Appendix 2

Issues and Options report

Proposed Northport Expansion

ISSUES AND OPTIONS REPORT

October 2022

Contents

1 Glossary of terms

ASC *"Auto Stacking Cranes"* (ASC) are automatically stacking rail-mounted gantry cranes for managing stacks of containers, e.g:

Beam The width of a ship at its widest point;

Break bulk cargo Products in individual packaging, loaded and unloaded individually without using containers;

Bulk cargo Products transported loose and stored directly into a transport vessel, without packaging;

CD Chart Datum;

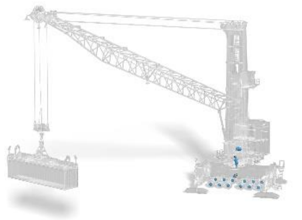
Draught/draft The maximum depth of any part of the vessel;

Fork hoist A vehicle used for stacking and moving containers, e.g:

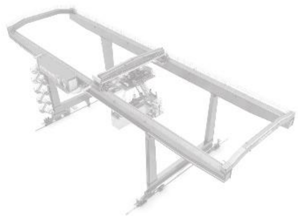
LOA Length overall;

MAFI trailer Used in the context of this report – dock truck and trailer combinations for transporting containers / break-bulk cargoes on terminal (can also be known as "terminal tractors");

MHC *"Mobile Harbour Cranes"* (MHC's) are versatile port cranes, suitable for handling general cargo, containers, and bulk materials e.g:



RMG *"Rail Mounted Gantry"* (RMG) cranes are mobile gantry cranes working on rail lines that are used for stacking and moving containers, e.g:



RS *"Reach stackers"* (RS) are vehicles used for stacking and moving containers, e.g:

RTG *"Rubber Tyred Gantries"* (RTG) are wheeled mobile gantry cranes operated to stack and move containers, e.g:

Straddle carrier A vehicle used for stacking and moving containers, e.g:

STS *"Ship-To-Shore"* (STS) cranes are gantry cranes found at container terminals for loading and unloading containers, e.g:

TEU Twenty-foot equivalent unit: a measure of volume in units of the standard twenty-foot containers;

UNI Upper North Island;

UNISC Upper North Island Supply Chain.

2 Executive Summary

Located at Marsden Point at the Whangārei Harbour entrance, Northport is New Zealand's northernmost deep-water port. It has three berths available for handling dry cargo vessels, with a total linear berth length of 570 m. The Northport facility totals 49.1 ha of land, including over 40 ha that is paved and used for cargo operations. Northport is among the most modern ports in New Zealand.

Northport is significant in the Northland region, and nationally, because of its commercial, transportation and infrastructure functions. Northport holds an important role in Northland's regional economy, supporting import and export activity. This role has expanded and diversified significantly since Northport began operating in 2002. The changes in Northport's freight tasks and opportunities for diversification are outlined in this report.

More than 20 economic studies have been conducted on the future of the UNISC and the implications for Ports of Auckland, the Port of Tauranga and Northport, including two recent well-resourced studies published by the NZ Government[1]. The UNISC is under pressure and additional container freight capacity and resilience is needed in the short to medium term. Additionally, growth in Northland's freight and diversification of freight types mean Northport's current facilities are under pressure and nearing their functional capacity. Northport is not developed to its full potential, or in a way that can effectively accommodate other freight streams, for example, containers, cars, and cruise vessels. Availability of berth space and appropriate handling infrastructure to efficiently load and unload container freight will become limiting factors at Northport, constraining its ability to handle increased cargo volumes and more diverse cargo types. Storage space immediately behind the wharf is also reaching capacity.

To accommodate the changes in freight tasks and to realise the benefits of the opportunities for the regional economy, Northport needs to expand into a facility capable of efficiently handling additional freight streams. It is imperative that Northport continues to undertake long-term planning that enables the port to meet the needs of the community and the economy.

Northport is in the unique position of having the essential attributes to efficiently enable an increase in port capacity and to provide additional freight capacity to Northland and the UNI. Northport is located within a sheltered harbour and has naturally deep water with good navigability, room to reclaim land, and proximity to road and rail transport networks - planned improvements to rail connectivity are expected to be constructed by 2028. Proximate to Northport is currently underdeveloped commercial, industrial, and port zoned land which could accommodate developing ancillary and support businesses and attract regional investment.

Northport's objectives for the proposed expansion are:

- To create a modern efficient terminal with a 700 m long container berth and sufficient terminal area to handle at least 500,000 TEU/annum.
- Locate all container services on the new terminal to enable growth and diversification of other freight on the existing footprint.
- Incorporate best practice operational and environmental controls to minimise effects on the surrounding environment and community.

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[1] Ministry of Transport (2018), *Upper North Island Supply Chain Strategy – appointed Working Group, August 2018;* Sapere (2020), *Analysis of the Upper North Island Supply Chain Strategy Working Group Options for moving freight from the Ports of Auckland.*

- Allow for the integration of rail freight following the construction of the Marsden Point spur.

Northport has developed the proposal that is the subject of this consent application over many years of design development and assessment of alternative options. The proposal's design progression, alternatives assessed, and the preferred design are set out in this report. In summary, several broad options were considered by Northport when evaluating how and where additional port capacity could be located to meet the project objectives, including:

- A location other than Northport.
- Reconfigure existing port operations.
- Extend the port footprint either west, north, south or east.

A summary of the evaluation process is set out in this report. Ultimately, an eastern expansion was chosen as the preferred option for the reasons outlined in this report.

In terms of the design of the proposal, any expansion and redevelopment of Northport is required to integrate with existing port operations and surrounding constraints. Northport commissioned WSP to provide initial, high-level advice on whether to undertake reclamation, or to construct a piled wharf. That advice was that reclamation is the only practicable option, for a number of reasons outlined in this report.

Northport also commissioned WSP to prepare a Concept Design Report which records the user requirements, constraints, and selection criteria (and assessment against them) for several wharf designs. Based on the relevant criteria, an open piled marginal wharf with rock revetment was the chosen option, for the reasons outlined in this report. Detailed design will be undertaken prior to construction. The Concept Design Report also identifies the proposed construction methodology for the indicative wharf design. A range of other wharf design options were considered and discounted, as described in this report.

In summary, ongoing national supply-chain pressures, long-lead times in the development of port infrastructure, and growing demand from shipping companies indicate that now is the appropriate time for Northport to expand its facilities. Expansion of Northport can deliver a purpose- built, modern and efficient container terminal. An expanding port will also represent a catalyst for better infrastructure and services for Northland, as well as providing for regional economic growth by facilitating new industries and jobs for Northland. The proposed expansion of Northport’s facilities will support the continued growth of Northland and add capacity to the UNISC by providing container freight services for North Auckland.

3 Project Rationale

The UNISC is under pressure and additional container freight capacity and resilience is needed in the short to medium term. Additionally, growth in Northland's freight and diversification of freight types mean Northport's current facilities are under pressure and nearing their functional capacity.

Northport is in the unique position of having the essential attributes to efficiently enable an increase in port capacity and to provide additional freight capacity to Northland and the UNI. Northport is located within a sheltered harbour and has naturally deep water with good navigability, room to reclaim land, and proximity to road and rail transport networks - planned improvements to rail connectivity are expected to be constructed by 2028. Proximate to Northport is currently underdeveloped commercial, industrial, and port zoned land which could accommodate developing ancillary and support businesses and attract regional investment.

An expansion of Northport's facilities will support the continued growth of Northland and add capacity to the UNISC by providing container freight services for North Auckland.

Outcomes of an expansion of Northport's facilities include:

- Adding an estimated 500,000 TEU/annum capacity to the UNI freight network.
- Increasing the resilience of the UNISC through ability to protect against disruptions at the other ports.
- Continuing to support the growth of Northland by connecting exporters/importers with cost-effective access to international markets.
- Allowing for a wider range of freight streams which supports a diversification of the Northland economy.
- Increase in cruise ship visits, with the corresponding increase in spending across the region.

Ongoing national supply-chain pressures, long-lead times in the development of port infrastructure, and growing demand from shipping companies, indicate that now is the appropriate time for Northport to expand its facilities. Expansion of Northport can deliver a purpose- built, modern and efficient container terminal. An expanding port will also represent a catalyst for better infrastructure and services for Northland, as well as providing for regional economic growth by facilitating new industries and jobs for Northland.

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- Allow for the integration of rail freight following the construction of the Marsden Point spur.

4 Northport

4.1 Location and attributes

Located at Marsden Point at the Whangārei Harbour entrance, Northport is New Zealand's northernmost deep-water port. It has three berths available for handling dry cargo vessels, with a total linear berth length of 570 m. An additional berth is consented but not yet constructed; if constructed, it would increase Northport's total linear berth length to 840 m.

Northport is among the most modern ports in New Zealand and is the only port that has been constructed entirely under the RMA. It is designed to meet very stringent environmental controls.

The Northport facility totals 49.1 ha of land, including over 40 ha that is paved and used for cargo operations. Of the existing 49.1 ha footprint, 33.6 ha is reclaimed land.

Northport operates 24 hours a day, seven days a week to meet the trade demands of Northland and the wider Auckland region, handling domestic freight and international imports and exports.

Logs, woodchip and processed timber for export comprise the bulk of cargo handled by the port. Recent investment in container handling equipment has seen an uptake in coastal and international container trade. Other export items include kiwifruit, cement, and manufactured goods. Imports are also an important part of Northport's business and include fertiliser, gypsum, coal, steel, project cargo, and animal feed supplements.

Current port area uses, by approximate percentage, are:

- Log marshalling (approximately 46% of the port area).
- Container handling (approximately 15% of the port area).
- Multi cargo (approximately 12% of the port area).
- Woodchips (approximately 5% of the port area).
- LVL (laminated veneer lumber) (approximately 3% of the port area).
- Coal (approximately 2% of the port area).
- Other wood products (approximately 1% of the port area).
- Agricultural imports (approximately 1% of the port area).
- Administration (approximately 10% of the port area).

Approximately 10 percent of the port area is under development. This area is used occasionally for project cargo, and more recently for storing containers from shipping services diverted away from a congested Ports of Auckland. This chip-sealed surface is lower than the rest of the port area, as it will be upgraded in the future with a high load pavement. This area has the potential to be used for handling multiple cargoes in the long term.

Figure 1: Map of Northport (Source: Market Economics, 2022)

Adjacent to the Port is 700 ha of commercial, industrial and port zoned land which is owned by third parties. This off-port land has future capacity to accommodate support facilities such as warehousing, log scaling and handling, and other port-related activities which do not need to be adjacent to a wharf.

4.2 Significance

Northport is significant in the Northland region, and nationally, because of its commercial, transportation and infrastructure functions. It is an integral part of the national network of safe ports recognised in the New Zealand Coastal Policy Statement 2010 and is recognised as "regionally significant infrastructure" in the Regional Policy Statement for Northland and the Proposed Northland Regional Plan.

It is imperative that Northport continues to undertake long-term planning that enables the port to meet the needs of the community and the economy.

4.3 History of Northport

Northland's port history from the early upper harbour ports to Northport at Marsden Point illustrates that developing port facilities takes many decades, both in terms of planning and construction.

For over a century, ports in Whangārei Harbour have been key infrastructure for Northland's economy. Originally, the town basin enabled exports of primary sector resources such as wood, Kauri gum and coal. Then Port Whangārei (first developed in the 1920s) catered primarily for import fertiliser products, dairy products, horticulture and forestry.

Over time it became increasingly difficult to maintain the channel and berth depths required for cargo vessels in the upper harbour. Marsden Point, nearby at the harbour entrance, offered naturally deep-water ideal for a commercial port facility.

In the 1960's the Northland Harbour Board first proposed developing the port at its current location. Technical studies were completed more than a decade later in 1976 and the Northland Forestry Port Study was released in February 1980, recommending that Marsden Point be developed as a deep-water port for exporting Northland's forestry products.

As Northland's forestry industry began to increase production in the 1990s, cargo volumes reached a point where the project was economically viable and provided the catalyst for the development of Northport. A summary of the key steps/events in Northport's development are set out in the following sections.

4.3.1 Northland Harbour Board container port (1969)

In the late 1960s, following a study to determine whether a proportion of cargo between the UK and NZ could be economically carried in containers, the Northland Harbour Board identified Marsden Point as a location to establish a new container port. Among other findings, the Northland Harbour Board suggested there were benefits to constructing one national container terminal port for New Zealand. Marsden Point was identified as the optimum location due to the physical, nautical, financial, economic and social advantages.

The (then) New Zealand Ports Authority did not approve the concept, and instead as part of the national ports plan, promoted container handling ports at Auckland, Wellington, Lyttleton and Otago.

The Northland Harbour Board were not to be deterred and continued to acquire land at Marsden Point and various coastal leases. Plans were prepared, and while funding (capital expenditure) was ultimately not approved for the project, the Northland Harbour Board proceeded to pass the Northland Harbour Board Vesting and Empowering Act which authorised the reclamation of 65 acres of land at Marsden Point. A sketch of the project is shown in Figure 2 below. In essence this was the start of the journey for the deep-water port at Marsden Point.

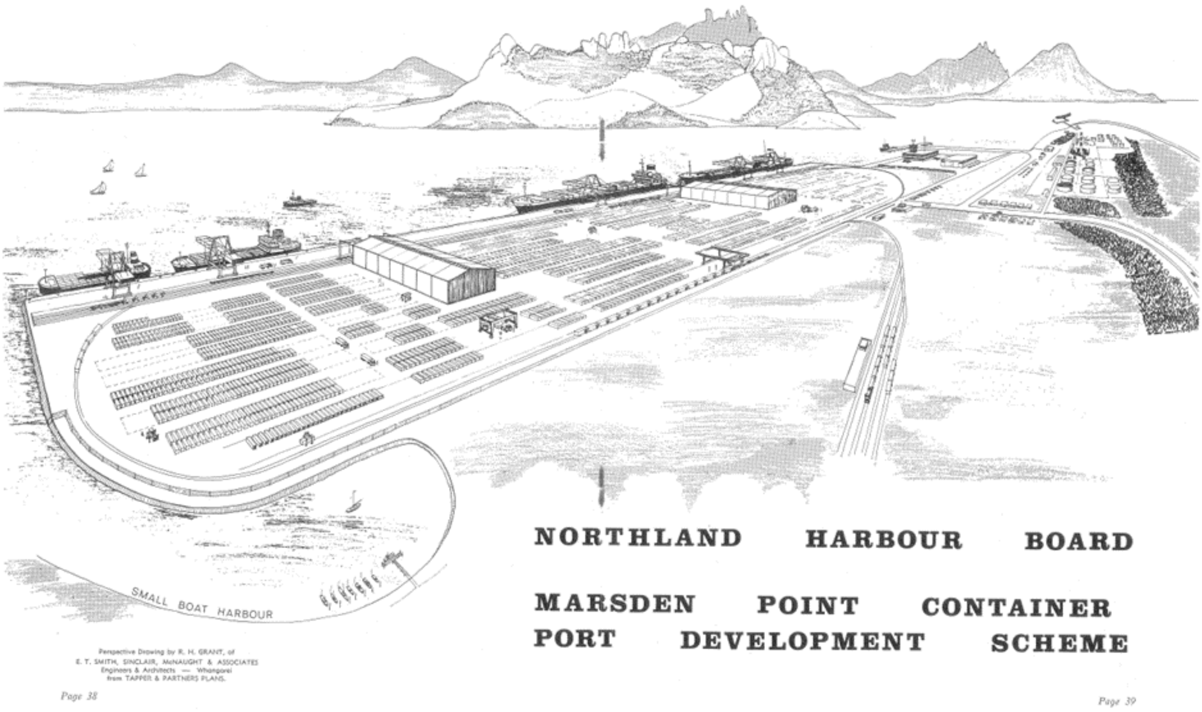

Figure 2: Sketch of Northland Harbour Board proposal for Marsden Point container port scheme

4.3.2 Northland forestry review

In or around 1980 a forestry freighting study was undertaken to investigate forestry port sites and transport systems. This study costed a number of port and transport combinations, including both single and twin port models. Numerous locations were considered throughout Northland to establish a new export forestry port, and it was concluded that a single port located at Marsden Point, Opua and Whangaroa should be further investigated. Drawings of locations considered are shown in Figures 3-5.

Further studies assessed the social and environmental effects of port development. These concluded that port construction at Marsden Point would minimise the impacts of port development upon the physical environment. Dredging requirements would be minimal by comparison with Opua, and the hydraulics of the Whangārei Harbour and the harbour ecology would be little changed. Reclamation would be limited to a small area of foreshore, and port operations would be in keeping with existing land use and zoning in the area. At both Whangaroa and Opua, port construction would require massive earthworks operations, and port operation and communication links would conflict with existing land use.

The following recommendations were made:

- Marsden Point be developed as a deep-water port for the export of Northland's forest products.
- A rail line be constructed linking Marsden Point with the North Auckland line at Oakleigh.
- Rail be used rather than road transport for the internal movement of forest products from the processing point to the port.
- A barge system be constructed to transport forest products from the Mangonui county.

