measures (PMMs) for managing potential impacts on environmental values in the master planned area and surrounding areas in accordance with principles of ecologically sustainable development (ESD)

The Ports Act requires that a master plan be prepared for each of the priority ports of Gladstone, Abbot Point, Townsville, and Hay Point and Mackay.

To support each master plan, the Ports Act also requires that a port overlay be made for each priority port as the relevant legislative instrument for the master plan over each master planned area.

1.2 Purpose

To support master planning for the priority Port of Gladstone, the Department of State Development (DSD) has prepared an evidence base which collates information on the economic, environmental, community and cultural aspects of the priority Port of Gladstone. The evidence base consists of the following reporting:

- Evidence Base Report for the Proposed Gladstone Port Master Planned Area (AECOM 2016) (herein referred to as the 'evidence base report')
- Capacity for Growth Scenarios – Master Planning for the Priority Port of Gladstone Master Plan (DSD 2016)
- Priority Port of Gladstone Master Planning – Risk Assessment (Aurecon 2016)
- Infrastructure and Supply Chain Requirements Assessment (ISCRA) Report (PSA Consulting 2016) (herein referred to as the ISCRA)

This report is an addendum to the ISCRA prepared by PSA Consulting, and provides additional information on the infrastructure and supply chain requirements to inform preparation of the priority Port of Gladstone draft master plan and preliminary draft port overlay.

This report contains sections on:

- **Port trade growth (Section 2)** – an outline of the growth scenario 3, with development of potential port throughput by specific cargo and description of corresponding infrastructure and shipping requirements. This section provides more detailed breakdown of throughput predictions by cargo, supplementing Section 4.1 of the ISCRA.
- **Potential marine infrastructure expansion (Section 3)** – presents the potential port throughput by specific cargo and a description of corresponding marine infrastructure and shipping requirements. This section also summarises possible vessel size changes, berth numbers and locations, and possible requirements for dredging, dredged material placement and emergency anchorages within the master planned area. Finally, this section provides a more detailed breakdown of throughput predictions by cargo, and highlights linkages between the predicted throughput and the potential expansion of port infrastructure, supplementing Section 4.1 and Section 4.2 of the ISCRA.
- **Supply chain linkage – infrastructure corridors (Section 4)** – a summary of the additional port supply chain linkages and infrastructure requirements required to support the master plan growth scenario 3. This section provides additional description to Section 4.3 of the ISCRA.
- **Optimisation of port infrastructure (Section 5)** – provides an overview of the principles and processes involved in the optimisation of port infrastructure.
- **Key considerations for the draft master plan (Section 6)** – summarises the key issues discussed in this addendum which should be considered in the preparation of the priority Port of Gladstone draft master plan and preliminary draft port overlay.

2 Port trade growth

DSD, in consultation with key stakeholders has determined the capacity for growth scenarios for the priority Port of Gladstone master planning process to a 2050 timeframe. Three scenarios were developed and documented by DSD in the Capacity for Growth Scenarios (DSD 2016).

The ISCRA discusses several growth scenarios and details the infrastructure and supply chain requirements for growth scenario 3. Growth scenario 3 has been considered further within this addendum report. The Capacity for Growth Scenarios prepared by DSD assumes that the master plan growth scenario 3 constitutes the industries within the master planned area as summarised in Table 2.1.

Table 2.1 Growth scenario 3 industries at the Port of Gladstone

Industry	Trade throughput	Growth
Coal	164 Mtpa	Coal exports
LNG export	50 Mtpa	LNG export
Bauxite import and alumina/aluminium export	40 Mtpa	Alumina and aluminium industry
Other commodities	40 Mtpa	Other existing commodities/general cargo, and formation of new industries including petroleum refinery, shale oil export, steel plant, nickel refinery and container import hub
Total	**294 Mtpa**	

Table notes:
LNG – liquefied natural gas
Mtpa - Million tonnes per annum

The master plan growth scenario 3 is consistent with the Gladstone Ports Corporation's (GPC) 50 Year Strategic Plan 2012 (the GPC 50 Year Strategic Plan). The 50 Year Strategic Plan states that the port may ultimately develop into a strategic port centre handling 250-300 Million tonnes (of cargo) per annum (Mtpa). The GPC 50 Year Strategic Plan showing existing and potential port centres and developments is shown in Figure 2.1.

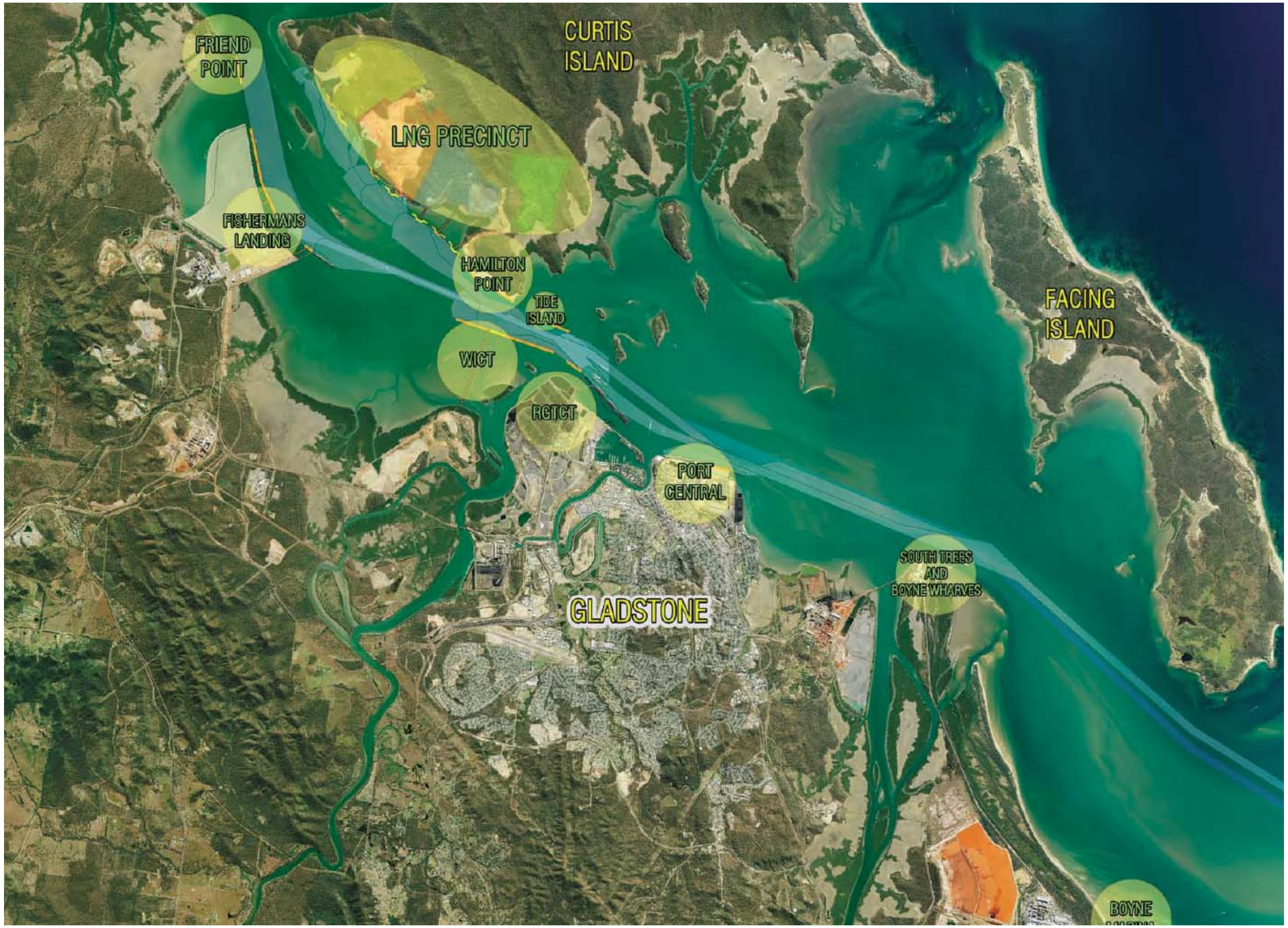


Figure 2.1 **GPC 50 Year Strategic Plan – port centres and planned development**

Source: GPC 2012

3 Potential marine infrastructure expansion

3.1 Overview

This section provides a description of the potential future marine infrastructure required to support the master plan growth scenario 3. This includes consideration of:

- Throughput for each cargo type
- Berth locations and requirements
- Channel expansion and capital dredging
- Maintenance dredging
- Material placement areas
- Emergency anchorages

3.2 Throughput growth by cargo type

The ISCRA describes general potential industry growth, but does not appear to nominate specific commodities, tonnages and number of berths required to reach the throughput capacity identified for the master plan growth scenario 3. The ISCRA and growth scenario reporting specifies throughput for coal, LNG and aluminium, and generally described throughput for 'other' industries.

Further consideration of specific throughput per cargo, corresponding number of berths, potential berth locations and corresponding shipping requirements has been made in this addendum report, to correlate the growth scenario to the infrastructure requirements needed in the master plan. In particular, more detail around a potential scenario for the growth of 'other existing commodities and new industries' to 40 Mtpa (DSD 2016) is required to identify possible future infrastructure requirements.

It should be noted that there is an inherent level of uncertainty in the size, form and timing of the development of new or the expansion of existing trades and industries within the Port of Gladstone. New industries can occur as a result of technology developments, or can become feasible on the back of other developments and industries expanding at the port. However, consideration of one of the potential trade growth scenarios to reach the master plan growth scenario 3 has been undertaken, to identify potential infrastructure and supply chain requirements.

A breakdown of the throughput growth and potential marine infrastructure requirements to achieve the throughput in the master plan growth scenario 3 is provided in Table 3.1.

Table 3.1 Marine and shipping requirements for growth scenario 3

Cargo type	Existing situation – berths and throughput	Master plan growth scenario 3 – maximum berths and throughput
Cargo export		
Coal	Wiggins Island -1 berth - 16 Mtpa	Wiggins Island - 4 berths - 84 Mtpa
	RG Tanna - 4 berths - 64 Mtpa	RG Tanna - 5 berths - 80 Mtpa
LNG	Curtis Island - 3 berths - 20.6 Mtpa	Curtis Island - 6 berths - 50 Mtpa
Alumina and Aluminium	Fisherman's Landing - 1 berths - 3 Mtpa	Fisherman's Landing - 2 berths - 6 Mtpa
	South Trees and Boyne - 2 berths - 3.3 Mtpa	South Trees and Boyne Island - 2 berths - 4 Mtpa

Cargo type	Existing situation – berths and throughput	Master plan growth scenario 3 – maximum berths and throughput
Cement, clinker, fly ash	Fisherman's landing - 1 berth - 2.1 Mtpa	Fisherman's Landing - 1 berth - 2.2 Mtpa
Grain	Auckland Point - 1 berth - 0.7 Mtpa	Auckland Point - 1 berth - 1.1 Mtpa
General and miscellaneous cargo	Various general cargo berths - 1.6 Mtpa	Various general cargo berths - 2.1 Mtpa
Petroleum and shale oil	N/A	Tide Island - 1 berth - 4 Mtpa
Nickel	N/A	Fisherman's Landing general cargo berth - 0.1 Mtpa
Steel	N/A	Fisherman's Landing - 1 berth - 4 Mtpa
Cargo import		
Bauxite	Fisherman's Landing - 1 berths - 9 Mtpa	Fisherman's Landing - 2 berths – 20 Mtpa
	South Trees - 1 berth - 10 Mtpa	South Trees - 1 berth – 10 Mtpa
Caustic soda and ammonia	Various general and multi cargo berths- 2.5 Mtpa	Various general and multi cargo berths - 3.2 Mtpa
Petroleum	Auckland Point - 1 berth - 1.6 Mtpa	Auckland Point - 1 berth - 1.6 Mtpa
	N/A	Fisherman's Landing - 1 berth - 2 Mtpa
General and miscellaneous cargo	Various general cargo berths - 0.5 Mtpa	Various general cargo berths - 2.1 Mtpa
Nickel ore and sulphur	N/A	Wiggins Island - 1 berth - 4 Mtpa
Limestone (steel industry)	N/A	Fisherman's Landing - 1 berth- 1.0 Mtpa
Iron ore (steel industry)	N/A	Fisherman's Landing - 1 berth- 5.6 Mtpa
Other		
Container hub	N/A	Hamilton Point - 3 berths - 1,000,000 TEU (approximately 7 Mtpa)
Cruise industry	N/A	Auckland Point - 1 berth
Total	**20 berths - 135 Mtpa**	**42 berths - 294 Mtpa**

Table notes:

** Current throughput based on 2016 published data, further to 2014/2015 data documented in Infrastructure and Supply Chain Requirements Assessment*
NA – Not applicable
Mtpa – Million tonnes per annum
TEU – Twenty-foot equivalent unit

It should be noted that different berths have different throughput capacities for a number of reasons. The different cargo types being shipped have different masses, use different cargo handling equipment with different capacities and have a different level of vessel queuing and berth utilisations which all impact throughput capacity. The maximum berth utilisation (time a vessel is at a berth) is also typically not more than around 70% due to the need to limit vessel queuing, and allow for vessel transiting, delays and other reasons. Container berths for example have a low density of the cargo and the container cranes handle containers one at a time, meaning a lower throughput per berth compared to a high throughput conveying and shiploading system installed on a coal export berth.

The container import hub identified in the evidence base report is a possible new industry to develop in the port over the life of the master plan. Currently a small volume of containers for the local region are imported at Auckland Point. However in the future should the Australian Rail Track Corporation's (ARTC) Inland Rail project be constructed, operated and extended to Gladstone, the Port of Gladstone will have access to an integrated east coast rail network. The Port of Gladstone has a natural advantage of a number of natural deep water berths in the inner harbour. If deep draft berths and rail access is developed, Gladstone could conceivably become a container import/export hub for the east coast of Australia, and part of an overall integrated east coast freight solution. The container import/export hub could accommodate post-Panamax container vessels. The port could accommodate vessels larger than existing design vessels at the current east coast container ports.

The east coast of Australia has a current throughput of approximately 5.5 million twenty-foot equivalent unit (TEU) (Ports Australia 2014), and over the life of the master plan this is expected to incrementally grow to over 10 million TEU. It has been assumed that Gladstone could capture 10% of this trade, and therefore have a possible throughput of 1,000,000 TEU per year (approximately 7 Mtpa), with 3 post-Panamax berths.

The evidence base report and the ISCRA describe the possible industry growth and drivers for the other industries included in the 40 Mtpa of 'other' throughput.

3.3 Vessel size

Consideration of shipping including future vessel size is a key factor for potential capital dredging and infrastructure expansion, and has been discussed at a high level in Section 4.2 of the ISCRA.

Over a number of decades, the maximum vessel sizes and average vessel sizes of the global vessel fleet have been increasing, making product transport more efficient. Low value cargoes in particular are often shipped in larger vessels to minimise the shipping costs per tonne of cargo. This trend is expected to continue into the future, and the master plan should allow for larger vessels using the channel and berths.

Recent developments and expansions of the key trade routes of the Panama Canal and Suez Canal have also opened up these routes for larger vessels and increased traffic. The increase in size of the Panama Canal will likely increase the number of New Panamax or post-Panamax vessels built, with a corresponding decrease in Panamax and smaller vessels. The trend of increasing vessel size is predicted to continue into the future, as older smaller vessels are scrapped and newer larger vessels continue to be built, and channel and berth infrastructure is incrementally expanded to cater for larger vessels.

The Panama Canal expansion can now cater for New Panamax vessels, including container vessels up to 14,000 TEU (increased from 5,000 TEU), bulk vessels up to 180,000 deadweight tonnage (dwt) and LNG vessels up to 177,000 m^3 (Panama Canal Authority 2016). The Suez Canal can already cater for vessels larger than this, up to 15,000 TEU and 185,000 dwt bulk carriers.

Typical vessel dimensions, characteristics and naming conventions are shown in Figure 3.1.

Classification	Displacement (t)	Capacity	Length overall L_{oa} (m)	Beam B (m)	Draught T_{FL} (m)
Tankers					
Panamax	90 000	70 000 DWT	245.0	32.2	12.0
Aframax	140 000	125 000 DWT	274.0	43.8	16.2
New Panamax	220 000	170 000 DWT	366.0	49.0	15.2
Suezmax	238 700	185 000 DWT	330.0	53.0	18.6
Bulk Carriers					
St Lawrence Seaway	35 000	25 000 DWT	226.0	24.0	8.0
Panamax	86 000	70 000 DWT	236.0	32.2	12.0
Capesize	192 000	150 000 DWT	294.0	45.9	17.5
New Panamax	220 000	180 000 DWT	366.0	49.0	15.2
Chinamax	450 000	400 000 DWT	365.0	65.0	22.0
LNG Carriers					
Spherical	107 000	145 000 m^3	283.0	42.7	12.0
QFlex	141 000	218 000 m^3	315.0	50.0	12.0
QMax	175 000	267 000 m^3	345.0	55.0	12.0
Container ships					
Panamax	83 000	5 000 TEU	290.0	32.2	13.2
New Panamax	180 000	13 000 TEU	366.0	49.0	15.2
Suezmax	210 000	15 000 TEU	382.0	56.4	15.5
VLCS	260 000	18 000 TEU	400.0	59.0	18.0

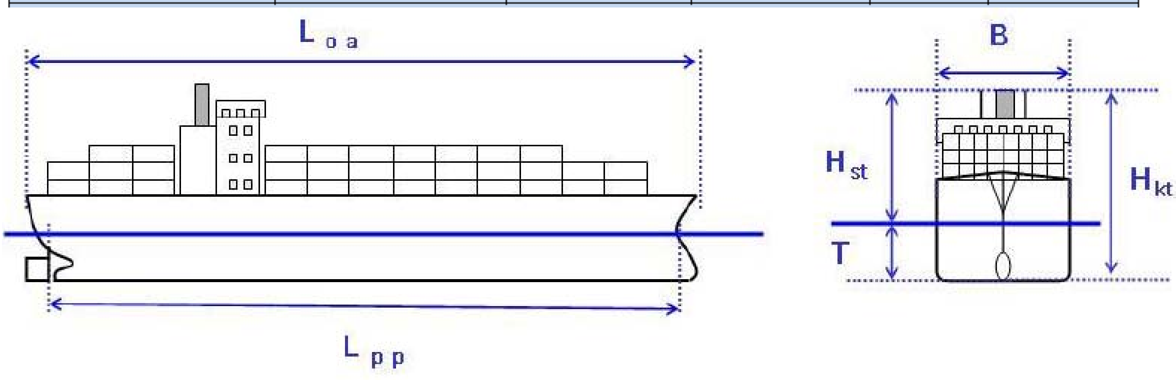


Figure 3.1 Typical vessel classifications and dimensions

Source: PIANC 2014

Large cape class bulk carriers can be up to 220,000 dwt, larger than shown in the reference above. The current design vessels at the Port of Gladstone are summarised in Table 3.2.

Table 3.2 Existing maximum design vessels

Berth	Maximum vessel size (fully loaded)
Boyne	60,000 dwt
South Trees East and West	80,000 dwt
Barney Point	90,000 dwt
Auckland Point 1-4	55,000 – 70,000 dwt
RG Tanna 1-4	220,000 dwt
Wiggins Island	220,000 dwt
Fisherman's Landing 2-5	25,000 – 80,000 dwt
Curtis Island 1-3	145,000 dwt (220,000 m^3)

Table note:
dwt – deadweight tonnage

Currently the design vessel for the Port of Gladstone is a 220,000 dwt coal bulk carrier. It is expected that if larger tankers, LNG carriers, or container ships are considered for new trades, they will choose a design vessel that requires similar navigational dredged areas to the current design vessel, in order to minimise additional dredging. This design vessel accommodates the majority of the global world fleet, and it is unlikely that additional dredging would be viable to capture a small fraction of the global fleet.

Although the maximum design vessel for the Port of Gladstone may not increase substantially, the percentage of larger vessels visiting the port is expected to increase over the timeframe of the master plan.

The increasing size of vessels will have some impacts on marine infrastructure requirements, with berths requiring slightly longer areas to accommodate the vessels and slightly deeper berth pockets. The main impact will be on shipping and channel requirements. The size and number of vessels using the port is intrinsically linked with any assessment of channel capacity, channel duplication or channel deepening. This is discussed further in Section 3.5.

Some of the potential trends in vessel size which should be considered in the master planning process are described in Table 3.3.

Table 3.3 Vessel size

Vessel	Historical trend	Possible future trend	Future Port of Gladstone impacts
Bulk carriers	Steady increase in size and proportion of cape class vessels used	Continued increase in fleet proportion of cape class vessels and post-Panamax vessels, putting additional demand on berth infrastructure and channel requirements	Increasing use of cape class vessels
LNG carriers	Have not significantly increased in size, but a larger proportion of the fleet is increasing in size to Q-Flex and Q-Max	A larger proportion of the global fleet likely to increase in size to Q-Max As LNG trade diversifies away from Qatar, deeper draft vessels could be procured specifically for new ports	Use of slightly larger Q-Max vessels likely (are similar draft to Q-Flex vessel though). A possible deeper draft vessel class could develop in the future and use the Port of Gladstone, but this is not currently planned

Vessel	Historical trend	Possible future trend	Future Port of Gladstone impacts
Container vessels	Fleet has rapidly increased in size over the last few decades, with both the size of the largest vessel and fleet proportion of post-Panamax vessels increasing significantly	Continued increase in maximum vessel size and proportion of post-Panamax vessels in fleet	New container facility to accommodate vessels up to New Panamax and Suezmax, equivalent to Cape Class vessels. Unlikely to accommodate VLCS
Bulk liquid tankers	Since ~1990, the average tanker size has not increased significantly. VLCCs and ULCCs have been used since then, but not in increasing number. Vessel size beneath that are limited by Suez Canal (Suezmax)	Likely continued use of VLCC and ULCC in some parts of world, but unlikely to be used in Australia due to port limitations	New bulk liquid industries to accommodate vessels up to New Panamax and possibly Suezmax, if located near deep channel areas Unlikely to accommodate VLCC and ULCC

Table notes:
LNG – Liquefied natural gas
VLCS – Very large container ship
VLCC – Very large crude carrier
ULCC – Ultra large crude carrier

3.4 Berths and shipping growth summary

The possible marine berth infrastructure and shipping growth for the master plan growth scenario 3 has been summarised in Table 3.4 based on comparing the existing infrastructure to the possible future requirements. The marine and shipping requirements have been split by cargo type, throughput and berth location, to allow specific berth locations and shipping requirements to be established. This is a key input to inform the master plan.