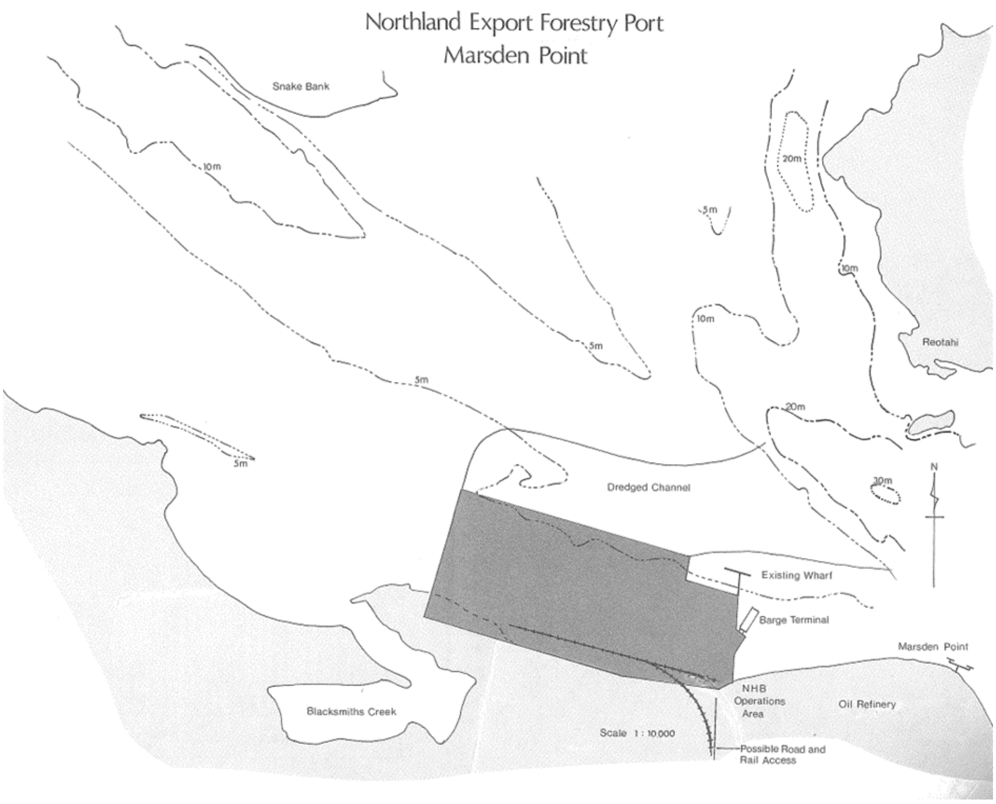

Figure 3: Drawing showing Marsden Point location for proposed export forestry port

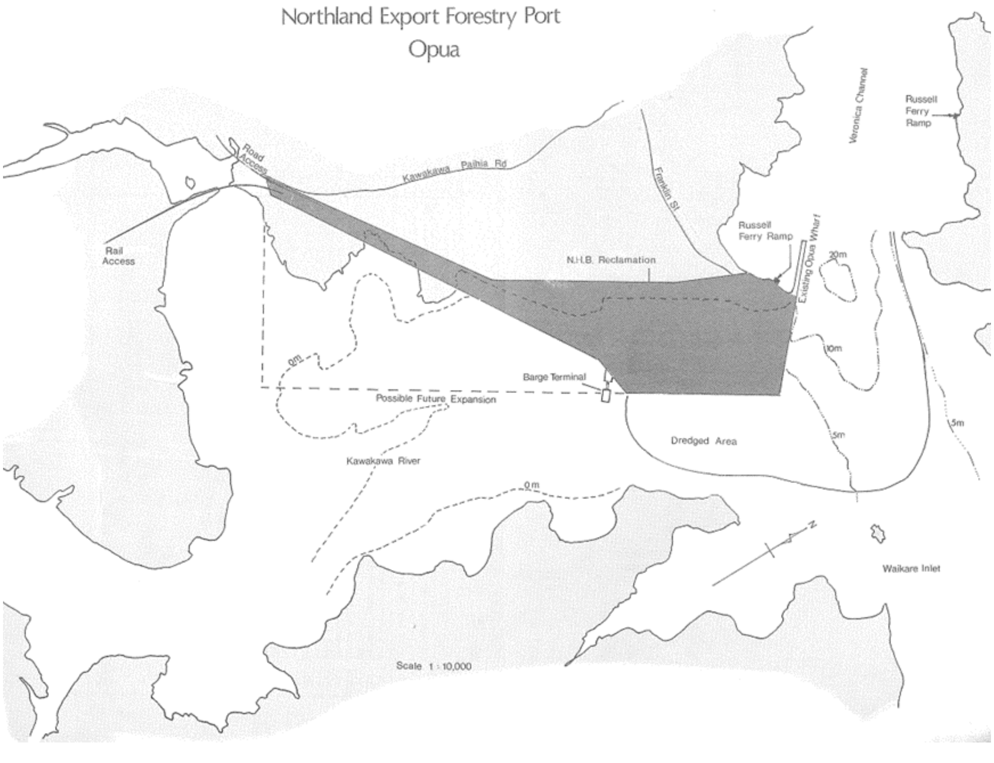

Figure 4: Drawing showing Opua location for proposed export forestry port

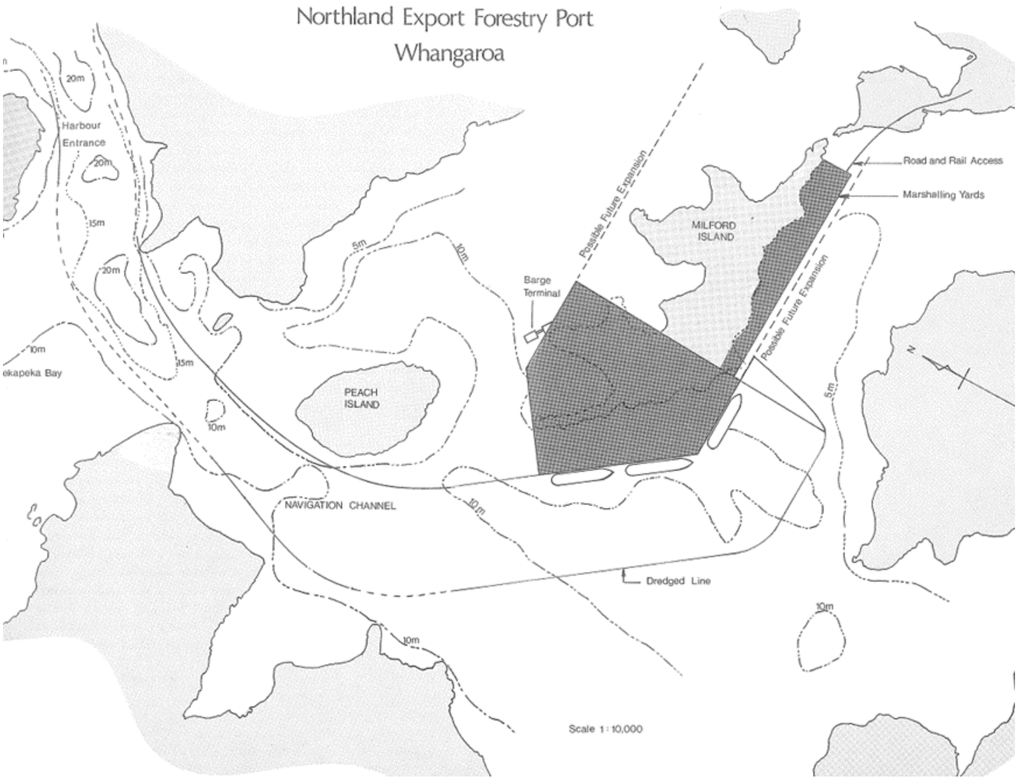

Figure 5: Drawing showing Whangaroa location for proposed export forestry port

4.3.3 Northland Port Corporation investigate and consent Marsden Point port (1990s)

The Northland Port Corporation considered three broad options for a port facility at Marsden Point. These were:

- Construction of a basin extending inland over part of the Blacksmiths Creek spit. Berthage would be developed inside the basin, adjacent to large areas of reclamation on both sides for storage and associated activities. Large amounts of dredging would be required, meaning spoil disposal would create a problem. The basin development would also constrain ship movements across the tidal stream and to and from the dock. This proposal required the highest development cost, and Blacksmiths Creek would virtually cease to exist.
- An island terminal located on Snake Bank with road and rail access via a bridge from One Tree Point. Dredging of berthages and channels would supply the reclamation fill. Shipping access to the upper harbour would be blocked by the bridge, therefore a shallow channel to the north of Snake Bank would need to be opened for smaller ships. While the orientation would have good characteristics for shipping, the cost of access, visual intrusiveness, noise effects on residential areas on both sides of the harbour, destruction of a valuable recreational and commercial shellfish bank, and significant effects on the hydrology of the lower harbour were material disadvantages.
- A basic straight wall westward of the existing Harbour Board jetty, parallel to the shore to some distance along the Blacksmiths Creek Spit. Dredging volumes to deepen the channel approximated the volumes required for filling in the reclamation. The costs were appreciably lower than the former two proposals, and the proposal provided room for expansion and was adjacent to existing industrial land. The social impacts were considered to have the least

effect on adjacent residential areas and the proposal was considered to involve reduced disturbance to the environment by comparison.

Drawings showing alternative schemes considered by Northland Port Corporation are shown below as Figures 6 and 7.

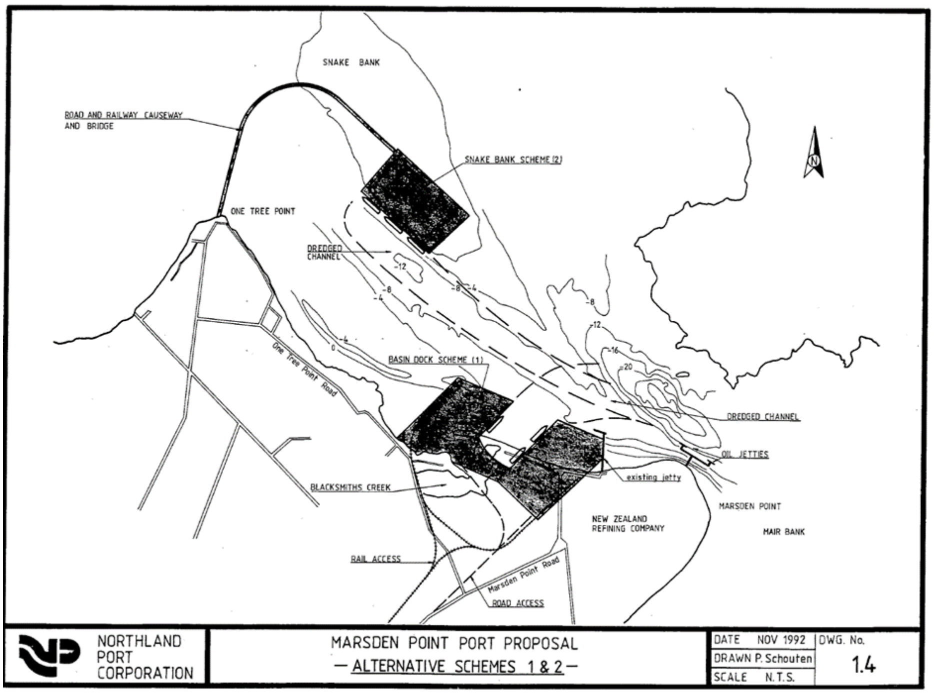

Figure 6: Drawing showing alternative schemes considered by Northland Port Corporation (1992)

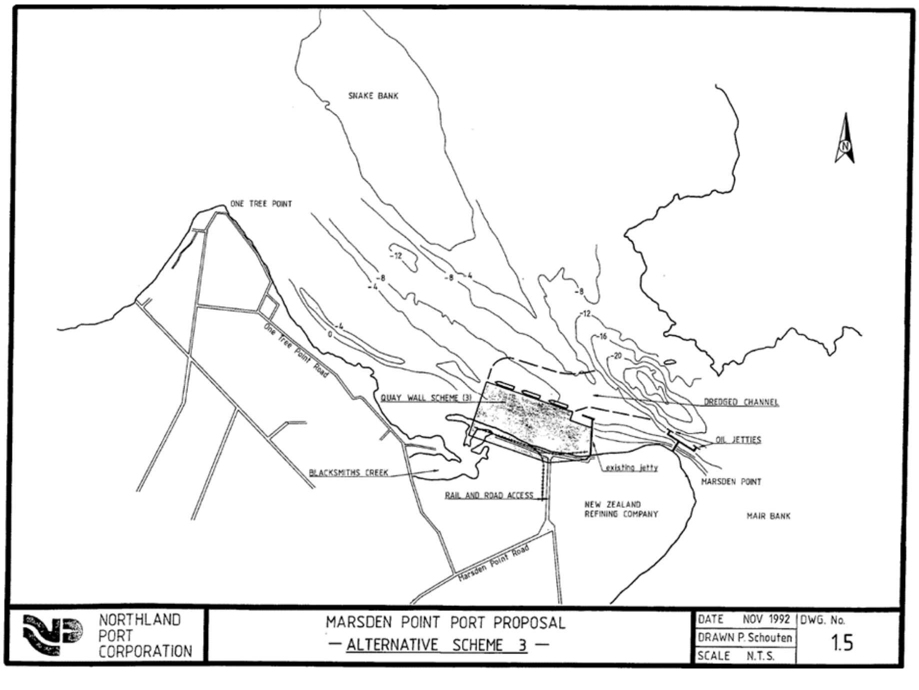

Figure 7: Drawing showing alternative scheme considered by the Northland Port Corporation (1992)

Following consideration and assessment, an application was lodged for resource consents necessary for dredging, reclamation, and port operations including cargo storage and a dry bulk cargo pier (and ancillary/related matters) at the current location. The decision to grant resource consents was upheld on appeal by the Environment Court in 1999.[2]

4.3.4 Construction of Stage 1 / Berths 1 & 2 (2000-02)

Construction of the Northport facility proceeded in an iterative, staged manner. This enabled design responses to demand and external factors.

Northport was originally designed and built to export unprocessed logs, other wood products, and dry bulk cargo such as fertiliser, cement, and gypsum. In its original form, the port offered two berths with an adjacent 'lay-down' area for bulk cargo storage and support facilities.

Berths 1 and 2 were designed according to the expected vessel size and with forecasts in shipping trends in mind. With an overall design berth length of 440 m and a berth face of 200 m per berth, the original facility was designed to accommodate a maximum ship draught of approximately 11.5 m (with a required under-keel clearance of 1.2 m).

Berths 1 & 2 were completed in 2002. The first two berths were developed with extensive open storage space to the south of the berth face. The rationale for two berths was based on the calculated ability of a single berth accommodating a throughput cargo volume of 1,200,000 tonnes per annum, and a second berth accommodating up to an additional 800,000 tonnes per annum.

Berths 1 & 2 together represent an as-built 390 m linear berth, dredging to enable a depth 13.0 m below chart datum, and a 34 ha reclamation to provide an operational port area. Berths 1 & 2 are shown in Figures 8 and 9.

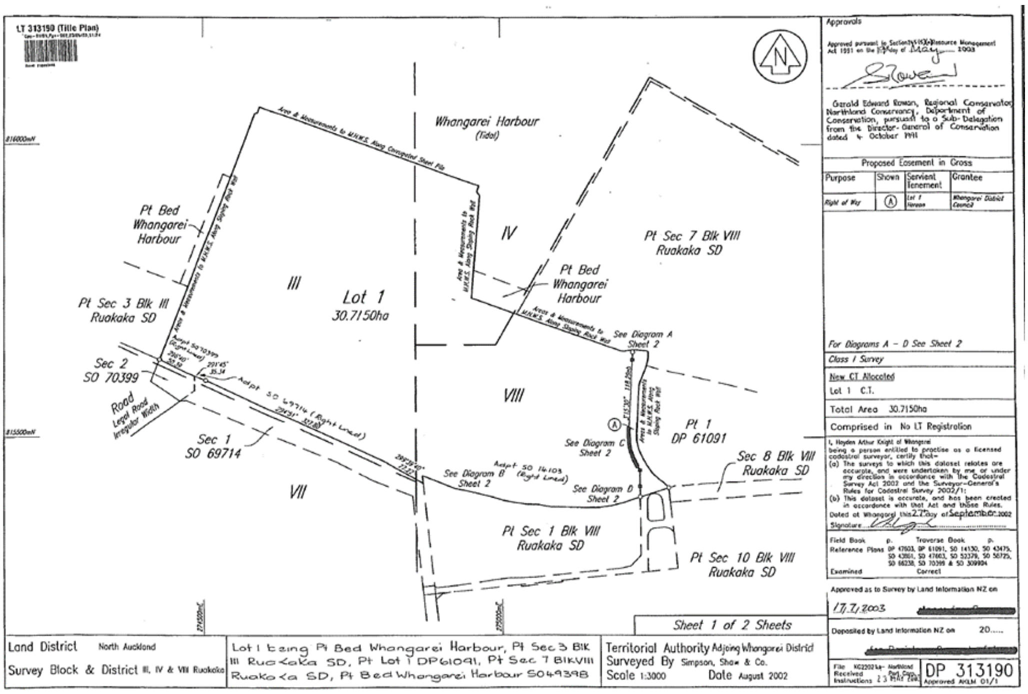

Figure 8: Drawing showing Berths 1 & 2

[2] Decision A53/99, Judge Sheppard, Whangārei, 7 May 1999.

Figure 9: Aerial photograph showing Berths 1 & 2

4.3.5 Consenting Stage 2 / Berths 3 & 4 (2004)

Following construction of Berths 1 & 2, Northport explored options for best continuing to develop the port facility. This was in response to demand and a range of external factors, including the closing of commercial shipping at Port Whangārei. A range of alternative designs for Berths 3 & 4 were considered, as shown in Figures 10-12 below.