It should be noted that the vessel size shown in dwt (dead weight tonne - average vessel cargo mass) is the average, and a range of vessel sizes and classes larger and smaller than this will use the facility.

The assessment suggests a total of 42 berths may be required under a possible master plan growth scenario 3. However it is important for the master plan to provide flexibility for future development. In some cases there is more than one location where this expansion could feasibly occur, and a pre-feasibility or feasibility study would be required to determine the preferred location for the new berth precinct. Therefore, in some cases, two different location options are identified for a particular potential development. For example, a deep draft container import/export hub could be located at Hamilton Point or on the potential West Banks Island material placement area. There are advantages and disadvantages associated with each option that would need to be explored in detail, should this new trade be realised.

This flexibility is important so future developments are not constrained to a particular location, and also given that the growth profile and throughput identified is only one possible future growth scenario.

Table 3.4 Marine and shipping requirements for the master plan growth scenario 3

Cargo type	Existing situation		Master plan growth scenario 3			
	Existing berths and throughput	**Average vessel size and type**	**Maximum berths and throughput**	**Average vessel size and type**	**Berths and shipping growth**	**Number vessels per year**
Cargo export						
Coal	Wiggins Island 1 berth - 16 Mtpa	95,000 dwt Up to Cape Class	Wiggins Island 4 berths - 84 Mtpa	120,000 dwt 75% Cape Class and 25% Panamax	3 additional berths, and an increase in Cape class vessel use	700 total 525 Cape Class
	RG Tanna 4 berths - 64 Mtpa	95,000 dwt Up to Cape Class	RG Tanna 5 berths - 80 Mtpa	120,000 dwt 75% Cape Class and 25% Panamax	1 additional berth, and an increase in Cape Class vessel use	667 total 500 Cape Class
LNG	Curtis Island 3 berths - 20.6 Mtpa	65,000 dwt 50% Q-Flex and 50% spherical and below	Curtis Island 6 berths - 50 Mtpa	100,000 dwt 25% Q-Max and 75% Q-Flex and spherical	3 additional berths, and increase in Q-Flex and new use of Q-Max	500 total No Cape Class
Alumina and Aluminium	Fisherman's Landing 1 berths - 3 Mtpa	35,000 dwt Panamax and Handy	Fisherman's Landing 2 berths - 6 Mtpa	35,000 dwt Panamax and Handy	1 additional berth, no major vessel use changes	171 total No Cape Class
	South Trees and Boyne 2 berths - 3.3 Mtpa	35,000 dwt Panamax and Handy	South Trees and Boyne 2 berths - 4 Mtpa	35,000 dwt Panamax and Handy	N/A	114 total No Cape Class
Cement, clinker, fly ash	Fisherman's Landing 1 berth - 2.1 Mtpa	20,000 dwt Handy	Fisherman's Landing 1 berth - 2.2 Mtpa	20,000 dwt Handy	N/A	110 total No Cape Class
Grain	Auckland Point 1 berth - 0.7 Mtpa	16,000 dwt Handy	Auckland Point 1 berth- 1.1 Mtpa	20,000 dwt Handy	N/A	55 total No Cape Class
General and miscellaneous cargo	Various general cargo berths 1.6 Mtpa	20,000 dwt Handy	Various general cargo berths 2.1 Mtpa	25,000 dwt Handy	1 additional berth, no major vessel use changes	84 total No Cape Class
Petroleum and shale oil	N/A	N/A	Tide Island- 2 berths - 4 Mtpa	70,000 dwt Panamax	2 additional berth	57 total No Cape Class

Cargo type	Existing situation		Master plan growth scenario 3			
	Existing berths and throughput	Average vessel size and type	Maximum berths and throughput	Average vessel size and type	Berths and shipping growth	Number vessels per year
Nickel	N/A	N/A	Fisherman's Landing - general cargo berth - 0.1 Mtpa	25,000 dwt Handy	N/A	4 total No Cape Class
Steel	N/A	N/A	Fisherman's Landing - 1 berth - 4 Mtpa	70,000 dwt Panamax and below	1 additional berth	57 total No Cape Class
Cargo import						
Bauxite	Fisherman's Landing - 1 berths - 9 Mtpa	70,000 dwt Panamax and below	Fisherman's Landing - 2 berths – 20 Mtpa	70,000 dwt Panamax and below	1 additional berth, no major vessel use changes	286 total No Cape Class
	South Trees - 1 berth - 10 Mtpa	70,000 dwt Panamax and below	South Trees - 1 berth - 10Mtpa	70,000 dwt Panamax and below	N/A	143 total No Cape Class
Caustic soda and ammonia	Various general and multi cargo berths - 2.5 Mtpa	40,000 dwt Panamax and handy	Various general and multi cargo berths - 3.2 Mtpa	40,000 dwt Panamax and Handy	1 additional berth, no major vessel use changes	80 total No Cape Class
Petroleum	Auckland Point - 1 berth - 1.6 Mtpa	20,000 dwt Handy	Auckland Point - 1 berth - 1.6Mtpa	25,000 dwt Handy	N/A	64 total No Cape Class
	N/A	N/A	Fisherman's Landing- 1 berth - 2 Mtpa	50,000 dwt Panamax & below	1 additional berth	40 total No Cape Class
General and miscellaneous cargo	Various general cargo berths - 0.5 Mtpa	20,000 dwt Handy	Various general cargo berths - 2.1 Mtpa	25,000 dwt Handy	1 additional berth, no major vessel use changes	84 total No Cape Class
Nickel ore and sulphur	N/A	N/A	Wiggins Island - 1 berth - 4 Mtpa	100,000 dwt 50% Cape Class and 50% Panamax	1 additional berth	40 total 20 Cape Class
Limestone (steel industry)	N/A	N/A	Fisherman's Landing - 1 berth - 1.0 Mtpa	40,000 dwt Panamax and Handy	1 additional berth	25 total No Cape Class

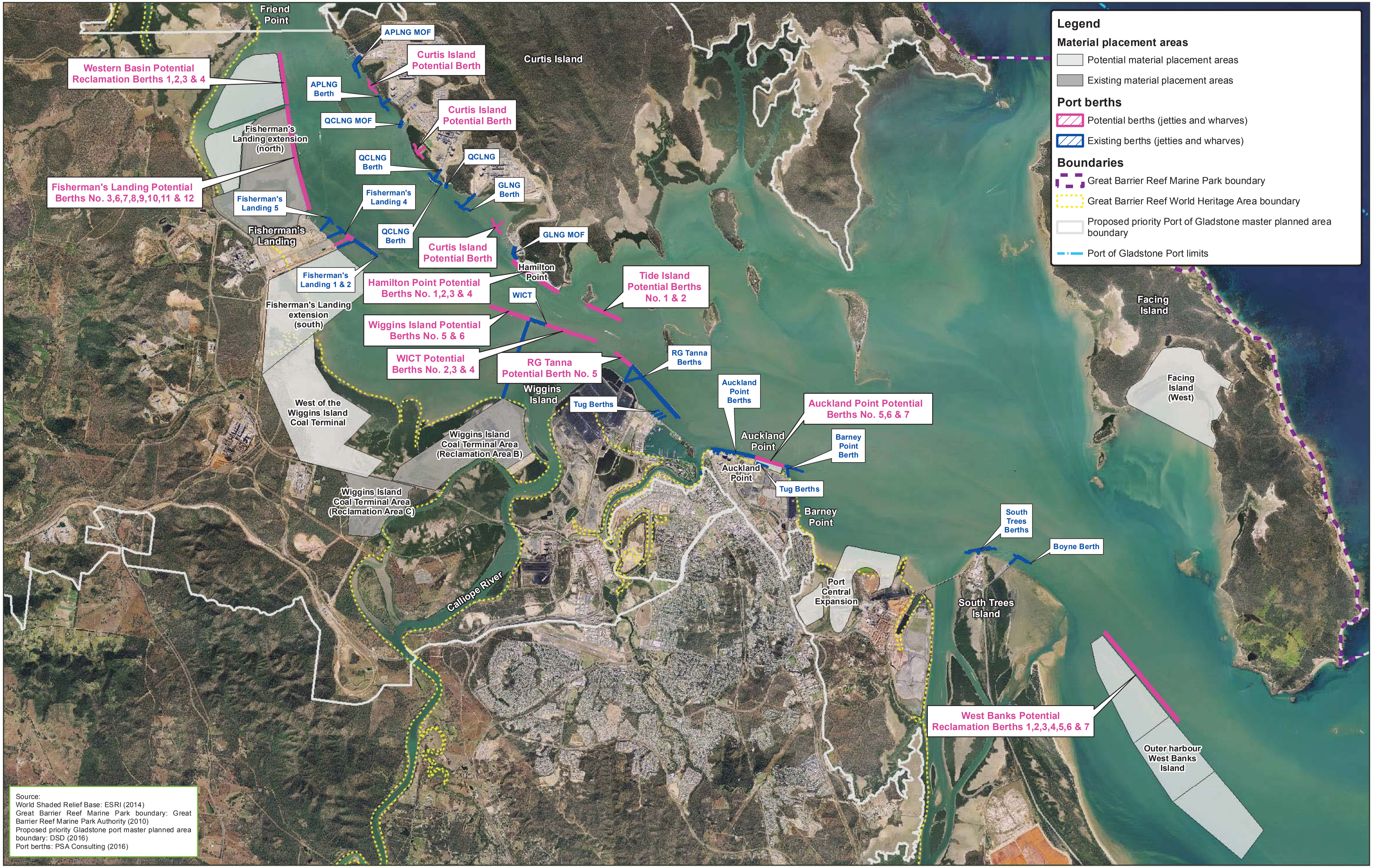
Cargo type	Existing situation		Master plan growth scenario 3			
	Existing berths and throughput	Average vessel size and type	Maximum berths and throughput	Average vessel size and type	Berths and shipping growth	Number vessels per year
Iron ore (steel industry)	N/A	N/A	Fisherman's Landing - 1 berth - 5.6 Mtpa	70,000 dwt Panamax and below	1 additional berth	80 total No Cape Class
Other						
Container hub	N/A	N/A	Hamilton Point - 3 berths - 1,000,000 TEU (approximately 7 Mtpa)	8,000 TEU average 75% New Panamax and 25% Panamax	3 additional berth	125 total 94 Cape Class equivalent
Cruise industry	N/A	N/A	Auckland Point – 1 berth	300m length	N/A- existing berths used	20 total No Cape Class
Total	**20 berths - 135 Mtpa**	**Varies**	**42 berths - 294 Mtpa**	**Varies**	**22 berths**	**3,476 vessels** **1,139 Cape Class**

Table notes:

** Current throughput based on 2016*

Of the 1,139 Cape Class vessels projected to use the port each year, indicatively 110 of these may be Cape Class Equivalent vessels importing cargo.

Figure 3.2 identifies the existing and potential berths to consider in the master plan as per the ISCRA report together with additional potential berths associated with the potential material placement areas identified through this addendum.



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Priority Port of Gladstone Master Planning Addendum to the Infrastructure and Supply Chain Requirements Assessment Report

Figure 3.2: Existing and potential berths and material placement areas

3.5 Channel expansion and capital dredging

Section 4.2.1 of the ISCRA describes the potential extent of deepening and duplication of the shipping channel and the resultant volume of dredged material requiring placement.

This section considers the vessel profile (number of vessels and vessel type) generated for the master plan growth scenario 3 (as detailed in Table 3.4), and demonstrates the requirement for a duplicated channel.

3.5.1 Tidally constrained export vessels

Tidally constrained export Cape Class vessels have a limited window to depart on the flood tide (incoming/rising tide). On average, approximately two Cape departures are possible on each flood tide with a 1 hour following headway between vessels. The following headway provides an allowance for aborting the manoeuvre in the event of a channel blockage by the preceding vessel. The existing single channel is therefore limited to approximately 750 departing Cape vessels per year.

The master plan growth scenario 3 includes 1,050 export Cape vessels per year, exceeding the capacity of a single channel. The following headway can be reduced to 30 minutes for Cape vessels for a fully duplicated channel. In this case, the following vessel has the option to change channels in the event that the preceding vessel becomes grounded. The reduction in following headway increases the number of tidally constrained vessels that are able to depart on a given tide, allowing for the number of Cape vessels forecast in the master plan growth scenario 3.

GPC has considered the option of deepening the existing channel, and compared it to the duplication of the existing channel. Deepening the channel does not allow for a potential need to accommodate Cape class import vessels in the future or the overall vessel movements required for the master plan growth scenario 3.

3.5.2 Passing of tidally constrained vessels

The master plan growth scenario 3 includes 123 Cape import vessels. If a Cape class import trade is developed at the Port of Gladstone, there is limited opportunity for deep draft Cape vessels to both enter (import) and exit (export) in the same tidal window, for a single channel configuration. A duplicate channel would allow deep draft Cape vessels to enter and exit the port simultaneously.

3.5.3 Overall channel utilisation

The growth trade profile detailed in Table 2.2 and Table 3.4 comprises approximately 3,700 vessels annually. Corresponding channel utilisation for a single outer harbour channel is 75-95% depending on the average number of inbound and outbound vessels that can be scheduled in convoy. This level of channel utilisation is not achievable in practice when port scheduling constraints and the limitations of other port resources, including berths, towage and pilotage, are taken into account.

Channel utilisation for a duplicated outer harbour channel is reduced to approximately 24% and is expected to be appropriate to enable the master plan growth scenario 3 trade profile. Duplication of the Auckland Channel may also be required to achieve acceptable port scheduling outcomes, providing full channel duplication from port entry through to the inner harbour.

Channel duplication also provides significant risk mitigation for the port. In the event of a vessel grounding over an extended period of time in a single channel section, closure of the port will be required for the duration of the grounding. With a duplicated channel however, in the event of a vessel grounding the port would be able to continue to operate albeit at a lesser capacity.

Deepening of some areas of the inner harbour channel may be required in the future to accommodate deeper draft vessels in the inner harbour areas, depending on the ultimate trade profile and industry developments. Extensions of the inner harbour channel and dredging of new berth pockets will also be required to accommodate new berths.

3.6 Maintenance dredging

Maintenance dredging of the channels, berth pockets and swing basins is necessary to maintain an operational port because siltation of these areas occurs over time, reducing the water depth. The ISCRA identified that the current annual maintenance dredging volume is 190,000 m^3 per annum, with 60% in the outer harbour and 40% in the inner harbour.

Future maintenance dredging would be undertaken under the Commonwealth and State approval processes and will comply with the Maintenance Dredging Strategy for GBRWHA Ports (DTMR 2016). GPC currently holds approval for the placement of maintenance dredged material at the existing East Banks dredged material placement area (DMPA), which is located within port limits. The East Banks DMPA has sufficient remaining capacity for the master plan timeframe (ie 2050), and no additional infrastructure is required for maintenance dredging.

Maintenance dredged material could also be placed in existing material placement areas within the master planned area.

The Maintenance Dredging Strategy for GBRWHA Ports provides an assessment on future maintenance dredging, and indicates that future maintenance dredging volumes with a duplicated and/or deepened outer channel will not be significantly higher than current volumes. Maintenance dredging of berth pockets will increase proportionally with increasing berth numbers.

3.7 Dredged material placement

3.7.1 Identification of potential material placement areas

GPC has undertaken a dredged material placement options investigation (DMPOI) as part of the Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Environmental Impact Statement (EIS). Whilst the primary objective of the DMPOI was to identify potential dredged material placement site options for the 12.6 Mm^3 of dredged material from the Channel Duplication Project, the following secondary objectives have also been sought:

- Support a strategic approach to planning for the long term dredging needs of the Port of Gladstone though consideration of the suitability of potential sites for other future Port dredging requirements (capital and/or maintenance dredging); and
- Development of a transparent, robust and repeatable process for how dredged material placement alternatives are considered and preferred options identified for future capital and/or maintenance dredging within the Port of Gladstone.

In seeking to achieve both these primary and secondary objectives, the DMPOI process was underpinned by a strong emphasis on early and ongoing stakeholder and regulatory agency engagement throughout the options assessment and decision making process.

The DMPOI process identified fifteen specific site locations which have the potential to receive dredged material. Figure 3.3 illustrates the location of these dredged material placement options.

As part of the DMPOI process and this addendum report, eight of the DMPOI site locations have been removed from further consideration as part of the master planning process, due to a combination of unacceptable factors, including:

- Potential Indigenous cultural heritage impacts
- Potential significant ecological impacts, including impacts on the OUV of the GBRWHA
- Insufficient dredged material storage capacity for capital dredging projects
- Not compatible and/or conflicts with the current and future industry operations
- High reclamation area construction costs and/or dredging costs

3.7.2 Potential dredging volumes

The potential dredging volumes, material placement areas (existing and potential) and capacity are described in Section 4.2 of the ISCRA. The report states that ultimate dredging requirements, including the channel duplication, channel deepening, Western Basin dredging and Targinie Channel deepening for Panamax vessels, is in the order of 68 Mm^3 of dredged material. This dredging volume requires a combined material placement area volume of 82 Mm^3, including a material bulking factor of 1.2.

The ISCRA identifies a number of potential material placement areas (Section 4.2.3 and Map 13), and a number of other potential material placement areas have fWICbeen identified in this addendum. Figure 3.2 shows the potential material placement areas identified through this addendum, however it should be noted that dredged material placement is not assumed to occur over areas where dredged material placement has already occurred and where infrastructure has been constructed (eg within the Wiggins Island Coal Terminal (WICT) Reclamation Area B).

A capacity comparison between the required volumes and identified potential material placement area volumes was not specifically undertaken in the ISCRA. The material placement areas identified and approximate capacity are detailed in Table 3.5.

Table 3.5 Material placement areas and capacities – existing and potential areas with remaining capacity

Area	Location	Approximate capacity
Area 1	Fisherman's Landing extension (north and south)	50 Mm^3
Area 2	Hamilton Point	Not applicable (NA)
Area 3	West of the Wiggins Island Coal Terminal	24 Mm^3
Area 4	Wiggins Island Coal Terminal Areas (Reclamation Areas B and C)	10 Mm^3
Area 5	Auckland Point	NA
Area 6	Port Central Expansion	18 Mm^3
Area 7	Outer harbour West Banks Island	46 Mm^3
Area 8	Facing Island (West)	8 Mm^3
Total		**156 Mm^3**

Areas 2 and 5 are likely to require minimum quantities, or may use earth fill rather than dredged material.

The material placement areas identified have potential capacities to store approximately 156 Mm^3 of material, compared to the ultimate 82 Mm^3 (approximately) required for the capital dredging.

While the areas identified are in excess of potential capital dredged material volume requirements, it is important that master planning presents options that ensure flexibility for future development. Flexibility in both the location and size of the material placement areas is required, to allow future developments to investigate alternative locations and determine the preferred site, taking into account all relevant factors at the time.

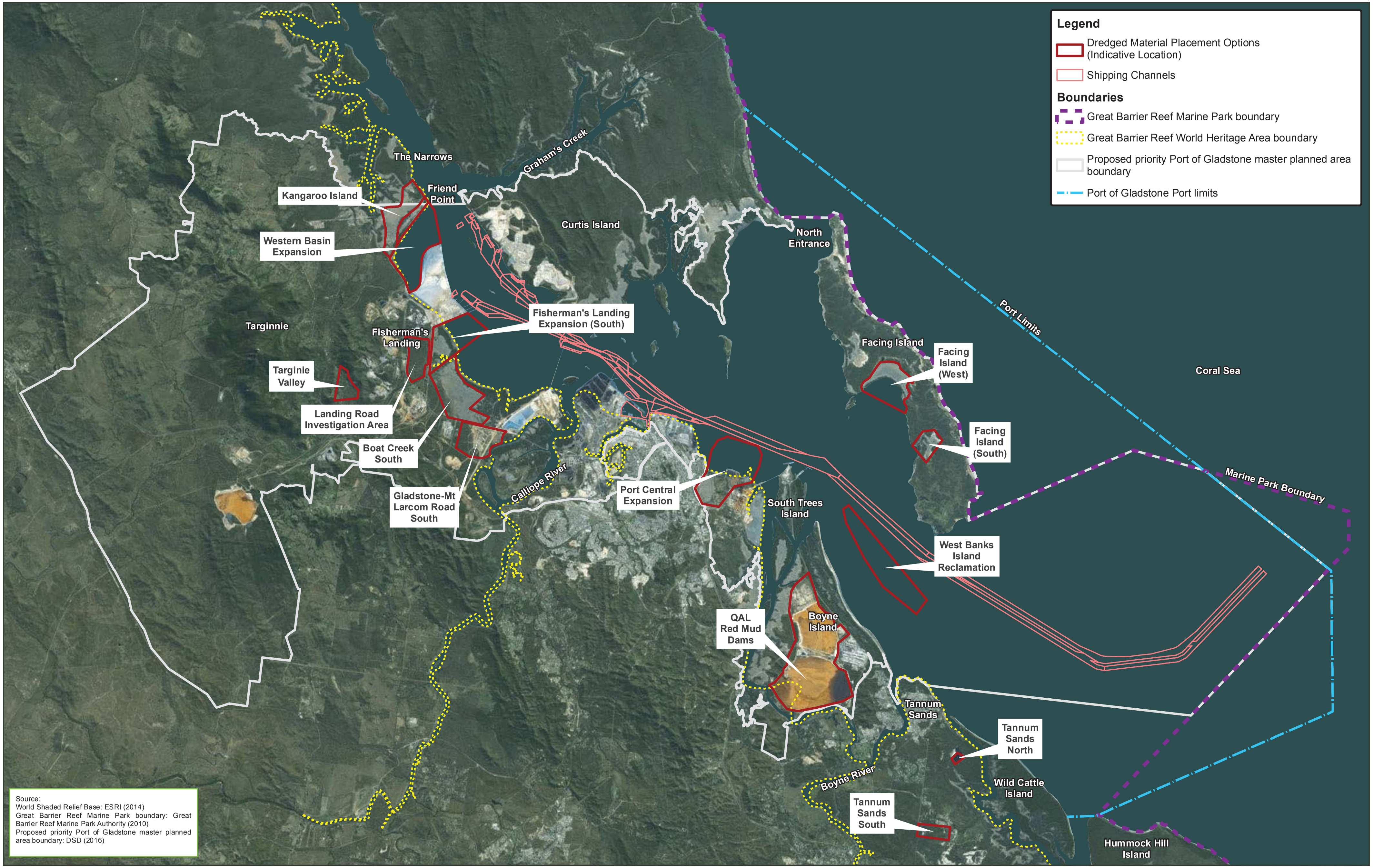

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Figure 3.3: Indicative dredged material placement options

3.8 Emergency and permanent anchorages

A number of emergency anchorages are situated in the inner harbour, adjacent to the Gatcombe and Auckland Channels. There are currently three major Cape class anchorages at South Trees, and three smaller anchorages for small vessels at the Quoin and South Trees anchorage. The existing anchorages are shown in Figure 3.4. These anchorages are not a permanent anchorage and are a safety feature for vessels to anchor at in an emergency situation, such as a vessel with engine failure, to prevent closure of the port or potential environmental issues with vessel groundings.