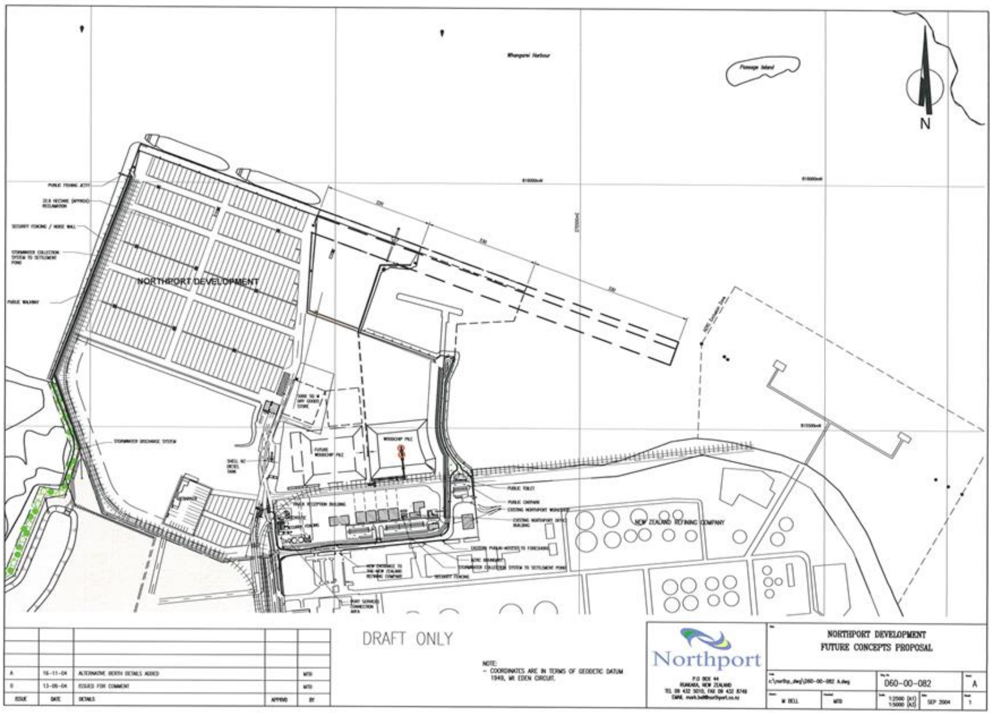

Figure 10: Alternative design for Stage 2

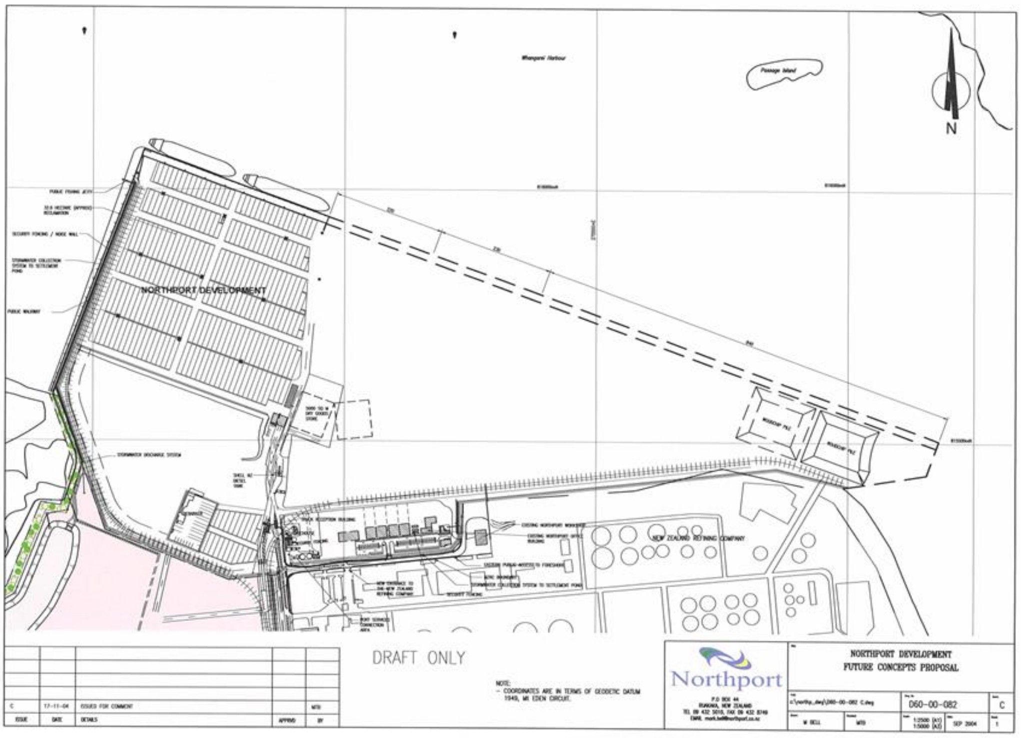

Figure 11: Alternative design for Stage 2

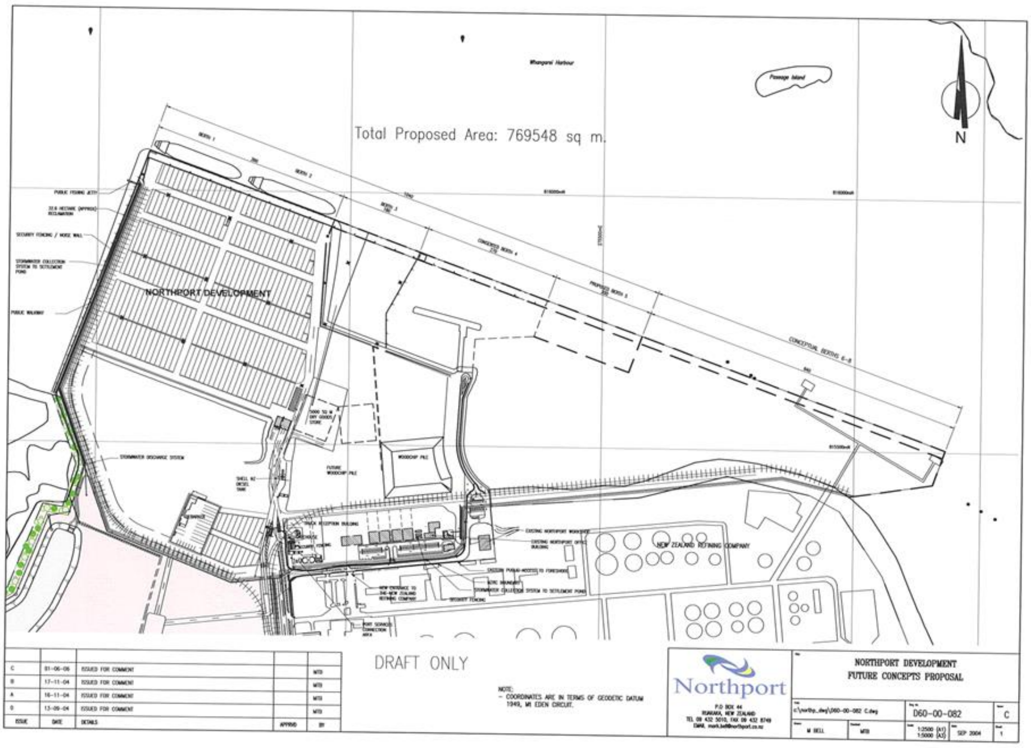

Figure 12: Alternative design for Stage 2

Ultimately, resource consents were granted in 2004 which authorised construction of an additional 400 m additional linear berth length to the east of Stage 1 (i.e. Berths 1 & 2), dredging to enable a depth 14.5 m below chart datum, and a 5.2 ha reclamation.

The consented design for Stage 2 is shown in Figures 13 and 14.

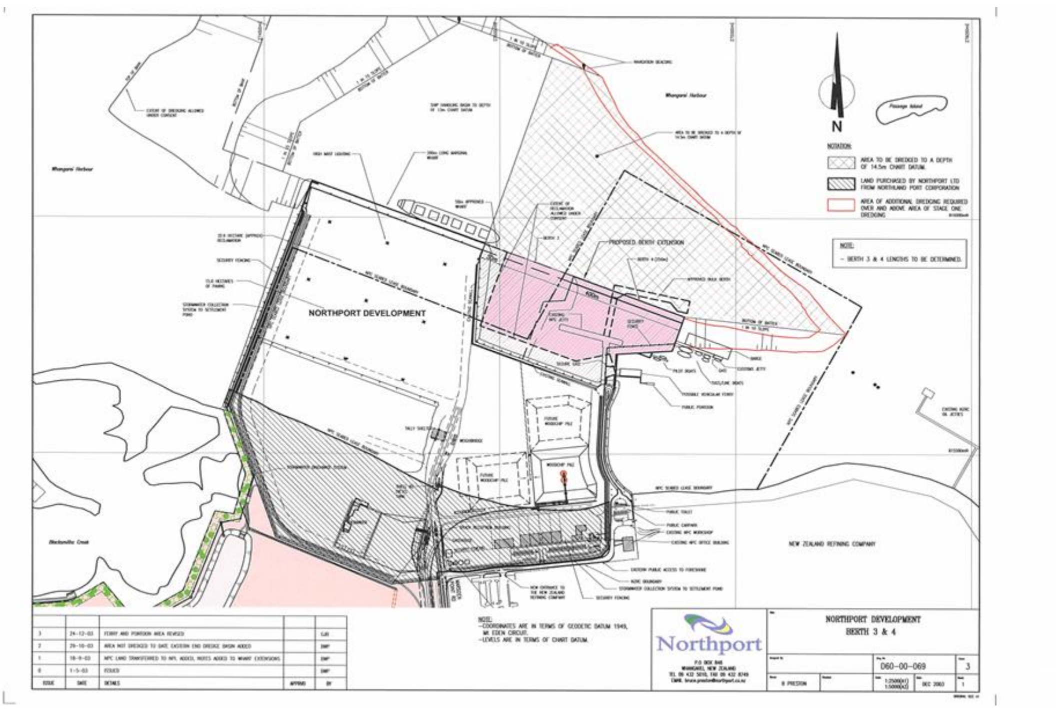

Figure 13: Consented design for Stage 2

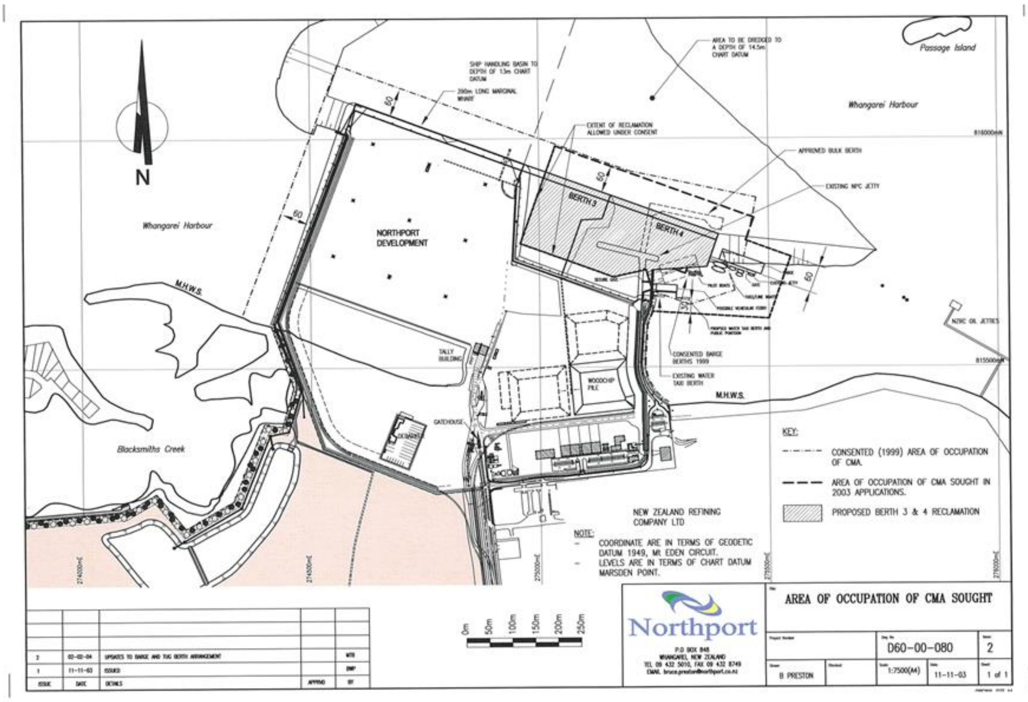

Figure 14: Consented design for Stage 2

4.3.6 Construction of Berth 3 (2006-07)

Construction of Berth 3 was completed in 2007. It involved construction of an additional 180 m extension to Berths 1 & 2, dredging to enable a depth 14.5 m below chart datum, and a 2.9 ha reclamation. This resulted in the current total berth length of 570 m and total site area of 49.1 ha - of which 33.6 ha is reclaimed. A plan summarising the eastern portion of the constructed berths, and the consented but not yet constructed berth areas, is shown in Figure 15;[3] and an aerial image showing the current Northport facility, including Berth 3, is shown in Figure 16.

[3] Below is a summary of what has been consented versus what has been constructed:

- *Stage 1 Consented:* Berth 440m long
- *Stage 1 Constructed:* Berth 390m long (Berths 1 & 2) [balance 50m]
- *Stage 2 Consented:* Berth 400m long (150m Berth 3; 250m Berth 4) [plus balance of 50m from Stage 1 (Berth 2)]
- *Stage 2 Constructed:* Berth 180m long extension (50m from Stage 1; 130m from S2 (Berth 3))

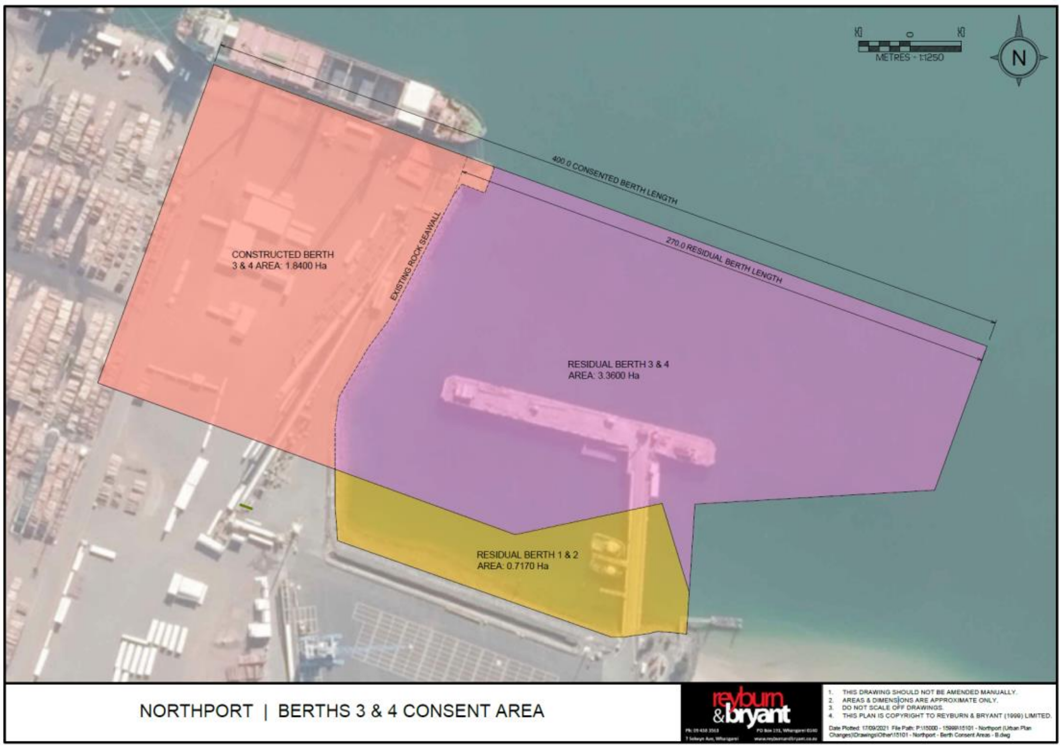

Figure 15: Constructed and consented berth areas

Figure 16: Aerial photograph of Northport showing completed Berths 1-3

Since the completion of Berth 3, Northport's management team and Board of Directors have continued to assess the business case to construct Berth 4. This consideration has necessarily included (i) the lead times required for port development, and (ii) the proposed expansion to facilitate increased port operations, particularly container trade, that is currently the subject of an application for resource consents.

5 Changing freight tasks and opportunities to diversify

Northport holds an important role in Northland's regional economy, supporting import and export activity. This role has expanded and diversified significantly since Northport began operating in 2002, when its primary purpose was to facilitate forestry exports at Marsden Point. Port Whangārei remained open for other bulk and break bulk cargoes.

Forestry exports are expected to remain the mainstay of Northport's export volumes, by weight and by value, but it is widely understood that the industry naturally experiences fluctuations in volumes. Increasing capacity and handling ability for container freight, vehicle imports and cruise ships will diversify Northport's services and smooth out the impacts of the peaks and troughs in wood availability.

The changes in Northport's freight tasks and opportunities for diversification are discussed in the following sections.

5.1 Fluctuations in forestry harvesting/wood availability

Log handling is an important part of Northport's business. Projected forestry volumes in the Northland region informed Northport's initial design and Northport continues to closely monitor forest harvest projections in the region to inform its long-term strategic and capital planning.

The most recent Northport Wood Availability Forecast,[4] prepared for Northport by Forme Consultants in March 2022, confirmed the total annual harvest is projected to reduce gradually from approximately 3.9 million cubic metres in 2022/23 to 1.8 million cubic metres by 2030. Total harvest will then plateau for five to six years until approximately 2035/36 before starting to rise again, to a peak of up to 6.0 million cubic metres by 2045. This will be a new high in Northland and can be attributed to the One Billion Tree programme plantings and other emissions trading scheme (ETS) related incentives which have incentivised forest establishment. While it is not expected that the full harvest volume will be exported via Northport, it is expected that pressure on Northport's log processing facilities will mirror these projections.

Figure 17 projects total forest harvest volumes out to 2070 and includes both large and small forest owners' harvesting and replanting intentions. The broad range of peaks and troughs in the small owner harvest profile reflects a variable planting profile, exacerbated by the Afforestation Grants in the mid-nineties and early 2000s, and since 2018 by the One Billion Tree programme plantings.

[4] *Northport Wood Availability Forecast March 2022,* Forme Consulting Group Ltd (2022).

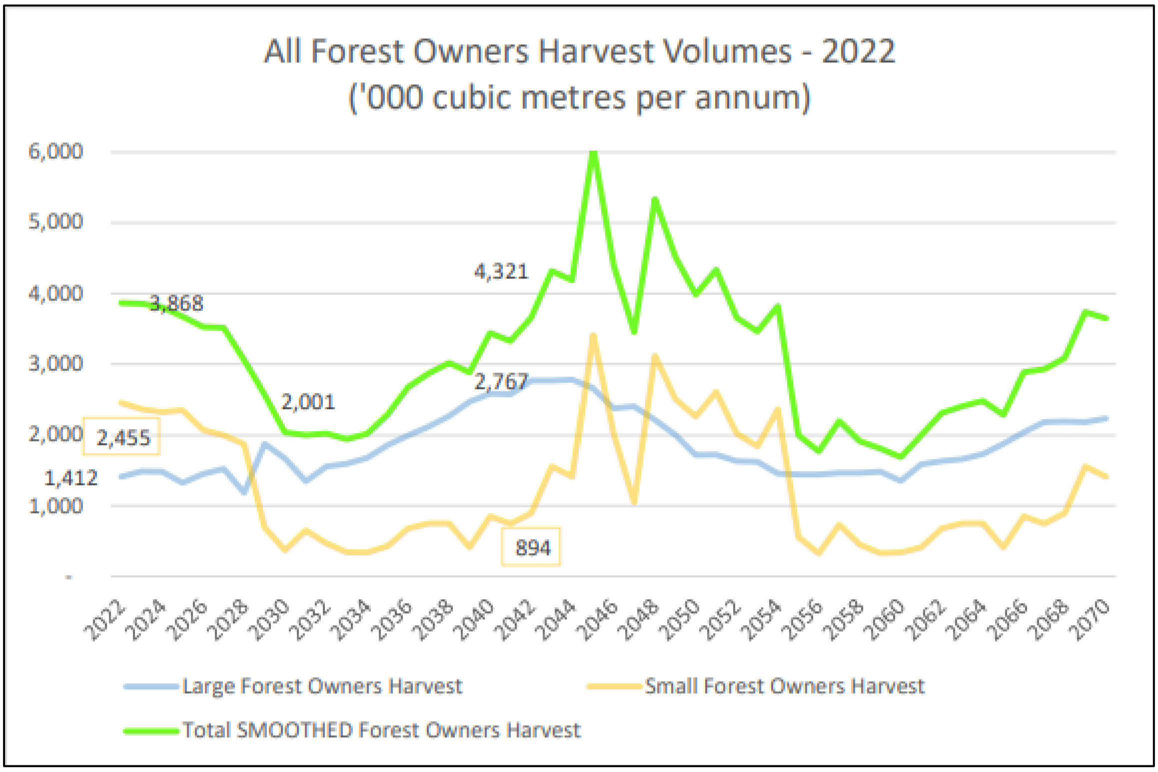

Figure 17: Projected forest harvest volumes to 2070 (Source: Forme Consulting Group Limited, 2022).

Northport will continue handling logs into the future as an important aspect of its business, however diversifying into trade types beyond forestry exports and increasing the volume of container freight that passes through Northport will provide a buffer against the expected troughs between forest rotations.

5.2 Increasing general container freight volumes

Container volumes flowing through Northport have grown from just under 3,000 TEU in 2015/16, to over 19,000 TEU in 2021/22 with contents ranging from fruit and timber products through to bulk cement. This represents growth of more than 300% over the period. Northport's budget forecasts show that the containerised trade is expected to continue growing at around 7,000 TEU per annum, reaching almost 50,000 TEU by 2025. Northport currently has sufficient port area to handle up to 50,000 TEU per annum, but this is dependent on the log downturn and the proposed consented expansion.

It is important to note that during this period, the Covid-19 pandemic impacted global trade and local economic activity in 2020 and resulted in change in the trade types and volumes handled by Northport. For example, the month of April 2020 was down by almost 60% compared to the previous April. However, trade handled by Northport has rebounded with most months since then having higher trade than the same month in the previous year.

The unexpected challenges in the shipping industry due to Covid-19, including congestion at other UNI ports, provided Northport with opportunities to demonstrate its ability to efficiently receive and handle container freight.