These key areas should remain in the master plan for use as emergency anchorages, and may be expanded as the port expands.

The majority of permanent anchorages are located outside of the master planned area, as shown in Figure 3.4, with only one permanent anchorage located within the master planned area, and one permanent anchorage approximately on the boundary.

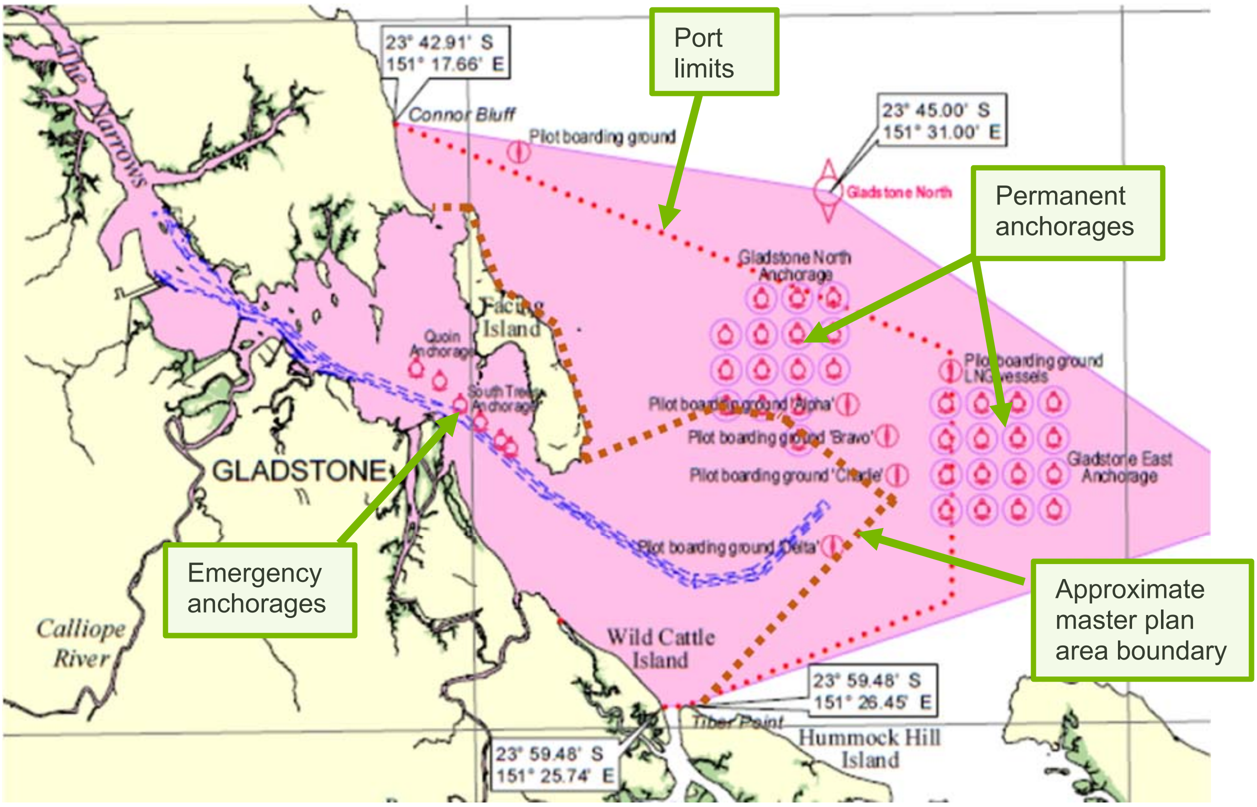


Figure 3.4 Existing emergency and permanent anchorages

Source: DTMR 2016

4 Supply chain linkage – infrastructure corridors

This section discusses potential infrastructure requirements across both land and marine areas, and recommends infrastructure corridors that should be preserved through the master planning process. A summary of the additional port supply chain linkages and infrastructure corridors required to support the potential port growth is provided. This section provides additional description to Section 4.3 of the ISCRA.

4.1 Requirements to protect supply chain infrastructure corridors

The efficiency and effectiveness of the Port of Gladstone is related to the extent that:

- Import cargoes can be efficiently transported to consumers in the broader region, including the Gladstone, Calliope, and the Hinterland, including Rockhampton, the Central Highlands and Dawson Valley
- Import and export cargoes can be efficiently handled through to the Gladstone State Development Area (Gladstone SDA) to encourage development of industrial facilities in the Gladstone SDA
- Export cargoes can be effectively transported from hinterland areas to the Port of Gladstone

This movement of goods from origin or destination to the port requires suitable road, rail, pipeline, services and conveyor corridors in appropriate locations to facilitate the movement of cargoes to the required port centre. It is therefore important that corridors be identified to preserve land allocation to linear infrastructure requirements and allow management of adjoining land uses for the future development of the master planned area.

4.2 Supply chain infrastructure corridor requirements

4.2.1 Potential industry triggers

The growth or development of potential industries is likely to trigger the need for supply chain corridors to accommodate industry enabling infrastructure, including road, rail, bulk materials transport and services. Based on master plan growth scenario 3, it is envisaged that the infrastructure corridors provided in Table 4.1 will be triggered by will be triggered by the potential industries listed in Table 4.1.

Table 4.1 Potential industry triggers for infrastructure corridors

Infrastructure corridor	Potential industry that will trigger the need for the infrastructure
Port Access Road extension (Stages 2 and 3)	Incremental development of the trades through Port Central (eg container, general cargo, minerals, cruise ship industry)
Gladstone SDA Link Road (Gladstone – Mt Larcom Road link to Bruce Highway)	Development of the Gladstone SDA enabling a more efficient road transport route to and from the Port of Gladstone
Mainland to Curtis Island road and rail link	Development of a major container terminal at Hamilton Point
West Bank Island material placement area road and rail link	Development of a major container terminal at the West Bank Island material placement area
Pipeline corridor from Tide Island to oil and petroleum industry	Development of oil refinery industries located west of Fisherman's Landing
Pipeline corridors through the master planned area to LNG plants	Development of additional LNG plants at Fisherman's Landing and/or Curtis Island
Services corridor from Aldoga industrial area to Fisherman's Landing	Development of Aldoga industrial area, including a potential steel plant

In the same way that Hamilton Point and West Banks Island are alternative locations for a potential container import/export hub, the mainland to Curtis Island road and rail link, and the West Banks Island material placement area road and rail link are alternative corridors to service these potential berth locations.

4.2.2 Road and rail infrastructure

To support the master plan growth scenario 3, four future public road and rail infrastructure corridors have been identified as shown on the ISCRA, Appendix 4, Map 9 (road) and Map 10 (rail).

Table 4.2 summarises where these identified potential road and rail infrastructure corridors have been included within existing planning instruments.

Table 4.2 Road and rail infrastructure corridor identification within existing planning instruments

Infrastructure corridor	Planning instruments		
	GPC Port Land Use Plan (2012)	**Gladstone SDA Development Scheme (2015)**	**GRC Planning Scheme (2013)**
Port Access Road extension (Stages 2 and 3)	Corridor not identified as outside of plan boundary	Corridor not identified as outside of scheme boundary	**Corridor identified**
Gladstone SDA Link Road (Gladstone-Mt Larcom road link to Bruce Highway)	Corridor not identified as outside of plan boundary	**Corridor identified**	Corridor not identified as outside of scheme boundary
Mainland to Curtis Island road and rail link	Corridor not identified as outside of plan boundary	Corridor not identified as marine areas outside of scheme boundary	Corridor not identified as outside of scheme boundary
West Banks Island material placement area road and rail link	Corridor not identified as outside of plan boundary	Corridor not identified as outside of scheme boundary	Corridor not identified as marine areas outside of scheme boundary

The purpose of the identified future road infrastructure corridors is to provide a supply chain link for road transport of the increased volume of materials to and from the Port of Gladstone. The future road corridors will link the port areas to existing major road networks, allowing efficient transport of materials, creating new development fronts, alleviating impact of heavy vehicles on the existing Gladstone road infrastructure and improving safety outcomes for the community. The new road infrastructure will also create potential industrial development fronts through the master planned area.

There is currently no access to the Port of Gladstone for road trains, and all road train freight is transferred into B-doubles at Gracemere and Banana and then trucked to the port. If Sheepstation Bridge between Biloela and Calliope was upgraded to road train capacity then agriculture products could possibly arrive from the Central West via Biloela, Calliope and the Dawson Highway, and then on to the Port Access Road (Stage 2) directly into Port Central.

The purpose of the identified future rail infrastructure corridors is to provide a supply chain link for a potential container import/export hub. The future rail corridors will link the port areas to existing major rail networks, allowing efficient transport of materials to and from the port areas, creating new development fronts, alleviating impact of heavy haul and freight rail on communities. If the inland rail project proceeds, the rail corridors will facilitate connecting the Port of Gladstone into an integrated east coast freight supply chain.

It is feasible that the master plan growth scenario 3 may trigger the use of short ‘sprinter’ trains to transport bulk materials locally within the master planned area, particularly between the port areas and the Gladstone SDA. Use of short trains could potentially be an alternative to off-road truck haulage or overland conveyor systems, and corridors for such have been identified in the road and services corridors sections of this addendum.

Aurizon has an established development plan (Aurizon Network Develop Plan 2015) detailing proposed upgrades to the Blackwater and Moura systems to support a rail system throughput of 230 Mtpa. These planned upgrades include the Aldoga Bank, North Coast Line bypass, Aldoga Rail Yards, Moura Link, future WICT Project rail expansions, East End Mine Branch duplication, and Callemondah Rail Yard.

A description of the identified road and rail infrastructure corridors required to support the potential future industry needs is provided below. It is noted that the identified rail infrastructure corridors are in addition to the rail upgrades planned by Aurizon.

Port Access Road extension (Stages 2 and 3)

The Port Access Road extension (Stages 2 and 3) would link the Port Central area to the existing Blain Drive and Red Rover Road via extension of the existing Port Access Road. The road infrastructure design will need to consider topographic constraints including the west Gladstone community and industry, tidal waterways, and multiple rail lines heading north from the Callemondah rail yard.

The Port Access Road extension has been identified within the strategic framework of the GRC Planning Scheme (2013) (Part 3.5 Connecting our places).

Gladstone SDA Link Road

The Gladstone SDA Link Road would connect the Bruce Highway to Gladstone-Mt Larcom Road through the master planned area, alleviating heavy haul movements along the existing Calliope River Road and through the township of Yarwun. The road corridor would be largely along the existing Aldoga Road alignment, and topographic constraints to consider would include terrestrial vegetation and creeks, and crossing of gas pipelines.

The Gladstone SDA Link Road has been identified within the Gladstone SDA Development Scheme (2015).

Mainland to Curtis Island road and rail link

The mainland to Curtis Island road and rail link would provide a corridor for road and rail infrastructure to connect from the mainland to Curtis Island via a bridge structure(s) across The Narrows.

On the mainland a road corridor would extend north from the existing Landing Road past Fisherman’s Landing to The Narrows. A separate rail corridor would link from the existing North Coast railway line, extending north-east from near the Mount Larcom township to run around the north of Aldoga and Mount Larcom landform, then east to The Narrows. There is also an option to extend the existing Fisherman’s Landing Branch Line north to connect to Curtis Island via the same bridge structure across the Narrows.

A substantial road and rail bridge structure(s) will be required at The Narrows to support road, rail, bulk materials transport and services infrastructure connecting between the mainland and Curtis Island. The bridge structure(s) could be located adjacent to the existing gas pipelines that cross beneath the seafloor at The Narrows.

On Curtis Island a road and rail infrastructure corridor would run east from The Narrows and then south-east behind the LNG plants to arrive at Hamilton Point. This corridor on Curtis Island has been identified in the Gladstone SDA Development Scheme.

Road and rail infrastructure design will need to consider topographic constraints, including crossing of gas pipelines, crossing of Queensland Energy Resources (QER) tenements, terrestrial vegetation, rugged terrain and hard ground associated with the foothills of Mount Larcom, tidal flats and mangroves along the shoreline, The Narrows crossing, and terrestrial vegetation and undulating ground on Curtis Island.

West Banks Island material placement area road and rail link

The West Banks Island material placement area road and rail link would connect the potential West Banks Island material placement area to the mainland. A common road and rail infrastructure corridor would be utilised.

A substantial bridge structure(s) would be required to span from the West Banks Island material placement area to the mainland, to support road, rail, bulk materials transport and services infrastructure.

On the mainland the corridor would need to connect the rail infrastructure to the nearby existing North Coast railway line, and to connect the road infrastructure to the nearby existing Gladstone-Benaraby Road or Boyne Island Road.

Road and rail infrastructure design would need to consider topographic constraints, including the crossing of the harbour from West Banks Island, shoreline tidal waterways, tidal flats and mangroves, 'red mud' dams, and crossing of Gladstone-Benaraby Road.

4.2.3 Bulk materials transport and services infrastructure

Potential industry located in the master planned area requires bulk materials transport corridors to provide access to berth areas. These corridors could be used for pipelines (to convey bulk liquid products), or for conveyors or private haul roads (to convey bulk solid products). Additionally corridors for services infrastructure such as power, water, sewerage, telecommunications and data to support the development of industry also need to be identified.

To support the master plan growth scenario 3, a future petroleum industry pipeline infrastructure corridor has been identified as shown on the ISCRA, Appendix 4, Map 5. Future LNG industry pipeline infrastructure corridors have been identified as shown on the ISCRA, Appendix 4, Map 4. Future services/haul road corridor has also been identified on the ISCRA, Appendix 4, Map 12.

Table 4.3 summarises where these identified potential bulk materials transport and services infrastructure corridors have been included within existing planning instruments.

Table 4.3 Bulk materials transport and services infrastructure corridor identification within existing planning instruments

Services infrastructure corridor	Planning instruments		
	GPC Port Land Use Plan (2012)	Gladstone SDA Development Scheme (2015)	GRC Planning Scheme (2013)
Pipeline corridor from Tide Island to oil and petroleum industry	Corridor not identified as outside of plan boundary	Corridor not identified as outside of scheme boundary	Corridor not identified as outside of scheme boundary
Pipeline corridors through the master planned area to LNG plants	Corridor not identified as outside of plan boundary	**Land corridors identified** Marine corridor not identified as outside of scheme boundary	Corridor not identified as outside of scheme boundary

Services infrastructure corridor	Planning instruments		
	GPC Port Land Use Plan (2012)	Gladstone SDA Development Scheme (2015)	GRC Planning Scheme (2013)
Services corridor from Aldoga industrial area to Fisherman's Landing	Corridor not identified as outside of plan boundary	**Corridor identified**	Corridor not identified as outside of scheme boundary

None of the identified pipeline infrastructure corridor have been included within existing planning instruments.

The purpose of the identified future services infrastructure corridors is to provide a supply chain link for transport of bulk materials (such as iron ore, steel, gas, oil and petroleum) to and from future berths.

A description of the identified bulk materials and service infrastructure corridor is detailed in the below sections.

Pipeline corridor through the master planned area to LNG plants

Pipeline corridors through the master planned area would deliver natural gas to potential LNG plants at Fisherman's Landing and Curtis Island. From the central and south-west Queensland gas fields the pipeline corridor would cross the western boundary of the master planned area, and then run east roughly parallel to the existing alignments of Aldoga Road and Mt Larcom-Yarwun Road, then passing between the Comalco rail balloon loop and Yarwun Refinery before branching to run along the Landing Road alignment to Fisherman's Landing. From Fisherman's landing the pipeline corridor could take a direct route beneath the harbour seafloor to Curtis Island, or alternatively the pipeline could run north to access Curtis Island via a road and rail bridge across The Narrows (as described above).

Pipeline corridor infrastructure design would need to consider the topographic constraints, including terrestrial vegetation and creeks, crossing of existing gas pipelines, road and rail crossings, tidal flats and mangroves along the shoreline, the seafloor crossing and marine infrastructure.

The pipeline corridor through the master planned area to LNG plants has been identified within the Gladstone SDA Development Scheme (2015) for the land infrastructure corridors, however the marine corridor components are not identified as they area outside of the boundaries of the noted planning instruments.

Pipeline corridor from Tide Island to oil and petroleum industries

A pipeline corridor would link from Tide Island to potential oil and petroleum industries located in the master planned area west of Fisherman's Landing. The pipeline corridor could take various routes, including along the road and rail corridors discussed above to cross from the mainland to Curtis Island across bridge structure at The Narrows. This corridor has been identified in the road and rail corridors described above.

Alternatively a more direct pipeline and services corridor to Tide Island could be established that includes infrastructure installed under the harbour seafloor and connecting to mainland corridors. The alignment and location of a possible pipeline route and corridor is not known, but may traverse between the GSDA and Tide Island area. Existing identified corridors within the Gladstone SDA Development Scheme (2015) could be used for any land infrastructure pipeline corridor, however the marine corridor components are not identified as they area outside of the boundaries of the noted planning instruments.

Pipeline corridor infrastructure design would need to consider the topographic constraints, including QER tenements, crossing of gas pipelines, road and rail crossings, tidal flats and mangroves along the shoreline, the harbour seafloor crossing and marine infrastructure.

Services corridor from Aldoga industrial area to Fisherman's Landing

A services corridor linking Fisherman's Landing to an industrial area located at Aldoga (including a potential Steel Plant). The services corridor from port to plant could be utilised for both import of iron ore and export of steel associated with the Steel Plant, and infrastructure running along the corridor could include a private haul road for trucking, overland conveyor, power, water and communications. From Fisherman's Landing the services corridor would run south parallel to the Fisherman's Landing Branch railway line before crossing the railway line and heading south-west roughly parallel to Gladstone-Mt Larcom Road and then head north-west to the Steel Plant at Aldoga on the west side of Mt Larcom.

Services corridor infrastructure design will need to consider the topographic constraints, including tidal flats and mangroves near Fisherman's Landing, terrestrial vegetation, undulating terrain and hard ground adjacent the Yarwun Quarry and the Mount Larcom foothills, as well as crossings of Landing Road, Targinnie Road and Fisherman's Landing Branch rail line. There is potential that WICT berths 5 and 6 could be used to service a steel industry rather than Fisherman's Landing, in which case the services corridor would need to extend further along a route roughly parallel to Gladstone-Mt Larcom Road/Port Curtis Way to connect to the WICT site.

The services corridor from an Aldoga industrial area to Fisherman's Landing has been identified within the Gladstone SDA Development Scheme (2015).

4.2.4 Summary of corridors required that are not within existing planning instruments

In summary, there are several supply chain infrastructure corridors which are likely to be required in master plan growth scenario 3, but which are not currently identified (or wholly identified) within existing planning instruments.

A number of other infrastructure corridors are identified within existing planning instruments.

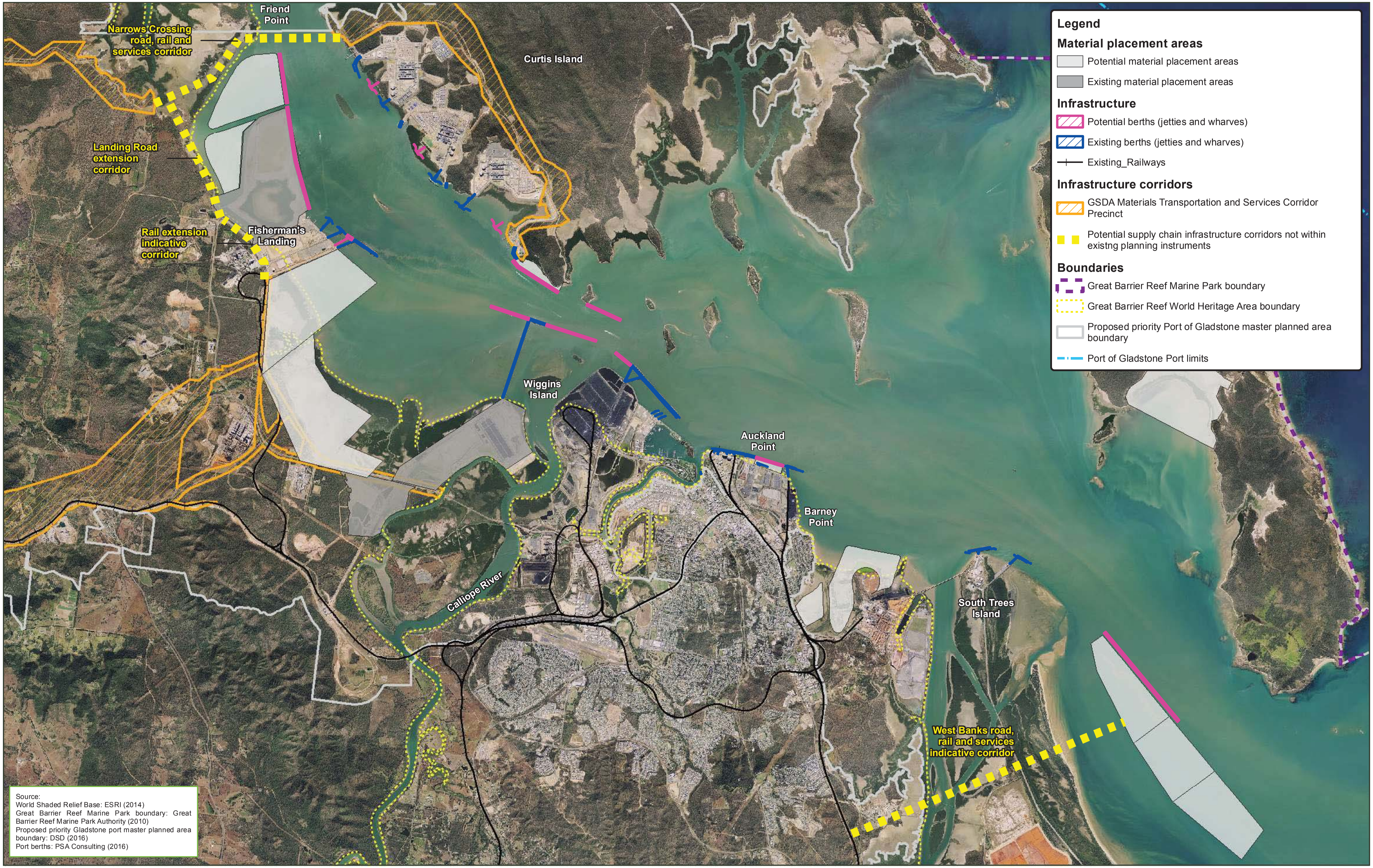
It should also be noted that a number of marine corridor crossings of the Port of Gladstone waters are likely to be required, however the marine corridor components are not identified in any planning instruments as they are outside of the boundaries of the land based planning instruments.