Several large container ships have repeatedly called at Northport to date. These recent container operations have gone well, particularly given Northport is not designed to handle large volumes of container freight in its current form. It was a slower process and greater logistical challenge than if

Northport were equipped with STS gantry cranes and an efficient layout that integrated sea, road and rail transport, but the operations confirmed Northport's capability in easing pressure on other UNI ports.

5.3 Increase in high value containerised horticultural exports

High value containerised horticultural exports from Northport currently comprise mainly kiwifruit. This freight stream is expected to grow and expand to other crops, such as avocados, berries and pipfruit, in the medium- to long-term. Northport's expansion into containerised kiwifruit exports has provided a cheaper alternative to transporting locally grown kiwifruit south to the Port of Tauranga via road.[5]

Approximately 40% of New Zealand's planted avocado land is in Northland, and this is expected to grow with substantial new avocado plantings in recent years or planned for the near future.[6] Similar growth has also been experienced in kiwifruit plantings.

Avocados are a high-value, high-growth export product with approximately 70% of avocado returns coming from exports. The majority are exported to Australia, along with growing markets in China, as well as Taiwan, Singapore and Thailand.[7]

Northport is well-positioned to support the growth of Northland's horticultural industry and the local economy. But to do so, Northport needs to plan for the necessary handling infrastructure for these high-value products. Additional berth space will also be required for efficient vessel movements, along with land adjacent to wharves for storage and handling to expedite these perishable products to their export markets.

5.4 Vehicle freight

Although Northport was not designed with car carriers in mind, an unscheduled call from the M.V. Istra Ace in February 2022 confirmed Northport's ability to receive and handle car carriers and roll-on/roll-off vessels.

The Istra Ace is a PCTC (Pure Car, Truck Carrier) purpose-built for transporting rolling cargo such as cars and trucks, heavy construction equipment and other substantial loads. The Istra Ace called at Northport enroute to Japan (after departing South America) to transport approximately 5,000 m^3 of Triboard from the Juken Mill in Kaitaia, providing the vessel with a 'backload' to Japan rather than having to sail the entire route empty. While there was no vehicle cargo involved, the call provided an opportunity to berth a vessel type that is an uncommon visitor to Northport.

Northport is well positioned to operate as a single hub for imported vehicle arrivals, storage, preparation and distribution. Northport also has access to ample vehicle storage space – an attribute missing from other UNI ports – with all remaining port area now chip-sealed to provide a surface ideal for light vehicles, plus access to further business-zoned land adjacent to the port boundary. Storing cars off-port frees up the port terminal for containers that rely on space immediately behind the wharf for efficient storage and handling.

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[5] Ministry of Transport/EY (2019) Economic Analysis of Upper North Island Supply Chain Scenarios.
[6] Polis Consulting Group. (2022). *Socioeconomic Impacts of Northport Expansion on Te Tai Tokerau/Northland.*
[7] Polis Consulting Group. (2022). *Socioeconomic Impacts of Northport Expansion on Te Tai Tokerau/Northland.*

5.5 Cruise vessels

Northport has scope to host cruise ship calls, bringing the opportunity to diversify into a completely new market for the port and offering benefits for Northland's tourism industry. Pre-Covid-19, Northport had taken bookings for six cruise vessel visits in the 2020/21 season, which was expected to coincide with the completion of the new tourism facilities in Whāngarei.

The pandemic severely impacted the cruise industry, and the 2020/21 and 2021/22 seasons did not bring cruise ships to New Zealand. It will take some time for the cruise industry to fully recover to pre-pandemic growth rates, but the industry is expected to rebound in the medium term, so it is important for Northport to plan for the eventual needs of the industry.

Northport currently has 12 cruise ship calls booked for the 2024/25 season. Cruise vessels can berth alongside commercial wharves so there is no need for a dedicated cruise vessel berth but Northport's limited capacity (with only three berths and a total wharf length of 570 m) restricts the number of bookings it can accept.

Cruise ships, by necessity, operate on rigid timeframes and need guaranteed berthing slots to allow passengers to attend onshore bookings before departing on time for the next port. Expanding the wharf length and increasing the number of berths will help alleviate future pressures and allow Northport to comfortably accommodate both cruise and commercial vessels.

6 Analysis of container freight capacity requirements

More than 20 economic studies[8] have been conducted on the future of the UNISC and the implications for Ports of Auckland, the Port of Tauranga and Northport, including two recent well-resourced studies published by the NZ Government[9]. While much of this recent work has focused on the viability of Ports of Auckland (in its current CBD location) as New Zealand's primary port over the long term, Northport is clear that its expansion is not intended to position it as a replacement for Ports of Auckland (POAL).

Both the recent reports reached different conclusions on where further capacity should be located – with one supporting shifting POAL's freight to Northport and the other favouring the development of a new port at Manukau Harbour. Both shared the view, however, that the development of port infrastructure takes many decades and requires significant financial investment.[10] Therefore, it is imperative that port operators, governments and decision makers employ a long-term horizon when planning for new marine infrastructure.

In preparation for the consent application, Northport commissioned Market Economics (ME) to undertake a comprehensive Economic Assessment of Northport's proposed expansion. The key findings of the Economic Assessment were supported by a subsequent Socioeconomic Impacts Assessment prepared by Polis Consulting Group (on behalf of Northland Inc). Both reports are discussed in the following sections.

6.1 Northport Expansion Economic Assessment (Market Economics)

Northport commissioned ME to assess:

- The role of Northport in the regional and national economies;
- How Northport's role can be expected to change in the future;
- The economic impacts associated with Northport's proposed expansion.

The assessment concluded that Northport has an important regional role as part of the national port network. In terms of its economic role, Northport currently facilitates $438 million in value added and the equivalent of 6,300 jobs in the Northland economy.[11]

Four scenarios were developed in the report – Business-as-Usual, North Auckland Imports, Upper North Island Ports Constrained, and North Auckland Growth – which showed the potential trade patterns that could eventuate over the next 30 years. All four scenarios indicated that Northport needs to invest in infrastructure upgrades, including wharf extensions and port area reclamation.

When assessed against the consented Berth 4 plans, ME found that demand under two of the scenarios is expected to exceed the capacity of the consented Berth 4 expansion by 2030 and under three of the scenarios by 2035. Over the long-term, demand under all scenarios exceeds capacity of

[8] Market Economics Limited (2022), *Northport Expansion (Berth 5) Economic Assessment.*
[9] Ministry of Transport (2018), *Upper North Island Supply Chain Strategy – appointed Working Group, August 2018;* Sapere (2020), *Analysis of the Upper North Island Supply Chain Strategy Working Group Options for moving freight from the Ports of Auckland.*
[10] Market Economics Limited (2022), *Northport Expansion (Berth 5) Economic Assessment.*
[11] Market Economics Limited (2022), *Northport Expansion (Berth 5) Economic Assessment.*

the consented expansion. This suggests that Northport may need the proposed expansion as early as 2030, in order to accommodate demands from outside of the region.

In terms of economic benefit, the assessment showed that Northport's role in the Northland economy could range from $1,094 million GDP and 14,800 jobs by 2050 under the Business-as-Usual scenario to $1,201 million GDP and 16,200 jobs by 2050 under the North Auckland Imports Scenario.

As the role of the port expands beyond the region, ME found that Northport's role could equate to $5.6 billion Value Added by 2050 in the New Zealand economy, which is equivalent to 60,900 jobs. These benefits are regionally (and indeed nationally) significant, predominantly accruing to the entire Northland region and community.

Significant Government investment in upgrades to regional road and rail links include a rejuvenated North Auckland rail line and spur to Northport. These improvements will support an increase in freight volumes passing through Northport and within the UNISC by reducing travel time, improving reliability, and reducing transport costs in the future[12].

While these improvements are also expected to improve the competitiveness of Northport relative to Ports of Auckland, Northport's primary role in the UNISC remains supporting freight movement and economic activity within the Northland region and Northern Auckland[13].

6.2 Socioeconomic Impacts Report (Polis Consulting Group)

An analysis of the socioeconomic impacts of the Northport expansion, prepared by Polis Consulting Group for Northland Inc, provides an understanding of the economic and related social impacts of Northport's proposed expansion.[14]

The socioeconomic assessment concluded that Northport is integral in the future of the UNISC and that an expanded Northport will increase supply chain resilience and increase logistic efficiency.

The socioeconomic assessment emphasised the importance of integrating Northport within the UNISC. It found that for Northport to play an expanded, integrated, and competitive role in the UNI, expanded sea, road, and rail connectivity is required.

With improvements to road and rail connectivity already progressing, now is the optimum time to for Northport to commence its expansion plans.

[12] Market Economics Limited. (2022). *Northport Expansion (Berth 5) Economic Assessment.*
[13] North of the Auckland Harbour Bridge.
[14] Polis Consulting Group. (2022). *Socioeconomic Impacts of Northport Expansion on Te Tai Tokerau/Northland.*

7 Constraints on diversification and growth at Northport

Northport is not developed to its full potential, or in a way that can effectively accommodate other freight streams, for example, containers, cars, and cruise vessels.

Availability of berth space and appropriate handling infrastructure to efficiently load and unload container freight will become limiting factors at Northport, constraining its ability to handle increased cargo volumes and more diverse cargo types. This is demonstrated by the current need to overhang large vessels at berth to enable the port to continue to operate as a three-berth facility. Storage space immediately behind the wharf is also reaching capacity, particularly following the discharge of containers from larger container vessels. These constraints are discussed in further detail in the following sections.

To accommodate the changes in freight tasks and to realise the benefits of the opportunities for the regional economy, Northport needs to expand into a facility capable of efficiently handling additional freight streams.

7.1 Freight handling facilities / terminal capacity

Though benchmarks exist, the translation from forecasting to terminal requirements is not a straightforward calculation. Many factors play a role in such a translation exercise. For defining the required ship-to-shore capacity, in addition to expected volume the following parameters play a role:

- **Vessel characteristics:** for example fleet mix, vessel sizes, call sizes
- **Cargo characteristics:** for example unit weight of unitised cargoes, the density of bulk cargoes
- **Crane productivity** (often expressed in tons/hr or containers/hr)
- **Working times:** for example the number of working days per week, the number of shifts a day, working time per shift, down-time due to adverse weather conditions or equipment breakdowns
- **Acceptable Berth Occupancy Factor (BOF)** (see below)

Northport currently has some capacity to handle containers but is constrained by berth length and storage capacity.

In 2015, Northport invested in its first mobile harbour crane, with a second purchased in 2020. Further investment followed in 2021, with two new reach-stacker container handlers purchased as part of an $8 million infrastructure investment package to support the growth of container traffic through the port. Other planned investments include new dock-truck and MAFI trailers, reach stackers (RS) simulation training equipment, expansion of the container storage area and lighting upgrades to enhance safety during 24-hour operations.

While these investments in handling equipment demonstrate Northport’s commitment to growing container traffic to service the trade needs of Northland and North Auckland, further substantial investment is required to efficiently handle the anticipated increased in general and high-value container freight outlined above.

7.2 Berth occupancy and berth length

The berth occupancy factor is the time that the berth is utilised, divided by the total available time.

A high berth occupancy rate indicates congestion and potentially low efficiency across the supply chain as vessels are spending longer at port loading and unloading freight, and/or waiting for a berth spot to become available.

The combining of physically distinct groups of berths into one berthing plan for the stream of traffic results in more flexibility and in a reduction in ship waiting time. Greater risk of queuing when groups of berths are treated independently arises as a result of the possibility of a ship having to queue for a berth in one group at a time when there is actually a vacant berth in another group.

UNCTAD[15] in the manual "Port Development" presents the following figure for recommended maximum berth occupancy factors for general cargo operations, which is generally consistent with other major publications:

UNCTAD Guidelines for BOF for conventional general cargoes

Number of berths	*Max BOF*
1	*40%*
2	*50%*
3	*55%*
4	*60%*
5	*65%*
6-10	*70%*

In line with international vessel trends, the average length of vessels visiting Northport has increased since its initial construction. This impacts on berth occupancy rates as fewer ships can berth simultaneously.

Northport's berth occupancy rates are variable across its three berths. Over the last four years, berth occupancy has averaged 66%. This is high compared with the worldwide industry standards recommended for ports to remain efficient.

Traditionally Northport has operated with tramp bulk ships which operate on more flexible timeframes and can anchor offshore. Going forward, Northport is dealing with liner services which more commonly seek guaranteed berth slots to maintain their schedules. This now compounds the berth occupancy statistics.

Increasing Northport's total berth length and storage areas, and upgrading its handling equipment, will improve the efficiency of the port and enable it to support the UNISC as freight volumes increase.

7.3 Freight storage area

Northport's open storage areas were designed to primarily store logs, break-bulk, and bulk cargoes. High volume/low value export commodities, such as logs, need to be in close proximity to the berths to enable consolidation pre-ship arrival, whereas dry bulk import cargoes can be stored further away as they are carted by truck from underhook at shipside to store, or direct to customer.

[15] United Nations Conference on Trade and Development.

Similarly, as Northport's container freight volumes grow, the efficient handling of container freight will be contingent on having storage and handling areas immediately adjacent to the berths, along with sufficient space for truck movements and associated container handling equipment storage and maintenance.

Container vessels in general call for large numbers of container exchanges (import/export). High productivity is required to maintain tight schedules and berth booking slots at other ports. To enable this the export cargo must be pre-assembled on port, close to the berth, before the ship arrives. Terminal Operating Systems are used to carefully pre-plan yard layouts to maximize discharge and loading operations, while facilitating storage of import containers for timely dispatch operations.

In the case of Northport, storage on-port is at a premium and must be carefully managed to ensure maximum productivity and timely departure of container vessels. Storage areas distant from the wharf significantly reduce a terminal's efficiency and longer-term viability.

Northport is located adjacent to circa 700ha of commercial, industrial, and port-zoned land. This land, while not owned by Northport, has the potential to support port-related growth by accommodating facilities such as bulk storage, empty container storage and maintenance, import vehicle storage, distribution hubs, warehousing, log-receival and scaling, and other port-related activities. However, this land is unsuitable for full container storage (export/import) due to its distance from the wharf.

8 Design drivers for Northport expansion

8.1 Container terminal design fundamentals

A container terminal's primary role is to switch transport modes – from sea to land transport (and vice-versa). A container terminal must handle freight in a timely and efficient manner to ensure it does not adversely impact the wider freight network.

At its simplest, a container terminal unloads containers from a vessel using quay cranes (ship-to-shore cranes (STS) and mobile harbour cranes (MHC)); those containers are then placed into storage in the 'yard'. After some time, the containers are dispatched via the road or rail network; or put back onto another ship (transhipped). The same system operates in the reverse order for a container being exported. How efficient a container terminal is, and its capacity, depends on how quickly the containers can be unloaded from a vessel, the container storage space and stacking method, and how soon the containers are dispatched off-port (dwell time).

At a high level, the factors that affect a terminal's capacity are:

- The length of the wharf.
- The rate at which the STS/MHC cranes can unload (or load) containers from the vessels (crane rate).
- The amount of space, or 'ground slots' available to store containers. A ground slot is defined as the space taken by a single 20ft container (TEU).
- The height and density (how close together) the containers can be stacked, which is dependent on the stacking equipment and the type of container.
- The time each container is stored on the port, (dwell time, typically expressed as an average in terms of days).
- How often container vessels visit the port and how many containers are unloaded/loaded. (Known as the exchange volume, expressed in TEU).

The wharf length and area of land occupied by the terminal are the two most significant pieces of infrastructure that underpin the design and capacity of a container terminal. As fixed infrastructure, these two components are difficult and very costly to alter once built. Consequently, these should be designed for the anticipated freight demand over at least the design life of the infrastructure, which is typically a minimum of 50 years.

The remaining infrastructure on a container terminal is operational. Whilst costly, these components can be progressively upgraded over the life of a terminal. Investing in quicker, more efficient, and denser/higher stacking operational infrastructure can incrementally increase the efficiency and capacity of a terminal over time. Many factors will contribute to decisions on what operational infrastructure to install, and when to replace/upgrade it.

8.2 Planning and evaluation of container terminals generally[16]

The planning and evaluation of a container terminal is a very complex task. It requires adherence to environmental, regulatory, and other constraints, and utilization of available resources to meet the required level of productivity, while trying to reach a balance between the needs of the port authorities, port operators, stevedore companies and container shipping lines.

[16] For much of this section, refer the *Port Designer's Handbook*, Thoresen C, Third ed 2014.

The following requirements should be satisfied:

- A sufficient approach channel to the port area.
- A sufficient harbour area, turning basin and water depth.
- A sufficient berth construction and a large terminal area.
- The possibility for expansion, including new berths and larger terminal areas.

Improvements to the port facilities and organisation, together with improvements in the port layout, will, in most cases, result in more efficient handling and storage of cargo. This means that the capacity of a modern port is dependent on efficient management, the amount of available land behind the berth and on new terminal equipment.

In the evaluation of new potential port areas, it is useful to divide the terminal area into the following:

- The apron, or the area just behind the berth front.
- The primary yard area or container storage area.
- The secondary yard area, which includes the entrance facility, parking, office buildings, customs facilities, container freight station with an area for stuffing and stripping, empty container storage, container maintenance and repair area.

As a rule of thumb, the area required for a multi-purpose terminal will vary between about 5 and 15 ha/berth; and for a container terminal between about 10 and 100 ha/berth, depending on the generation of container ships that the port will serve. These figures include areas for offices, sheds, workshops, roads, etc.

Generally, the total yard area can be divided into: $A_T = A_{PY} + A_{CFS} + A_{EC} + A_{ROP}$ where:

A_{PY} = the primary yard area or container stacking area. The area is circa 50-70% of the total area.

A_{CFS} = the container freight station (CFS) with an area for stuffing and stripping etc. The area is circa 15-30% of the total area.

A_{EC} = the area for empty containers, container maintenance, and repair area, etc. The area is circa 10-20% of the total area. Generally, in modern container terminals, empty containers are stored and repaired outside the terminal area, if possible.

A_{ROP} = the area for the entrance, office buildings, customs facilities, parking, etc. The area is circa 5-15% of the total area.

To appropriately provide for future expansion, the storage area should have an additional area of 25-40% as reserve capacity.

Ideally, the quay wall is a single straight-line berth, so that the berths can accommodate varying lengths of ships while maximising quay usage. Containers are stacked in a rectangular area directly behind the apron, allowing optimal stacking density, and hence utilisation of the stacking equipment. Other facilities are located at the back of the terminal, away from the quay and stack operations, where they do not impact on the productivity of the terminal. Similarly, landside traffic and the rail terminal are separate from the core terminal operations at the quay and the stack.

In practice the ideal concept is subject to compromise in response to available space.

8.3 Vessel characteristics

To inform the design process, ports typically establish a 'design vessel'. The design vessel represents the largest vessel expected to visit the port. The container wharf, cranes and navigation channel are designed to accommodate this vessel (and vessels smaller than it). The expected frequency and mix of other vessels calling at the port are also used to inform the design.