The additional infrastructure corridors identified which are not within existing planning instruments are:

- Mainland to Curtis Island road and rail link
- West Banks Island material placement area road and rail link

The supply chain infrastructure corridors not within existing planning instruments are shown in Figure 4.1. It should be noted that the corridors shown in the figure are indicative only and a number of corridor locations and alignments exist, and engineering and environmental studies would be required to identify the preferred corridors in more detail.

A pipeline corridor from Tide Island to oil and petroleum industry may also be required and is not specifically within existing planning instruments, although a number of other infrastructure corridor options exist to reach Tide Island, including the Curtis Island road and rail link. However while the marine corridor components are not identified, they area outside of the boundaries of the existing planning instruments, and existing land corridors within the Gladstone SDA Development Scheme (2015) could be used for any land infrastructure pipeline corridor. The pipeline corridor has not been shown on Figure 4.1 for these reasons.



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Priority Port of Gladstone master planning Addendum to the Infrastructure and Supply Chain Requirements Assessment report

Figure 4.1: Infrastructure corridors - additional corridors not within existing planning instruments

4.3 Infrastructure connecting to the master planned area boundary

The key existing infrastructure elements that cross the master planned area boundary and facilitate transport of materials and services to and from the Port of Gladstone need to be been considered in the master planning process. These include:

Road

- Bruce Highway
- Dawson Highway
- Gladstone-Mt Larcom Road
- Gladstone-Benaraby Road
- Calliope River Road
- Red Rover Road
- Port Access Road

Rail

- North Coast Line
- Moura Short Line
- East End Mine Branch Line

Services

- High voltage electricity supply mains (Powerlink and Ergon)
- Raw water supply pipelines (GAWB)
- Gas supply pipelines (Jemena)
- LNG pipelines (namely APLNG, QCLNG and GLNG)

The key existing marine infrastructure elements that interface with the master planned area boundary and facilitate transport of materials to and from the Port of Gladstone include:

- Movement of vessels through designated navigation shipping routes
- Permanent anchorages for vessels waiting for a berth spot to become available

5 Optimisation of port infrastructure

5.1 Background from the Independent Review of the Port of Gladstone 2013 and Reef 2050

In 2012, the Commonwealth Government commissioned the Independent Review of the Port of Gladstone in response to a request from the World Heritage Committee. This request, and a later additional request, placed a strong emphasis upon reviewing and recommending management arrangements for the Port of Gladstone that would improve optimisation of port development and operation of the port and on Curtis Island, as well as for other existing port developments.

The independent review committee produced an initial report in July 2013 followed by a supplementary report in October 2013 which identified key principles to guide future planning and port operations within the GBRWHA. In particular, the supplementary report recognised the need to improve port optimisation practices in order to ensure that ongoing growth of port capacity along the coast adjacent to the GBRWHA is managed to ensure it does not compromise the OUV of the GBRWHA by:

- Concentrating development within existing port footprints through better use of long-established port nodes; together with
- Continually improving environmental management within priority ports through leading and best practice in port planning, environmental assessment and decision making, monitoring and reporting, and compliance (Commonwealth Government 2013b)

The Independent Review identified a set of best practice principles, which in relation to port optimisation included:

- Principle 5 - Port planning and operations should be reviewed and improved regularly, informed by advances in technology and knowledge
- Principle 6 - Existing developed footprints within port areas should be optimised to the greatest extent possible prior to expansion into greenfield sites, including through consolidation and sharing of infrastructure (Commonwealth Government 2013a)

Following on from the findings and recommendations of the Independent Review of the Port of Gladstone, the Reef 2050 was prepared and included a specific action requiring the Queensland Government to address 'port infrastructure optimisation' through master planning for each of the priority ports. This requirement is now being addressed through the master planning process mandated by the Ports Act.

5.2 Definition of optimisation

Historically, port infrastructure has been optimised through sound port development planning decisions by the relevant port authority to make efficient use of strategic port land, minimise capital intensive marine based infrastructure, and minimise capital dredging. However, the underlying guiding principles of these port planning decisions have not previously been formally described.

Optimisation can be defined as an act, process, or methodology of making something (as a design, system or decision) as fully perfect, functional or effective as possible.

Parameters that may typically impact on the optimisation of a port include:

- The extent of capital dredging (ie shipping channels, swing basins and/or berth pockets)
- The number of berths
- The distance between land based facilities and berths

- The extent of land-based storage and facilities
- Corridors
- The environmental outcomes
- Capital expenditure for a single proponent's project
- The operational efficiency of the supply chain
- The operational efficiency of the port in isolation.

Where one parameter only is selected for optimisation, the outcome of that optimisation will be different depending upon which parameter is optimised. Optimisation of one parameter can sometimes result in a sub-optimal outcome in a different parameter.

In terms of port infrastructure, optimisation usually centres around the resources that are the scarcest. However, different developments may require different aspects of the infrastructure development to be optimised, depending on the economic, environmental and social context of the project.

The optimisation of a port, and in particular a proponent's project, requires a balance across a number of these parameters.

5.3 Principles of optimisation of port infrastructure

Some of the primary principles of optimisation of port infrastructure are detailed below, along with case studies from the Port of Gladstone, where these principles have been adopted in the past.

5.3.1 Optimise the requirement for capital dredging, while still providing navigable access to the berths

The avoidance of capital dredging can have significant impact on the environmental aspects of a port.

Optimisation can be achieved through:

- Navigation modelling to ensure the minimum safe swing basin geometry is provided (this is the current practice for any Port of Gladstone development)
- Having a tidally restricted port, that requires laden vessels to transit during a limited tidal window, to reduce the required depth of the shipping channel (refer case study 1)
- Co-locate trades where a smaller class of vessels is typically required, to reduce the depth of dredging required (eg restricting the vessel size that berths at Fisherman's Landing results in a shallower Targinie Channel)
- Maximisation of the transit windows through changing of operational practices. This is achieved through berthing and sailing on all states of the tide.

Case study 1 – Cape class vessels are tidally restricted at the Port of Gladstone. This means that the fully laden deep draft vessels can only sail out of the Port on the high tide.

This is because the depth of the shipping channel was optimised, resulting in sacrificing operational flexibility. The resultant optimised channel depth is RL -16.1 m compared with a RL -20.0 m deep channel that would be required for vessels with an 18 m draft to have non-tidally-restricted access.

- Encouraging larger vessels in precincts where berths are designed for cape class vessels, in order to reduce the number of vessel movements, for a given trade volume, to maximise channel capacity. This approach can be somewhat constrained factors outside the ports control, such as destination port draft restrictions, and the way traders enter into shipping contracts.

All of these considerations have been adopted at the Port of Gladstone.

5.3.2 Optimise the requirements for additional berths

Where capability exists to avoid the development of a new berth there is a potential flow on for the requirement to dredge for the berth pocket and access to the channel.

Optimisation can be achieved through:

- Maximising throughput via a given berth by providing high throughput rate cargo handling equipment on the berth, to allow for an efficient vessel turnaround time, which in turn maximises throughput capacity for a given berth
- Where several entities wish to import or export the same type of cargo, provide multi-user facilities that allow for aggregation of the cargoes at a single terminal (implemented at both the RG Tanna Coal Terminal (RGTCT) and WICT)
- Where one trade does not have enough throughput to fully utilise a berth, provide multiple types of cargo handling equipment to allow sharing of a berth by several different cargoes. The time taken to clean up the berth and cargo handling system when changing products to ensure quality assurance/quality of exported/imported cargo (which results in a reduced berth capacity) also needs to be taken in to account (refer case study 2).

However, in some cases an additional berth is provided in order to allow the efficient operation of a tidally-restricted channel. For example, at RGTCT four berths are provided, even though there are only three shiploaders, so only three vessels can be loaded at any one time. This additional berth is provided to allow vessels, once loaded, to wait for the tidal window within which they can depart, and also to maximise the available time that the shiploaders can operate by reducing the time they are waiting for vessels to berth and de-berth.

Case study 2 – Magnesia, Calcite, and Break Bulk is handled across Auckland Point Berth No.1. Cruise ships also berth there from time to time.

Using a single berth for multiple products and uses is effective when the contamination issues between the products are not significant, and the cargo handling equipment is compatible or does not interfere with each other, and the trade volumes do not require the full utilisation of the berth.

Case study 3 – Four berths being serviced by three shiploaders at the RGTCT.

This allows for ships to wait for the tide to depart while the shiploader moves onto a different ship. This enables the operation of a tidally restricted shipping channel, while still keeping shiploaders and conveyors fully utilised.

This is an example where the number of berths is not optimised, in order to optimise the shipping channel depth and reduce the extent of capital dredging and hence reduce dredging costs, and in order to optimise the utilisation of the outloading conveyors and shiploader which in turn reduces the capital and operating cost of the terminal (refer case study 3).

5.3.3 Optimisation of land backed berths

Some cargo handling methods (wet bulk) can operate on island berths, or (wet bulk, dry bulk) berths with access jetties remote from land based facilities, whereas others (container, general cargo and break bulk, roll on-roll off (RoRo), and material offloading facilities (MOF)) require suitable deck areas for cargo handling operations.

At the Port of Gladstone, berths which are land backed, or have access to natural deep water close to available strategic port land, are generally prioritised for the container, general cargo, breakbulk, and RoRo facilities, in order to optimise the use of available land backed berths.

Although wet bulk and dry bulk facilities do not need to be land backed, the distance between the berth and the storage facilities (tanks/stockyards) still needs to be minimised in order to transfer the cargo efficiently from the berth to the storage. Consideration needs to be given to optimal pumping distances for wet bulk products based on viscosity and temperature (cryogenic) of the products handled. Consideration needs to be given to conveyor length and optimal loading /unloading rates and hence conveyor drive capacity for dry bulk products.

5.3.4 Optimisation of jetty length (distance from port lands to berth)

For cargoes which can be conveyed or piped over a jetty back to land (eg coal, LNG, bulk liquids, cement, bauxite, alumina) the length of jetty can be optimised either by increasing the extent of dredging, or by undertaking reclamation or causeway development out to the deeper water. The extent to which a jetty length should be optimised depends upon the relative environmental and economic impact of reclamation, jetty length and dredging.

The dredging of an approach channel to bring the berth closer to the shoreline may introduce potential environmental impacts associated with dredging works. Similarly, the introduction of a causeway or reclamation may introduce potential environmental impacts through changes to the hydrodynamics of the harbour waters.

Long jetty infrastructure has the potential to impact on the economic viability of a project.

5.3.5 Optimisation of wharf decking type and layout

Once it is a determined that a berth will be used for a certain cargo, the design of the berth structure can be optimised for that cargo. For example, a container berth requires a very large deck structural capacity and good access for transfer of the containers back to shore via mobile equipment and/or trucks. Manoeuvring room for the equipment requires a wide deck area to allow for efficiency and safety in the operation of the equipment.

A dry bulk berth needs large capacity rail girders to support the shiploader or ship-unloader, but then only needs a limited deck area and capacity to suit vehicles and cranes for operations and maintenance activities.

By allocating precincts or berths to a certain industry or cargo, the berth structure can be optimised for that cargo (refer case study 4).