Northport has determined the following characteristics for the design vessels:

(a) Current port and consented areas:

- Class: Panamax
- LOA: 294 metres
- Beam: 32 meters maximum
- Draught: 12.5m maximum
- Capacity: 4,500 TEU

(b) Proposed Container Terminal (some channel marker re-configuration required but no dredging; increase in future tug horsepower/bollard-pull and potential design parameters (eg: escort tug)):

- Class: Post Panamax
- LOA: 320 metres
- Beam: 43 metres
- Draught: 14.5m maximum
- Capacity: 8,500 TEU

With respect to vessel class for the proposed container terminal, New Panamax (LOA: 366m; Beam: 49m; Draught: 15.2m: Capacity: 12,500 TEU) were reviewed but considered unlikely to call and would require some channel optimization involving dredging and buoy realignment. Tug power requirements would also be significantly increased.

8.4 Navigation channel and vessel access

Vessels access Northport via a navigation channel, which serves the Channel Infrastructure and Northport facilities at Marsden Point as well as other facilities further up the harbour, such as Golden Bay Cement. The channel provides a certain depth of water over its navigable width (or fairway). The depth of water changes with the tide state and to a lesser extent the sea state. Deeper draught vessels may have to wait for the right tidal conditions (height/flow) before they transit the channel. Similarly, certain weather conditions (strong winds, limited visibility) may prevent the safe navigation of the channel by large vessels. The type and size of tugs can also impact what conditions a vessel can navigate the channel.

These restrictions can limit when a vessel can arrive and leave the port, affecting the availability of the berth. For example, a large container vessel may have finished its container exchange but must wait several hours for the tide to rise so it can depart the berth. Consequently, the berth is occupied for a longer period and is unavailable for incoming vessels. A similar situation can result during adverse weather conditions. Either way, incoming vessels may have to wait at anchor causing delays to the set shipping schedules.

8.5 Predicted future freight volumes

Freight volume is typically stated in Twenty-foot Equivalent Units (TEU) per annum. A TEU is an expression of container volume and is based on a twenty-foot container, i.e. a 40ft container would equate to 2 TEU.

The annual container freight volume is determined by the expected freight demand in the port's catchment and includes import, export and transhipment. This volume is a function of the nature and scale of the economic activity in the port's freight catchment and the port's connection to the wider sea freight network. Container volumes typically increase steadily over time as a function of economic growth. Larger, or more sudden, changes in a port's freight demand can result from a redistribution of freight across the network. This may be due to commercial factors or upgrades to the external transport network.

Prediction of Northport's future container freight volumes, to be used as a basis for design of the terminal, was informed by ME's economic analysis[17] (ME's analysis was informed by a range of sources, including Northport's financial and trade data and budget forecasts). ME's analysis predicted the annual freight volumes across a range of growth and freight network scenarios out to 2050. The medium-high scenario predicts Northport could see annual container volumes in excess of 400,000 TEU by 2050 (see Figure 18).

This finding was reinforced by the subsequent Socioeconomic Impacts Assessment (prepared by Polis Consulting Group for Northland Inc) which found that under a medium scenario, container volumes would reach approximately 400,000 TEU by 2060 (see Figure 19) before becoming constrained by rail/road capacity. If road/rail improvements occur, Polis predict container volumes could reach in excess of 700,000 TEU in 2070, which is approximately the time when the fixed infrastructure would reach its theoretical design life (of 50 years).

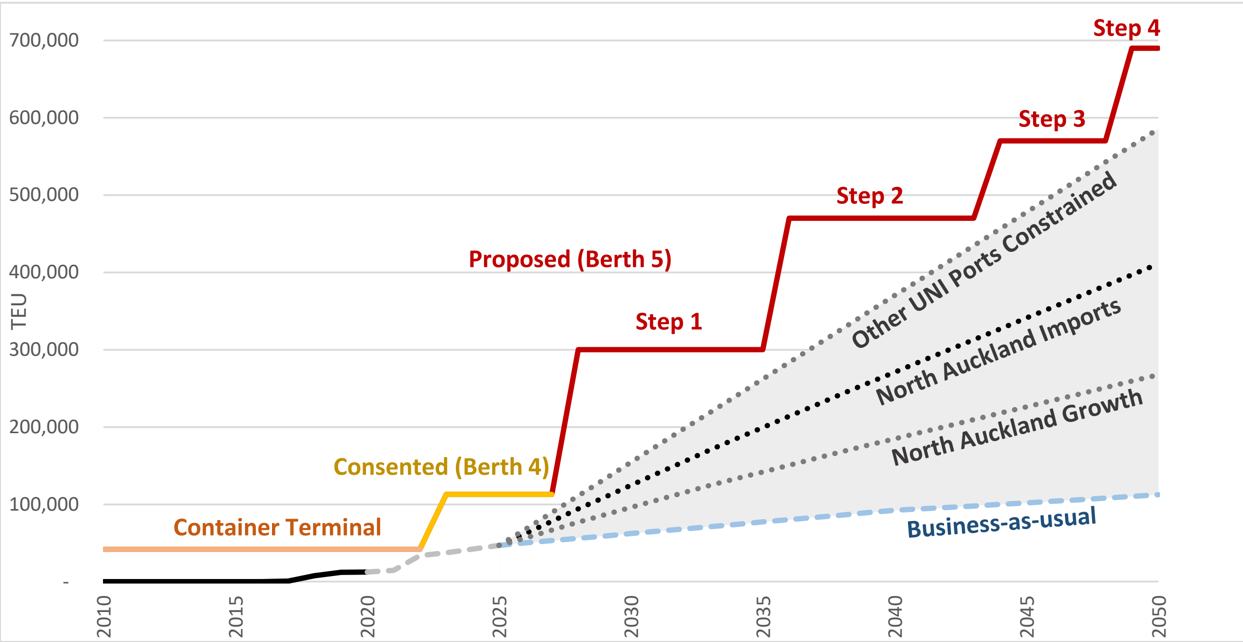


Figure 18: Northport Container Terminal Capacity and Demand Scenarios, 2018-2050 (Source: Market Economics, 2022.)

[17] Market Economics Limited. (2022). *Northport Expansion (Berth 5) Economic Assessment.*

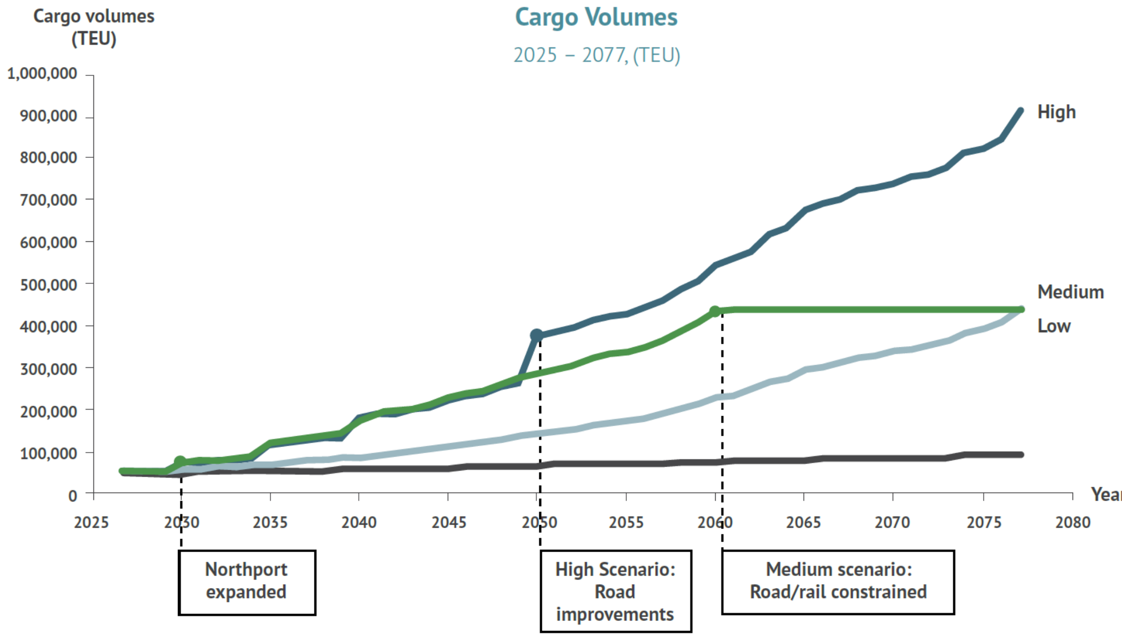


Figure 19: Northland cargo volume scenarios (Source: Polis Consulting Group, 2022).

To determine the design freight volume for the eastern development, Northport evaluated the following:

- The range of freight volume predictions by ME and Polis;
- The likely timeframes to gain approvals, acquire funding and ultimately construct the facility;
- The need to take a long-term view for the development of significant Port infrastructure;
- Northport's knowledge and understanding of the shipping trends in New Zealand and internationally, particularly Northport's experiences with container shipping lines over the last 18 months.

Northport concluded that a design volume of at least 500,000 TEU was appropriate for the 50 year design period, with the understanding that a higher capacity could be achieved in the future with technology/equipment improvements.

8.6 Operational analysis and container terminal concept design – TBA Group evaluation

As set out in sections 8.1 and 8.2, the optimum design of a container terminal depends on a range of variables, many of which are based on future predictions and factors outside of a port's control. To test the preliminary concept design and the influence of those variables, Northport engaged TBA Group, a specialised container terminal design and operations consultancy.

TBA Group have significant experience in the design and operation of container terminals in New Zealand and internationally. Through this work, they have an extensive database of operational and industry factors to draw from to inform the design process and enable scenario testing and simulation. TBA Group was tasked by Northport to confirm:

- The wharf length needed to handle the design TEU capacity
- The number and type of quay cranes needed

- The mode of terminal operation and the type and scale of equipment needed within the container yard
- A concept layout of the terminal and space requirements
- Relative costs between viable options
- How the operational mode of the terminal could be progressively upgraded as volumes increased

TBA Group undertook a series of design evaluations, with each step analysing the likely range and permutations of external factors and how they would impact the overall design. The process undertaken was:

- Collection of existing Northport data (vessel calls, pilotage times, channel restrictions, berth occupancy etc) as well as available trade data from other similar ports (NZ and international)
- Confirmation of assumptions (available wharf length, container trade mix, TEU mix, vessel size and calling frequency, likely mix of container exchange volumes per call, seasonal variations, crane efficiencies etc)
- Berth simulation to evaluate the proposed wharf length
- Yard analysis to evaluate the area needed, type of equipment and progressive development of operating mode.

The last two steps provided design outcomes and recommendations for the future terminal operations. The outcomes are summarised in the following sections, and the full TBA Group report is attached as **Appendix A**.

8.6.1 Berth simulation and required wharf length

The initial Northport concept was for a 700 m container wharf, with 50 m shared with the break bulk berth (Berth 3). TBA Group ran a berth simulation with that berth length and assumptions about the other factors that determine a berth's capacity. The key assumptions are detailed in the TBA Group report and the relevant factors are shown in summary form in Figure 20.

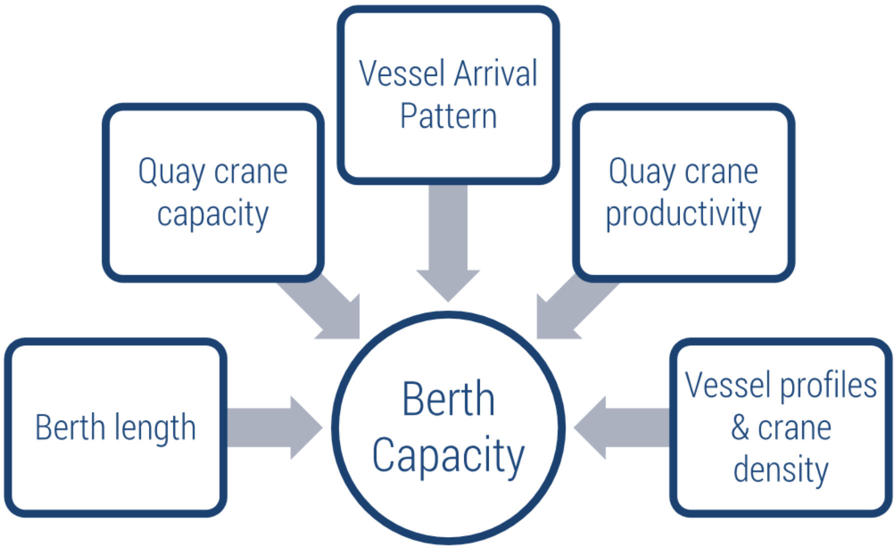


Figure 20: Key factors that determine berth capacity

The TBA Group analysis revealed the following conclusions:

- Confirmation that 700 m of quay length (two berths) is required for the design container volume.
- The wharf provides sufficient length for concurrent visits of a 366 m and 270 m vessel, 330 m and 300 m vessel or several different combinations of smaller vessels.
- Acceptable service times can be provided with two gantry cranes and two mobile harbour cranes.
- With two gantry cranes and two MHCs, 700 m of berth could theoretically handle 650,000 TEU per annum across the wharf with the right yard equipment.
- Tide and wind restrictions may cause delays for ships entering/exiting the port.
- Four weekly vessel calls are needed for the design capacity of 500,000 TEU, comprising 315,00 individual containers with a TEU factor of 1.65. Five vessel calls per week are needed for 600,000-700,000 TEU.

TBA Group did not analyse the type of wharf needed as this was outside the scope of their evaluation, and we return to design alternatives below. The TBA analysis confirmed the need for the larger gantry cranes, which has a direct impact on the wharf design (geometry and structure).

8.6.2 Yard analysis, area needed and operational mode

Following the confirmation of the 700 m wharf length and the type and number of cranes needed, TBA Group turned their attention to the size and operating mode of the yard. Like the berth analysis, the yard capacity is dependent on a range of factors as set out in Figure 21. TBA Group also completed a high-level financial analysis to determine the relative yard and equipment investment costs as well as ongoing maintenance costs.

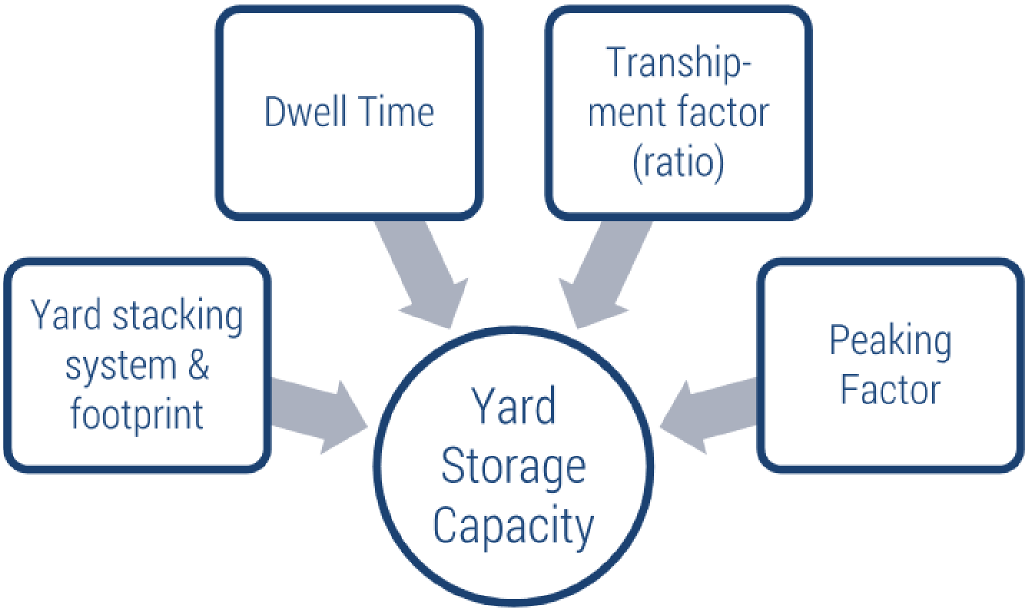


Figure 21: Key factors that determine yard storage capacity

As these factors are assumptions, determining the yard capacity is an iterative process. To start the process, TBA Group used data from other NZ ports who handle a similar volume of containers to the design capacity. Assumptions are also needed about the mix of containers (import/export/transshipment/empties etc) and how long those containers would sit at the terminal (dwell time). Some of the key initial assumptions made were:

- An import-biased container mix (similar to Ports of Auckland) with over 50% import, 20% export, 20% domestic and the remainder transhipment.
- Dwell times of 4-7 days with 14 days for empty containers. This is longer than other ports but it reflects the location of Northport relative to the freight catchment.
- 18-21% of the weekly volume is done on the peak day, with 7-8% of the daily volume done in the peak hour.
- All container handling modes/equipment to be assessed, with potential for automation to be considered.
- Investigate operations commencing with lower cost low density mode then transition to a higher cost, high density operating mode as volumes increase.

TBA Group considered three primary operating modes: reach stackers (RS), auto stacking cranes (ASC) and rubber tyred gantries (RTG). Northport currently operates two RS, and this is a relatively low cost, but low-density, stack height option. Both ASCs and RTGs require higher capital investment but can stack in denser, higher blocks.

Cantilevered rail mounted gantry cranes were considered, but not investigated in detail as they are not suited for this type of terminal and have very high cost. Straddle carriers, which almost all existing NZ container ports use, were also not considered as they are not compatible with mobile harbour cranes.

The analysis showed that ASCs, RTGs and RS could all theoretically provide the required capacity within the concept design footprint.

TBA Group tested different dwell times for the above layouts/operating modes to ascertain how this would impact on the yard capacity. With dwell times of 7 days, the RS operating mode cannot provide the required capacity of 500,000 TEU/year, but it can at 4 days dwell time. For the footprints set out in Figures 22 and 23, both ASC and RTG operating modes have the same capacity for 4- and 7-day dwell times.

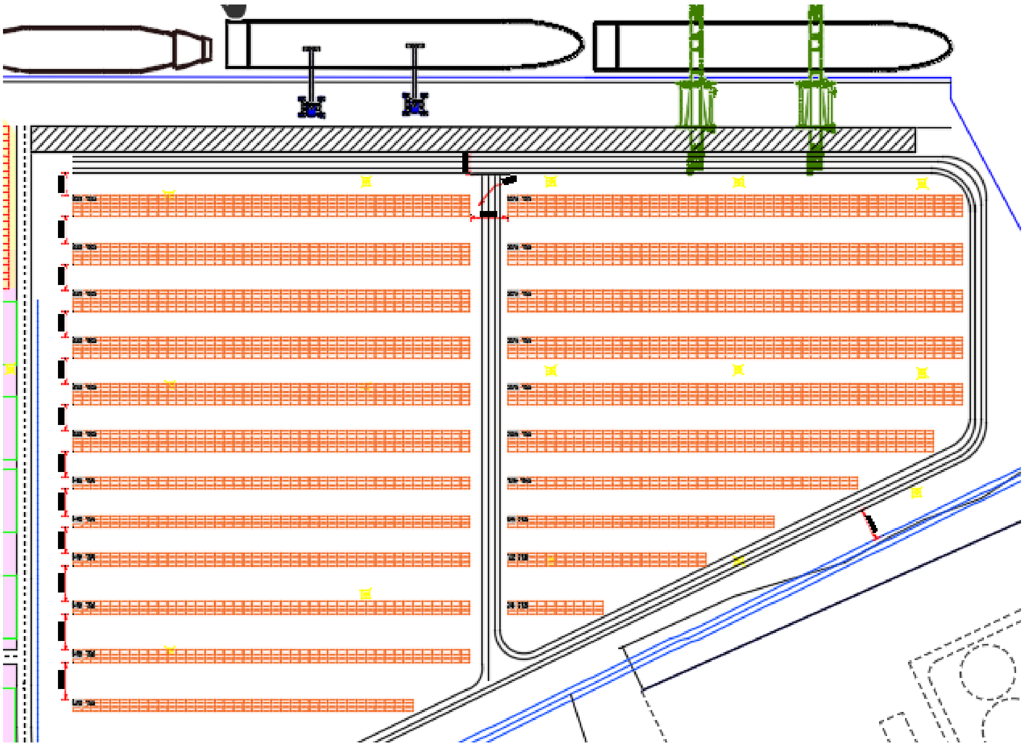


Figure 22: Full Reach Stacker layout (Source: TBA Group report).

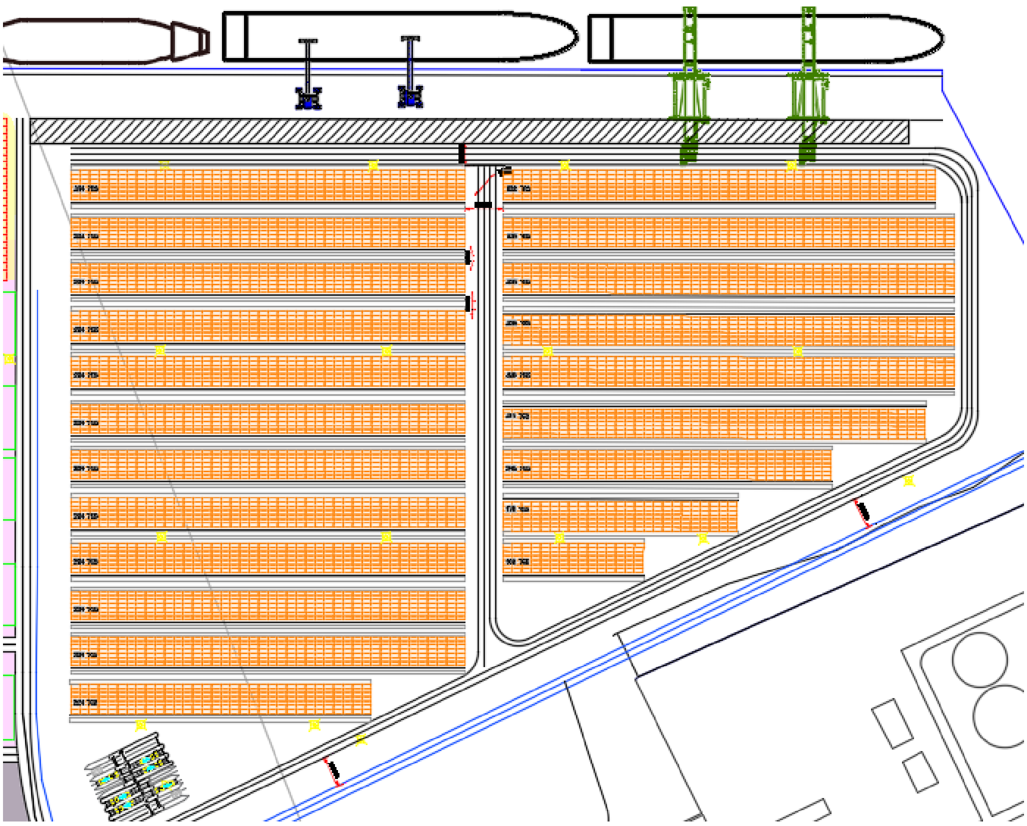


Figure 23: Full Rubber-tyre gantry layout (Source: TBA Group report).

The next step in TBA Group's analysis was to compare the financial viability of the options. Both the capital and operating costs were evaluated. Capital costs included the equipment and the pavement or tracks the equipment operates on. OPEX costs included maintenance, labour, energy required and depreciation. TBA Group's analysis, while quantitative, is useful only as a comparison of the relative costs between operating modes, not the total costs. Figure 24 presents the CAPEX comparisons, showing a $44m additional cost for the ASC operating mode. This is primarily due to the higher cost of the ASC units.

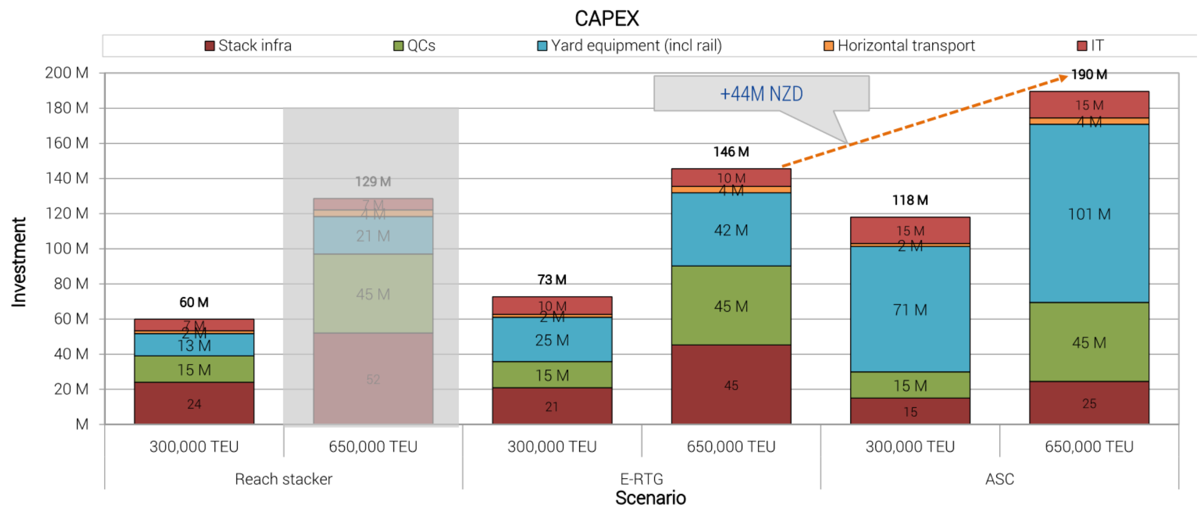


Figure 24: CAPEX costs for the three considered modes (Source: TBA Group report).

OPEX costs are similar across all modes, although the trend is opposite to the CAPEX: ASCs have the lowest OEPX, then RTGs, with RS having the highest OPEX (see Figure 25).

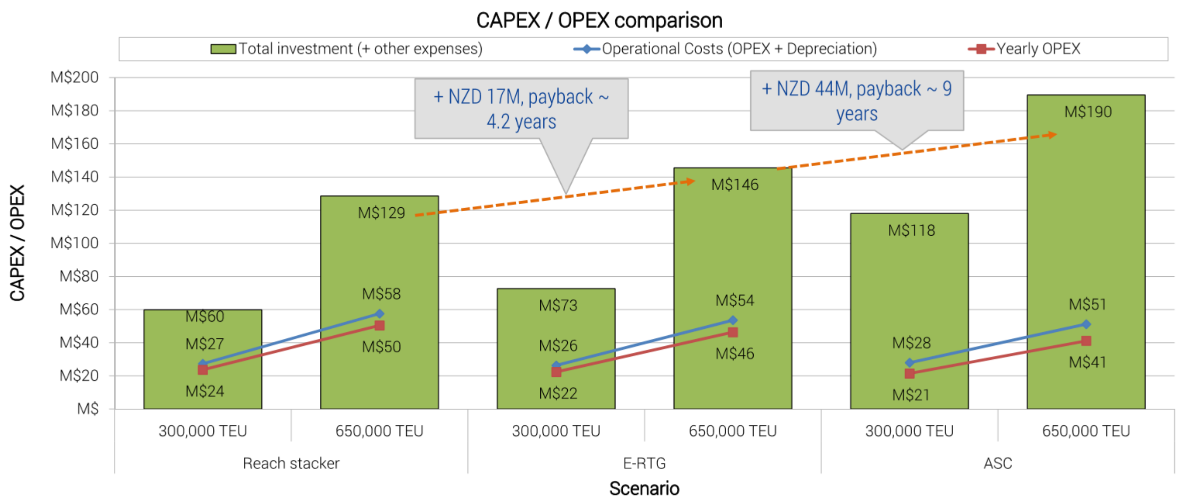


Figure 25: CAPEX/OPEX comparison for all three considered modes (Source: TBA Group report).

Having determined that a container yard with the required capacity can operate within the proposed footprint, TBA Group then turned their attention to how the terminal could be progressively developed to match growing demand. For Northport, this is particularly important as the terminal is being developed on a very low existing container freight volume. It will take time for container volumes to grow to a point that justifies investment in high density/high stack height equipment.

Working with Northport, TBA Group arrived at a progressive development scenario that commences with a RS mode that transitions to a RTG mode as volumes increase. This was the preferred option because:

- The alignment (parallel to the berth) of RS rows matches the RTG alignment, meaning both modes can operate concurrently.
- The block widths of RTG rows are similar to that needed for the RS, so consistent terminal infrastructure can be used (i.e. foundations for the RTG, light tower spacing etc), minimising costs and disruptions during transitions.
- Northport is familiar with to operating and maintaining RS's.
- It provides the most flexible and agile option which can readily respond to shifts in freight volumes.
- It requires the lowest CAPEX investment.

Figures 26 and 27 set out a possible scenario for the terminal development, assuming a transition from RS to RTG's.

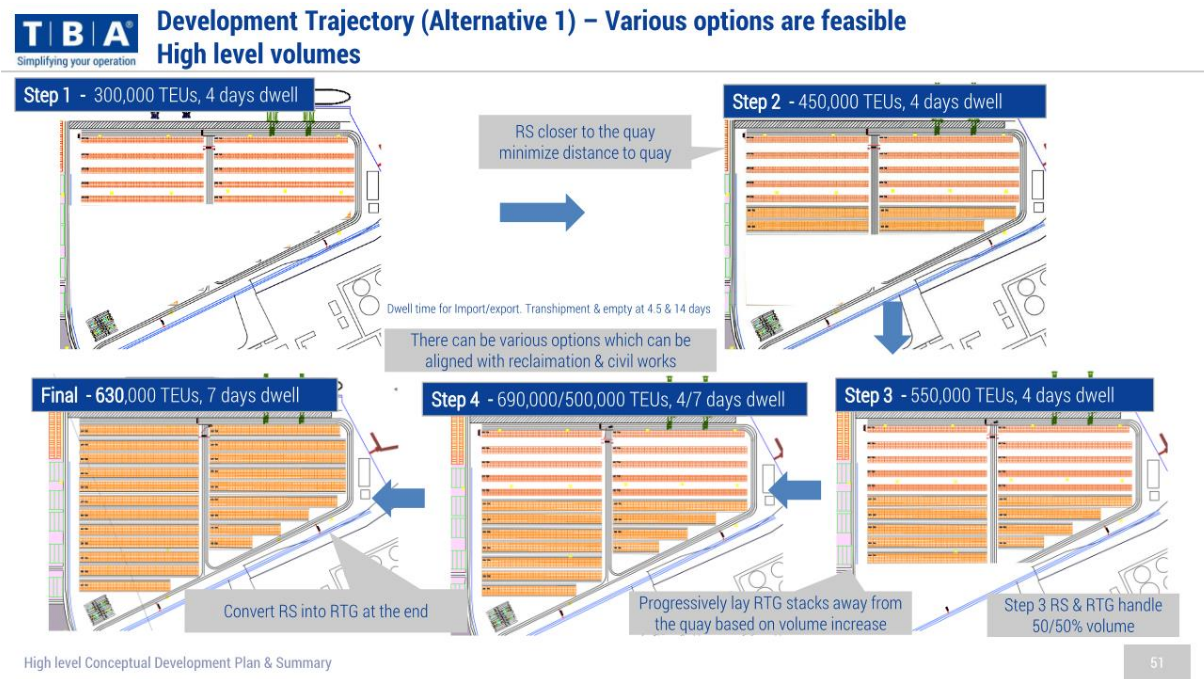


Figure 26: Development trajectory (Alternative 1) (Source: TBA Group).

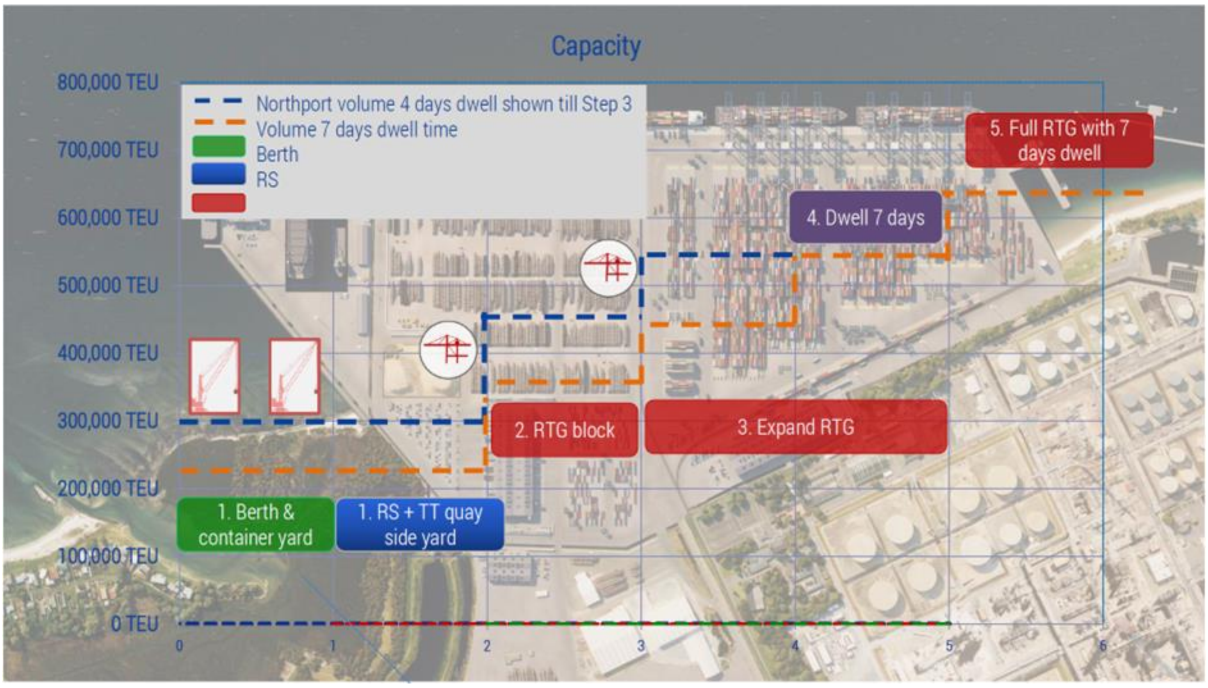


Figure 27: Concept 'stepped' capacity increase (TBA Group report)

In summary, the detailed analysis by TBA Group has confirmed the key aspects in Northport's initial concept design, namely:

- 700 m of berth length is required for container handling operations.
- Two mobile harbour cranes and two fully operations STS gantry cranes will allow that wharf to theoretically handle 650,000 TEU/annum.
- A fully developed terminal on the proposed footprint will have a theoretical capacity of 630,000 TEUs/annum assuming a full build out with RTGs and a 7-day dwell time.

9 Alternative options

Northport has developed the proposal that is the subject of this consent application over several years of design development, consultation and assessment of alternative options. The proposal's design progression, alternatives assessed, and the preferred design are set out in the following sections.

9.1 Options evaluation since 2010

Since the completion of Berth 3 in 2007 (refer section 4.3.6 above), there have been numerous workstreams to consider options to expand the port.

Options were considered for the expansion of freight operations at Northport in the context of the following core operational requirements, which have been tested and refined through the process:

- Berth must be long enough to provide for the size and number of container vessels, and volume of freight, anticipated.
- The wharf must have structural capacity for STS container cranes.
- The berth needs to be deep enough to allow container vessels to approach and remain alongside the wharf while loading/discharging through full tidal cycles.
- Sufficient land is needed behind the wharf to store, move and load/unload containers, accommodate future rail links and associated ancillary services.

Options have been comprehensively evaluated over a 12-year period from 2010, both by Northport and externally, with multiple design options being prepared and reviewed by a range of port and environmental experts. We summarise the key options (and the workstreams and/or reports informing them) below.

9.1.1 2010 Strategic Plan

In 2010 Northport had completed Stage 1 of the port build and had provided for the closure of Port Whangarei by building an additional 180m third berth at Marsden Point. The company had originally been set-up as a PropCo/OpCo model. In 2006 this model was dismantled, and Northport emerged as a Port owned and operated facility with common user access.

With the new model operating efficiently and working hard to meet the growing forestry export demand, the company undertook a review of its current and consented infrastructure, what options there were to reconfigure the built areas, and what potential there was for future expansion.

The first series of staged growth and trigger points were presented to, and adopted by, the Northport Directors.

In 2010 Northport considered a range of future layout options to meet the expected freight demands for Northland and the North Auckland area. Among the options considered was an eastern extension to provide additional berthing and reclaimed area. This is shown in Figure 28 below.

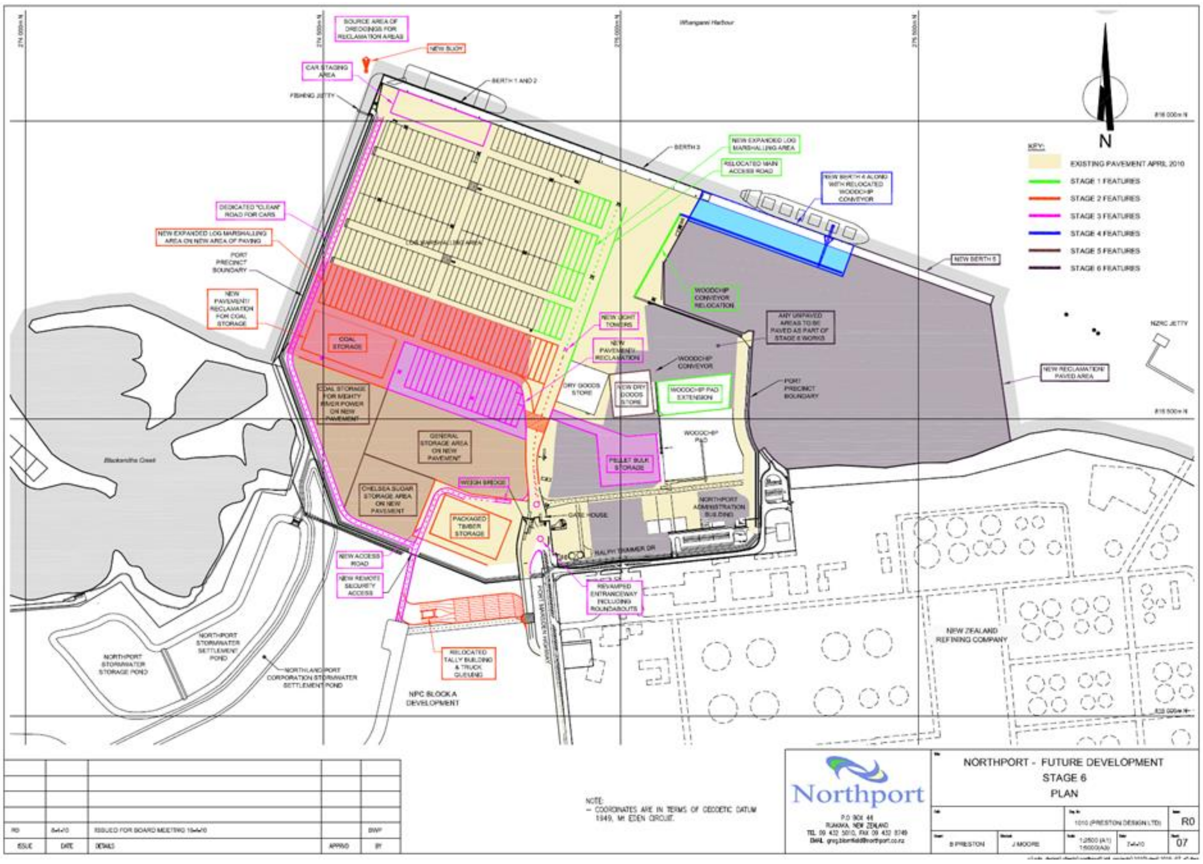


Figure 28: Future layout option considered as part of Strategic Plan 2010

9.1.2 Forme Report: Review of Freight Availability 2012

In 2012 Northport was reviewing its strategic positioning with a focus on likely capital expenditure required to support potential Northland and North Auckland freight growth. As a regional port Northport had been operating primarily as an export hub for logs from the Northland region.