Case study 4 – Fisherman's Landing Berth No. 5 (top berth in picture) is an island berth with a very limited decked area, optimised for wet bulk cargoes

Fisherman's Landing Berth No. 4, 2, and 1 are dry bulk berths which have limited deck capacity, that have been specifically designed for dry bulk cargoes. Berth No 3 is a temporary aggregate loadout facility, and therefore does not required any decking.

5.3.6 Optimisation of cargo storage facilities

Stockyard facilities provide a buffer between the land transport (rail or road or pipeline) and shipping in the supply chains. They enable cargo to be aggregated and enable different transport mode schedules to be accommodated.

A stockyard allows for operational features such as blending of products, and the ability for multiple users to store product in different areas.

The extent of storage required depends on the extent to which the rail/road and shipping schedules are optimised. For example, regular railing or trucking results in the least number of rolling stock/truck fleet, but also results in the largest stockyard requirement at the port.

Campaign railing or trucking, where cargoes are delivered just in time to meet the shipping schedule, results in the largest rolling stock/truck fleet requirement (and larger stockyards elsewhere), but a lower volume stockyard at the port.

The stockyard and storage facilities need to provide as a minimum, the ability to assemble the full cargo requirements for a shipment. In the event that a full shipment is not available, there is a potential for a high social impact from increased demands in the supply chain, particularly through the use of trucks.

The extent to which the stockyard is optimised usually depends upon the ability of the upstream supply chain to deliver or receive a product, the availability of storage at the port, the noise and congestion issues associated with campaign trucking or railing operations, the number of products to be stored, and any special storage requirements.

In optimising the relationship between the point of supply, storage areas, and berth location, the transfer between the storage and vessel should be at the highest practical rate, whilst transfer of product between the supply point and the storage can be at a lower regular delivery rate. The latter reduces the demand on the supply chain and social interaction while the former optimises the berth.

5.3.7 Optimisation of land transport corridors

In order to facilitate both trade and industry, both Industrial land and strategic port land needs to have access to berths, through land allocated to transport and service corridors. By allocating common corridors for all proponents to co-locate their linear infrastructure (eg road, rail, conveyor, pipeline, power, water, sewerage), land used to access the port can be maximised, in turn facilitating a maximised extent of land that can also be used for industry.

This is a clear example where the optimal solution for a specific proponent is different from the optimal solution from a whole of port and state development area perspective. A proponent would typically want to select a route that is the shortest distance from the industrial/stockyard site to the berth, whereas, the port would want the routing to be inside designated corridors, to ensure future development is not denied access.

5.3.8 Repurposing of redundant facilities

When a cargo or industry no longer needs port facilities, consideration should be given as to how these facilities can best be repurposed. Consideration needs to be given to the age and condition of the facilities, and whether it is more practical and safe to extend their life, or to demolish them and reuse the berth to a new purpose (refer case study 5).

5.3.9 Shared infrastructure

Optimisation can occur by sharing infrastructure across industries or cargoes. For example the water and power distribution networks for the port can be sized for the total demand for industries expected within the precinct, rather than just being sized for a single proponent's needs. The challenge of this approach is in determining an equitable way of investing capital when a particular proponent (the first mover) may only need a portion of the installed capacity.

Road and rail links to the port are another example of where infrastructure is shared. The Port Access Road to Port Central and Fisherman's Landing corridors (and in the future the road link to West Banks Island, and the road link to Curtis Island) are used by multiple users requiring truck haulage to the port.

Where there is a requirement for continuous haulage, possibly using off-road trucks with unregistered vehicles, a private haul road a private road is required to ensure separation between public use of roads, and a continuous haulage operation. This is an example where the road infrastructure may not be able to be shared, but the private haul road could be sited in a shared services corridor.

Case study 5 – The Barney Point Coal Terminal has been decommissioned and is on longer exporting coal, due to proximity of coal stockpiles to urban areas, and the development of WICT, enabling this trade to be moved to the WICT.

The facility is now being considered to be repurposed for other uses (eg bulk export with covered storage) that can potentially make use of the existing berth, shiploading conveying and hardstand infrastructure.

5.3.10 Environmental outcomes

In some cases, it is decided to adopt a solution that requires more infrastructure in order to achieve an environmental or community outcome. For example a road or rail corridor might not take the shortest route from origin to destination, in order to avoid wetlands, or be a certain distance away from residential areas to limit noise impacts.

5.4 Constraints to optimisation in port planning

There are other principles of competition policy, ecologically sustainable development (ESD), and cargo handling methodology which constrain the goal of infrastructure optimisation in port planning. These include:

- **Competition policy** – if two different port operators are providing a competitive service, then they might not be in a position to share infrastructure, without either creating a situation of collusion, or a situation in which one proponent loses its competitive advantage
- **ESD** – if a significant environmental impact is identified for a project, additional infrastructure might be built in order to reduce the environmental impact
- **Cargo handling methodology** – as different cargoes are handled in different ways, it is sometimes difficult or impossible to collocate cargoes on the same berth, or even in the same precinct

5.5 Approach to optimisation of port infrastructure

Section 5.2 discussed examples where optimisation of various elements of the port results in a sub-optimal outcome in another area of the port. In these instances, either a prioritised approach or a balanced outcome approach needs to be considered as follows:

- **Prioritised approach** - where one aspect is given priority over other aspects, and the higher priority aspect is optimised.
- **Balanced outcome approach** - where a number of aspects are important, so the system is optimised to give a balanced outcome. Depending on the nature of the project, an example of a desired balanced outcome could be a combination of:
  - The ability for port to be operated safely
  - Ecologically sustainable development
  - Lowest port capex
  - Lowest port opex
  - Lowest port whole of life costing
  - Lowest risk to disruption of operation (reliability)

5.6 Process for achieving optimisation of port infrastructure

In order to achieve optimisation of port infrastructure, the principles of optimisation need to be cascaded through master planning, statutory planning, proponent planning, feasibility studies and finally through to detailed design and implementation. Different entities have different responsibilities at different stages through the planning and project lifecycle. There is also a distinction between projects that are developed by a private proponent and multi-user or common-user infrastructure that might be either funded or developed by GPC or the state. Table 5.1 shows an example of a model for the instance where a project is developed by a private proponent.

Table 5.1 Example model for enabling cascading of principles of optimisation for a private project

Status of port planning/ development	Responsible entity	Action required	Other entities involved	Responsibility of other entities
Port master plan	DSD	Ensure port infrastructure optimisation is included in the master plan objectives and desired outcomes To specify the port infrastructure optimisation considerations in the preliminary draft port overlay development assessment requirements	GPC, GRC and other key stakeholders	To provide input and review
Port overlay	DSD	Preliminary draft port overlay to respond to the objectives of the port master plan	GPC, GRC and other key stakeholders	To provide input and review
Port strategic plan	GPC	Provide a plan for the development of existing and potential strategic port land Optimisation of the relationship between port lands, berths and channels	DSD, DTMR and GRC	To provide input and review
Project plan	Proponent	Provide a plan for how a proponent proposes to develop their facilities To ensure early consultation occurs with GPC	GPC, DSD, DTMR and other key stakeholders	To appropriately locate proposed development and allocate land and berth slots according to port infrastructure optimisation principles
Project feasibility and identification of approvals pathway	Proponent	Demonstrate feasibility and confirm port and other infrastructure and services requirements (construction and operation) Confirm planning and environmental approvals pathway and supporting studies needed	GPC, DSD, DTMR and other key stakeholders	To ensure the proponent continues to develop the detail of the project in accordance with port optimisation principles
Preparation of development applications and supporting information (including an environmental impact assessment (EIA) if required)	Proponent	Prepare concept design and obtain approval in principle from port and other infrastructure and services entities on proposed strategy Prepare and submit project EIA and development applications	GPC, DSD, DTMR and other key stakeholders	To ensure the proponent continues to develop the detail of the project in accordance with port optimisation principles

6 Key considerations for the draft master plan

This addendum has provided additional information on the infrastructure and supply chain requirements to inform development of the priority Port of Gladstone draft master plan and preliminary draft port overlay. The ISCRA summarises key considerations for the master planning process (ISCRA Section 5).

The key outcomes of the overall infrastructure and supply chain assessment are summarised below.

Marine berths and channels

Expansion in the number of industries, port throughput, number of berths, number of vessels using the port and the extent of channels will be required to accommodate the master plan growth scenario 3. The assessment suggests a total of 42 berths may be required. It is important for the master planning process to provide flexibility for future development, and in some cases, two or more different location options may be identified for a particular proposed development. This flexibility is important so that future developments are not constrained to a particular location, and also given the growth scenario and throughput identified is only one possible future growth profile.

A number of emergency anchorages are also situated in the inner harbour, and these key areas should remain in the draft master plan for use as emergency anchorages, and may be reviewed as port throughput increases.

The existing and potential berths to consider in the draft master plan are shown in Figure 3.2. Master planning should address the need to protect existing and potential marine berth areas, anchorages and shipping channels.

Dredging and material placement areas

Capital dredging will be required to accommodate the master plan growth scenarios. Deepening and duplication of the shipping channel is required to accommodate the increase in number of vessels, the increasing use of deeper draft Cape Class vessels and the development of import industries requiring Cape Class vessels. Capital dredging of new channels and berth pockets are also required to service new berths. This capital dredging is a key requirement for the growth of the port.

Capital dredged material requires placement, and a number of potential material placement areas have been identified. The potential dredged material placement areas are typically in locations which will create beneficial port land and provide economic benefit, or in locations to provide environmental benefit.

Maintenance dredging of the channels, berth pockets and swing basins is necessary to maintain an operational port, and will be an ongoing requirement. No additional infrastructure is required for maintenance dredging, with the existing East Banks DMPA having sufficient remaining capacity for the master plan timeframe, although maintenance dredged material could also be placed in existing and potential material placement areas within the master planned area.

The existing and potential dredged material placement areas to be incorporated into the master planning process are shown in Figure 3.2. Master planning should address the need to protect dredged material placement areas, shipping channels and the East Banks DMPA.

Supply chain linkage – infrastructure corridors

The movement of goods to and from the port requires suitable road, rail, pipeline, services and conveyor corridors in appropriate locations. The master planning process should preserve appropriate infrastructure corridors to meet the future infrastructure requirements, and allow management of adjoining land uses for the future development of the master planned area.

A number of potential infrastructure corridors have been identified in the assessment. A number of these potential infrastructure corridors are already identified within existing planning instruments of the GPC Port Land Use Plan, Gladstone SDA Development Scheme and the GRC Planning Scheme.

Additional infrastructure corridors have been identified which are not within existing planning instruments, as shown in Figure 4.1. The additional corridors are:

- Mainland to Curtis Island road and rail link
- West Banks Island material placement area road and rail link

A number of marine corridors crossing the Port of Gladstone waters are also likely to be required, including a possible petroleum pipeline to Tide Island, and these marine corridor components are not identified in any planning instruments as the area is outside of the boundaries of the land based planning instruments. The master plan should consider these marine crossings.

Master planning should address the need to protect the infrastructure corridors required, including both the land based and marine based corridors.

Optimisation of port infrastructure

Reef 2050 includes a specific action requiring the Queensland Government to address 'port infrastructure optimisation' through master planning for each of the priority ports.

In order to achieve optimisation of port infrastructure, the principles of optimisation should be cascaded through master planning, statutory planning, proponent planning, feasibility studies and finally through to detailed design and implementation. The requirement for optimisation needs to be incorporated into the master planning process.

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