Log export volumes for the region were close to peaking, and Northport was keen to identify new growth opportunities by identifying existing and emerging freight volumes, including timing and growth patterns in the wider Northland and North Auckland region.

The report identified that certain barriers prevented Northport from capturing the majority of the freight opportunities, as these were predominately containerised. The port facility at that time lacked container handling capability such as plant and equipment, suitable storage areas and reefer capability.

The 2010 Northport strategic plan was designed to be flexible to allow it to respond to changing patterns in freight demand and transport modes; the Freight Availability Review provided strong guidance for a review of the plan to be undertaken.

One of the future layout options considered as part of the 2012 Freight Availability Study is set out below.

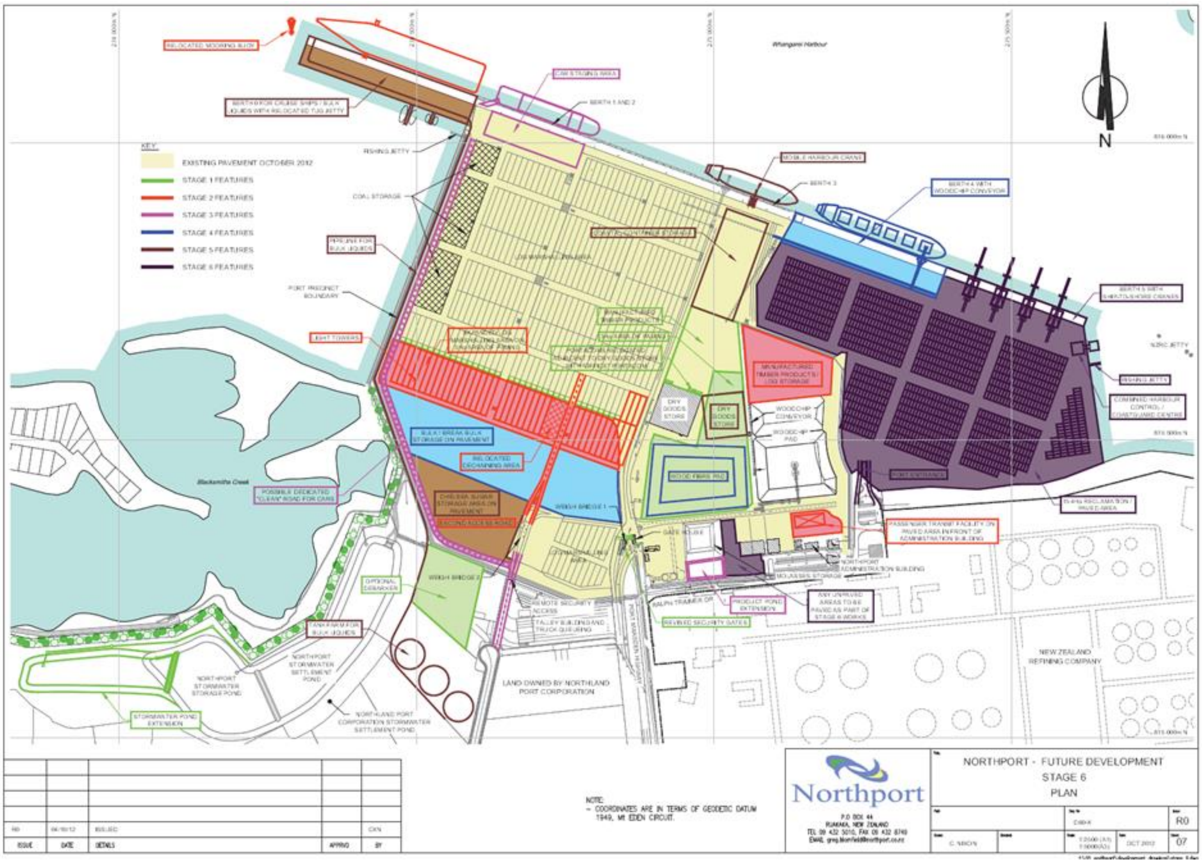


Figure 29: Future layout option considered as part of 2012 Freight Availability Study

9.1.3 2012 (November) PWC Report for the Upper North Island Strategic Alliance: How can we meet increasing demand for ports in the Upper North Island?

This was a technical study of the supply and demand for ports and port-related infrastructure in the UNI. The report identified that the UNI port network has the capacity to meet the projected freight task, provided that efficiency gains, incremental investments in infrastructure and the uptake of already consented works are undertaken in a planned and timely manner. The greatest opportunities for efficiency gains to access additional capacity are in relation to container trade.

It also highlighted that over the following 30-years, the most efficient and cost-effective options for meeting the projected freight task are likely to be based around improved efficiency, incremental growth at each port, and planned improvements in the land transport system, complemented by changes in relative prices that direct customers to where spare capacity exists in the UNI port system.

9.1.4 2012 Northport Strategic Plan Review

Based on the information provided in both the Freight Availability report and the UNI Port Report, Northport undertook a review of the 2010 Strategic Plan and provided for additional berthage to the west of the current facility as well as a review of the overall container capability, and potential areas for future expansion.

The 2012 updated series of staged growth and trigger points were presented to, and adopted by, the Northport Directors.

9.1.5 2014 Review of Northland Forestry & Log Availability (Forme: August 2014)

Forme Consulting Group was commissioned by Northport to undertake a review of the Northland region log volume availability to provide projections for planning purposes. Questions had been raised regarding possible variations in recent Northland forest harvest patterns compared with availability forecasts reported in the Northland Forest Industry and Wood Availability Forecast 2009 (NFIWAF). Increased or decreased log export demand and prices can be major drivers to create changed harvesting, replanting, and tending practices of forest owners.

Review information was prepared by direct survey and interview with forest owners, log processors and other stakeholders in Northland and analysis of the 2013 NEFD data. The collated data was analysed, and a new wood flow analysis was prepared by Forme (See figure 30 below).

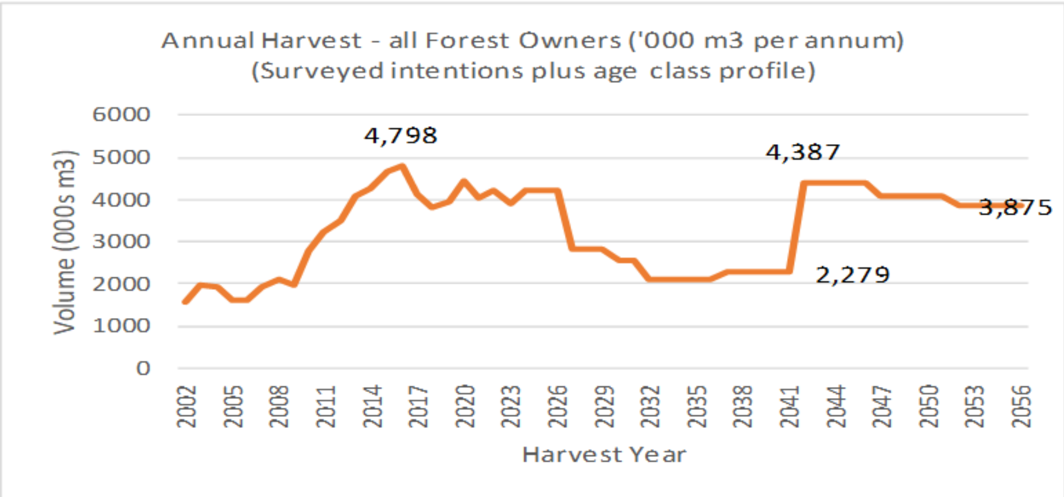


Figure 30: Forecast annual harvest to 2056 (Forme: 2014)

Support for the review was strong from most participants and most information requested was provided willingly, albeit in strict confidence.

The wood flow analysis portrays average harvest availability for all users of approximately 4.2 million m³ per annum leading up to 2026. It then shows a fall to an average harvest availability of 2.4 million m³ per annum between 2027 and 2041.

The dip in harvest availability projected in approximately 2026 as illustrated in the preceding figure arises from historic variations in planting activity from year to year that caused "humps" in the regional age class profiles.

Initially the wood flow analysis was not accepted or acknowledged by the Northland forestry sector, however, after a further independent review undertaken by the Ministry of Agriculture and Forestry there was a general acceptance that Northland was heading towards a major downturn in log availability.

9.1.6 2015 Northport Strategic Planning

Following the Review of Northland Forestry & Log Availability, Northport undertook a review of options that would enable the business to sustain the projected downturn in log availability. The outcome of this review was a decision to invest in plant & equipment that would enable container handling on a small scale while the business developed; the first customer to embrace the container option was GBC with containerised (ISO Pods) bulk cement powder for the South Island.

The staged growth plans were reviewed, and additional storage areas included to the west to enable the development of container terminal capability well into the future. The Vision for Growth project was launched and consultation with the port's community, local Iwi and commercial stakeholders commenced.

9.1.7 2015 Survey of Northland Container Freight Availability (Forme & Northport)

While Northport had made a commitment to purchasing a mobile harbour crane to facilitate container trade from producers in Northland, it was necessary for Northport to understand the opportunities and then further develop the containerisation activity. The first step was to undertake a survey of the patterns and status of actual container movements from Northland so as to capture relevant information from exporters and importers that could be used by to plan and develop the related business.

The survey identified a total volume of circa 577,000 tonnes of annual freight movement which comprised of 519,000 tonnes (96%) of exports and 24, 0000 tonnes (4%) of imports; the tonnage converted to an estimated annual movement of 47,000 TEU per annum.

The projected volume provided a solid base for the business case for Northport to further develop the container trade through Marsden Point.

In summary terms, the outputs of the study suggested that:

- The future of Northport should expand its focus beyond bulk cargoes, to include dedicated container handling.
- A development footprint should be based around locating:
    - Forestry and bulk cargo to the west of the existing port (i.e. west of Berth 1). This was for numerous reasons, including that these vessels require shallower draught compared to container vessels; and to better accommodate associated noise and visual impacts.
    - Container operations to the east of the existing port (i.e. constructing Berth 4 and extending further east).

Based on the study, Northport decided to make public its 'Vision for Growth' consultation programme. This was intended to notify and bring the community and stakeholders on the journey of realising Northport's expansion plans. Designs proposed as part of Northport's original Vision for Growth are shown below as Figures 31 and 32.

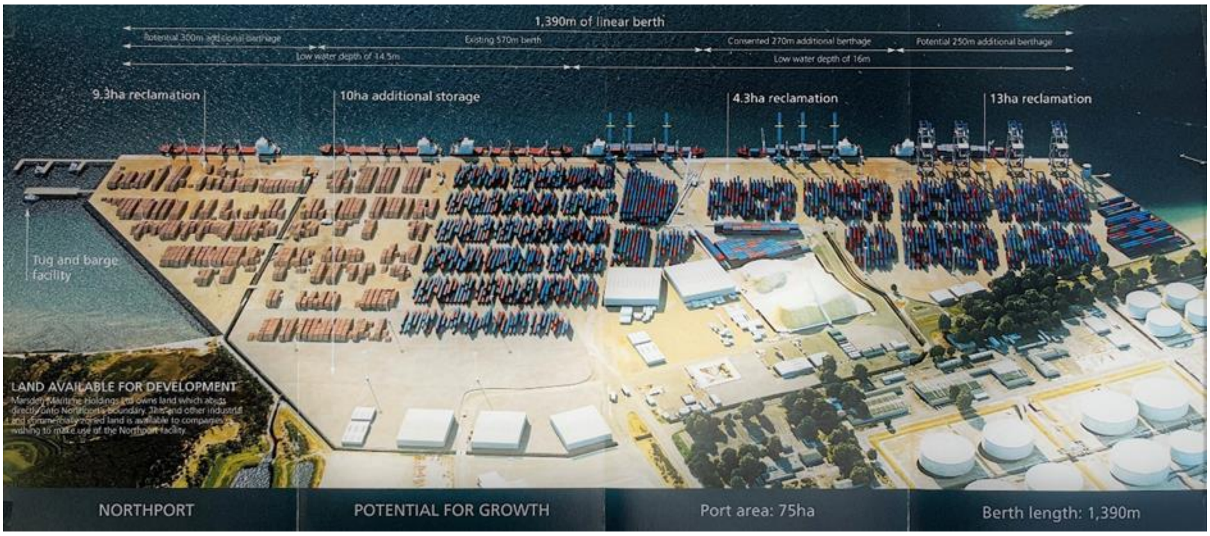


Figure 31: Original Vision for Growth design proposal (2015)

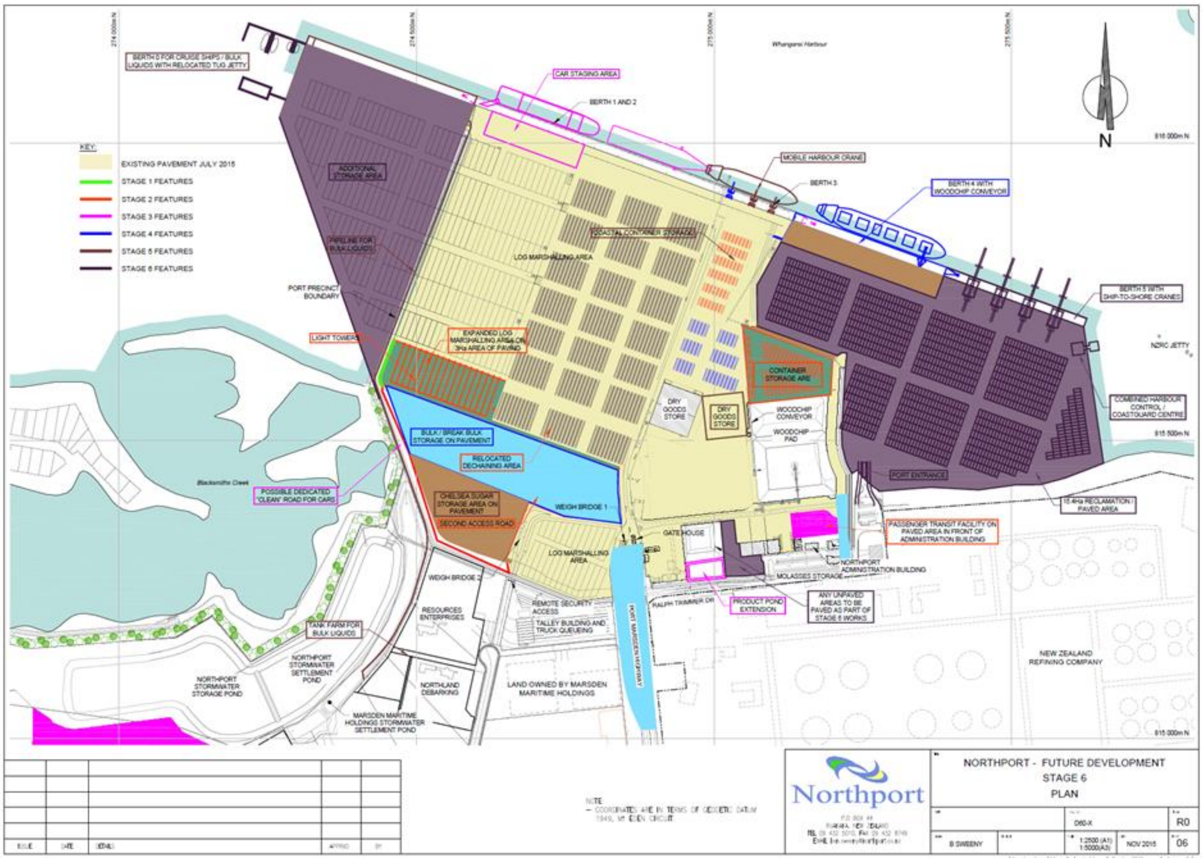


Figure 32: Future layout option considered as part of the 2015 container and freight availability study

9.1.8 Review of shipyard facility (2018-19)

A New Zealand based shipyard and drydock facility has been widely discussed for many years. Earlier studies had looked at Taranaki, Picton, and Port Whangarei, however none of these met the overall requirements of the Navy or the commercial shipping lines.

In 2018 the New Zealand Defence Force (NZDF) and the Navy maintenance contractor Babcock NZ Ltd approached Northport with a proposal for Northport to consider the siting of a floating drydock provided by NZDF/Babcock. A scope was provided and a workshop to explore options for the facility was undertaken. The best of the options was presented to NZDF and Babcock for their review and input.

Later that year an application was made to the Provincial Growth Fund (PGF) for Development Funding of $1.3M to enable a feasibility study for a shipyard and floating drydock at Northport, a high-level review of constructability and costs, a review of the consenting reports that had already been started for the port development, and a review of overall space utilisation requirements for the future freight demand.

Northport engaged with the potential stakeholders; KiwiRail Interislander, New Zealand Shipping Federation and other domestic/international shipping lines, NZDF and Navy, Babcock NZ Ltd, and local ship repair contractors, to ensure the scope was fit for purpose. The preferred location option and floating drydock design were modelled in an in-house port/ship simulator, and the findings used to finalise the shipyard design and construction methodology and cost to build.

An interim report, including a visual overview in video format, was provided to the PGF in early November 2019, with the final report completed in May 2021. The concept and video were included in the Vision for Growth consultation programme from October 2021.

While the shipyard project has not been progressed any further at this time, it was concluded that the only option available for the location of the shipyard and floating drydock was to the west of the existing port operations.

A range of options for locating a shipyard facility were examined, as broadly illustrated by Figures 33 and 34 below.

While the shipyard has not been progressed any further, it was concluded that it could only be located to the west of existing port operations.

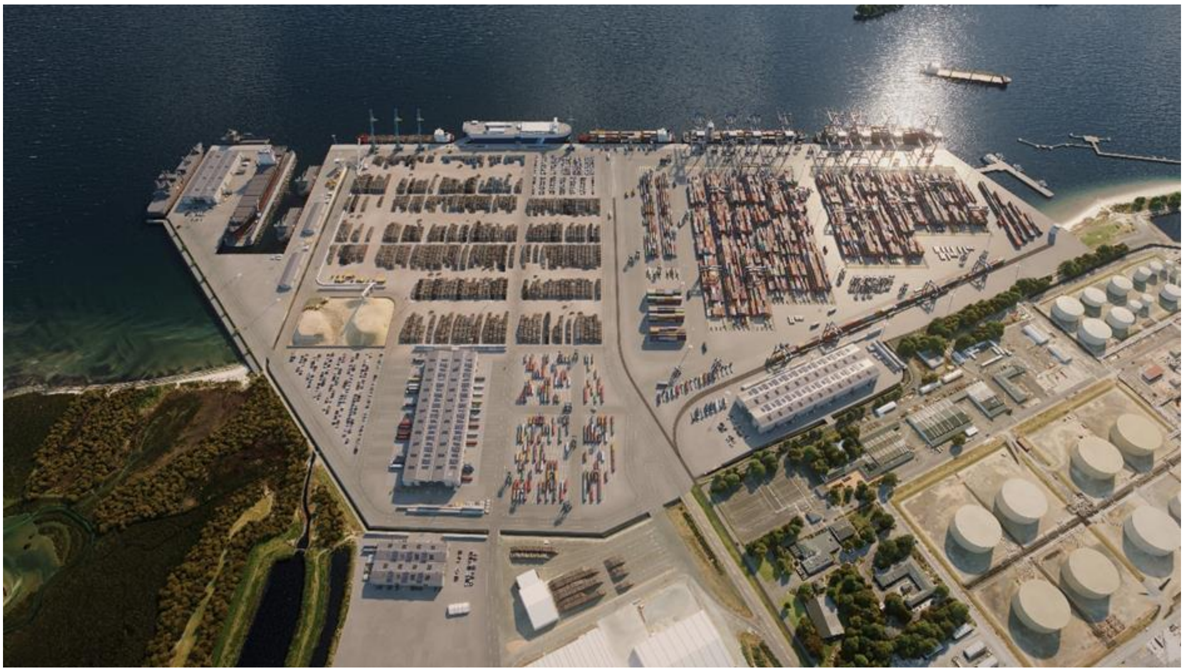


Figure 33: Design proposal showing shipyard to west of existing port facility

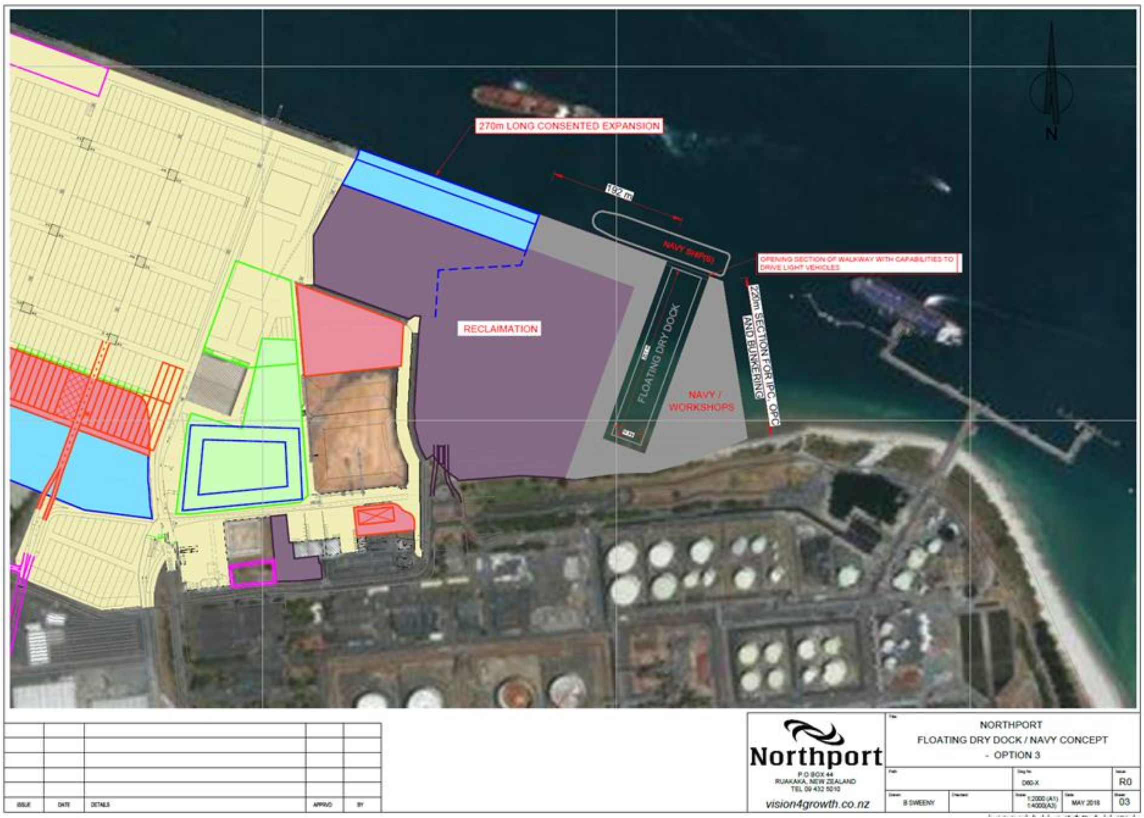


Figure 34: Early design proposal showing shipyard to east of existing port facility

9.1.9 External strategic reports (2019-2020)

A range of external studies and reports into supply chain scenarios and future development of Northport have recently been undertaken. Prominent among these are:

- *Economic Analysis of Upper North Island Supply Chain Scenarios: EY for Ministry of Transport (August 2019)*

- *Transforming Auckland; Transforming Northland: Final Report of the Upper North Island Supply Chain Strategy Working Group: consortium appointed by Ministry of Transport (November 2019)*

  This report had a strong focus on closing Ports of Auckland and relocating the freight to Northport and Port of Tauranga. The six recommendations were:

  1. Ports of Auckland CBD freight operations is no longer economically or environmentally viable and is constrained by landside infrastructure failure. It is in the interests of taxpayers and ratepayers that it be progressively closed and the land it currently occupies be progressively rezoned for higher and better use.
  2. Northport should be developed to take over much or all of Auckland's existing and projected future freight business.
  3. Port of Tauranga's existing expansion plans should proceed to accommodate growth.

4. Auckland's cruise ship terminal should be modernized and the Waitemata become a commuter, tourism, and recreation harbour.
5. The new two-port configuration should be supported by a rejuvenated North Auckland rail line and spur to Northport, and a new inland freight hub in northwest Auckland to complement and be connected to Metroport in the south.
6. This transition should begin immediately and be fully completed by no later than 2034.

On 9th December 2019, following references from the Cabinet Economic Development Committee, Cabinet agreed to a work programme to inform future decisions on the UNI Supply Chain Study, with Ministers reporting back to Cabinet in May 2020. It was noted that as part of the work programme, officials will access the Working Group's recommended Northport scenario and other scenarios looked at by the Working Group.

- *Analysis of the Upper North Island Supply Chain Strategy Working Group Options for moving freight from The Ports of Auckland: Sapere (June 2020, reissued August 2020)*

  This report responded to Cabinet's request to officials for further advice on UNISCS, following receipt of the Independent Working Group report in December 2019. The commissioned analysis was required to: (a) assume the relocation of all freight operations from POAL; and (b) consider five options for relocation:

  - Northport expansion
  - Port of Tauranga expansion
  - A shared increase in capacity at both Northport and Port of Tauranga
  - A new port (greenfield site) on the Firth of Thames, and
  - A new port (greenfield site) on the Manukau Harbour.

  There was a gateway test of sufficient long-term capacity: the test was whether an option can future proof the UNI supply chain by providing long-term capacity to accommodate the future freight task. Given the scale of investment and the long-lived nature of port assets, the test used was 60-years of capacity to handle current POAL freight volumes, allowing for a reasonable rate of growth.

  Regarding Northport the report noted: Northport could provide sufficient berth capacity until around 2060, which is not materially longer than the estimated 30- year capacity at POAL. To accommodate the freight task for the minimum test of 60 years, marine and coastal engineers conclude that Northport would need a 2km long quay, involving dredging and reclamation that expands beyond identified constraints to the west (residents, wetlands) and to the east (into Refining NZ's (now Channel Infrastructure) liquid berths and well beyond) with significant impacts on coastal processes affecting the nearby coastline and channel.

  The report also noted: a shared increase in capacity at Northport and POTL could accommodate the freight task at 60-years, based on an assumed freight volume split, at which point these ports would likely be at, or near, full capacity with little or no room to expand.

  The report was not required to, nor did it consider, what an UNI three-port strategy could or would look like, and therein lies the largest error.

  Several concept layouts outlined in the report are illustrated in Figures 35-36 below.

Figure 35: Concept layout for Northport expansion (forecast freight task, 2079)- Sapere, 2020

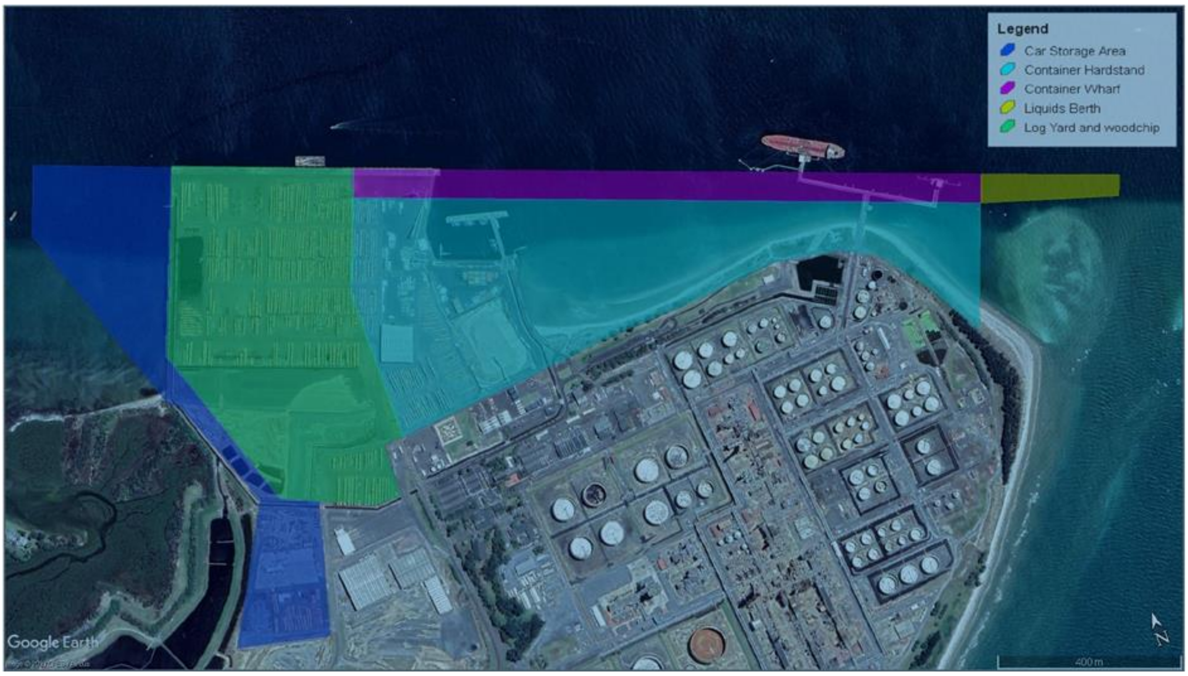


Figure 36: Concept layout for Northport expansion under split option – Sapere, 2020

In August 2020 Northport provided its Position Statement:

> ***Northport's Growth Opportunities***
>
> *Northport has a greater role to play in the development of resilient upper North Island supply chain alternatives. It has a vision for growth which takes advantage of significant development opportunities and available land holdings.*

Development of supply chain alternatives will take time, collaboration and considerable investment in infrastructure to achieve an outcome that has both regional and national significance.

The Government announcements to date and future announcements surrounding upper North Island infrastructure are positive and necessary first steps to facilitate any shift of cargo handling activities north to Northport.

Moving POAL

Northport's growth opportunities and supply chain alternatives have the ability to relieve the pressure on the Ports of Auckland Ltd (POAL) and the increasing demands on the Auckland waterfront. We see realising Northport's significant growth opportunities as a staged and complementary process to supporting POAL rather than a short-term complete relocation of the Auckland port.

Opponents of moving POAL to Northport have cited the negative environmental impacts of the move. There has been considerable misinformation around this as it assumes all cargo will be moved to Northport and that all cargo will be transported via road.

A full end to end supply chain analysis which utilises all solutions including road, rail and coastal shipping needs to be carried out incorporating the impact of a reduction in the trucking pressure and congestion on downtown Auckland and surrounds.

We must be mindful that helping to reduce the congestion of NZ's largest city and its waterfront by relocating cargo to Northport may bear an extra cost in the short term, but it is the right thing to do to ensure a resilient supply chain for the future, potentially neutralising any extra cost.

Channel dredging

Northport is a deep-water port located in a natural deep-water harbour. Despite many claims to the contrary, the Refining NZ 'Deeper Story' channel dredging programme is not connected to Northport's Vision for Growth. There is no current or future requirement for Northport to dredge the channel to enable larger dry-cargo/container ships to be handled.

9.1.10 Northport's Vision for Growth updated (October 2020)

Northport re-launched its 'Vision for Growth' concept with a refined layout, drawing on the many studies and reports, including the TBA Group report attached as **Appendix A**.

The Vision for Growth incorporated container port operations to the east of the facility, and a shipyard (including floating dry dock) to the west. The concept is shown in Figure 37.

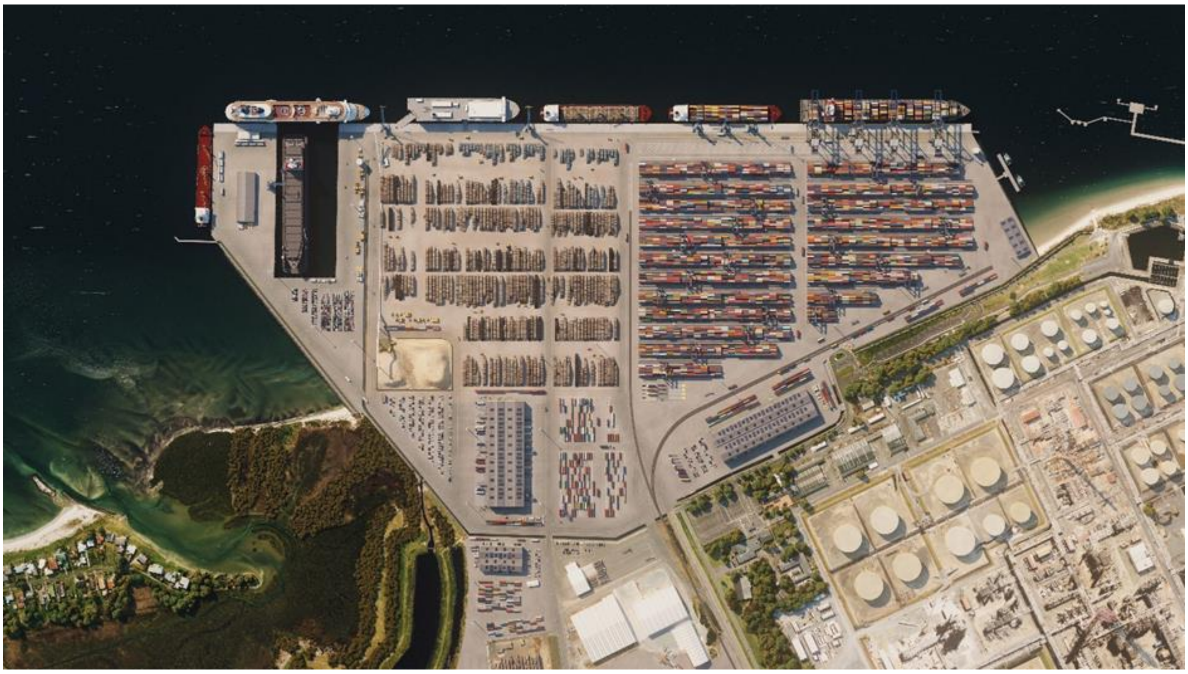


Figure 37: Proposed Vision for Growth development, October 2020

In early 2022, Northport decided to 'de-couple' the proposed Eastern and Western developments to enable a greater level of focus and consultation. Northport remains of the view that the shipyard and floating drydock project is a nationally significant and regionally strategic project which presents a great opportunity for regional growth while dealing with ship maintenance shortfalls within New Zealand and Australia.

9.2 Alternatives considered

Historically - both leading to the current port design and layout (as described in sections 4.3.1 to 4.3.6) and, more recently, since 2010 (as described in sections 9.1.1 to 9.1.10) - Northport has considered and refined the objectives and options for expansion. This iterative process has informed and contextualised the current assessment of alternative options available to Northport.

Several broad options were considered by Northport when evaluating how and where additional port capacity could be located to meet the project objectives, including:

- A location other than Northport
- Reconfigure existing port operations
- Extend the port footprint either west, north, south or east

A summary of the evaluation process is set out in the following sections.

9.2.1 A location other than Northport

Northport tested, at a high level, whether its existing location was the appropriate place for additional port capacity to serve Northland and northern Auckland's growing freight needs. Was there somewhere else that would provide a better solution and/or would two ports in Northland be a better outcome? Northport briefly considered several locations, including:

- Re-establishing the previous port in Whangārei
- Other locations in Whangārei Harbour

- Other east coast locations in Northland (i.e. Bay of Islands)
- West coast locations in Northland (i.e. Kaipara or Hokianga Harbours)

Whilst some of these locations have some of the physical attributes needed to establish a modern container terminal (i.e. deep water, sheltered harbour, flat land or the ability to reclaim) none have all of these features combined with appropriate connections to the land transport network and a setting that would be environmentally or socially appropriate for a port development.

All locations would require significant investment. Port infrastructure would need to be established (both land and water side). Besides the cost, establishing this infrastructure at a new location would also likely present very significant consenting challenges.

In contrast, the majority of the supporting infrastructure (i.e. navigation channel, navigation aids etc.) already exists at Northport and is financially supported by range of users (i.e. Channel Infrastructure and Golden Bay Cement). Northport is proximate to both a range of trained and experienced workers and ancillary downstream businesses.

Due to these factors, and the benefits of developing an existing facility, all other location options were discarded, and the expansion of Northport's existing Marsden Point facility was chosen as the most viable option.

9.2.2 Reconfigure existing port operations

9.2.2.1 Existing port footprint

Northport's current footprint totals 49.1 ha, made up of a 570 linear metre berth, and 33.6 ha of reclaimed land. Reconfiguring the existing footprint was evaluated as an alternative to reclaiming additional land to develop a container terminal and provide additional freight capacity.

Reconfiguring the existing footprint would involve the following:

- Relocation of storage for low value commodities. This would likely involve moving those low value commodities further from the wharf frontage, and this distance would quickly make handling uneconomic.
- Considerable investment to increase the structural capacity of the existing wharves so that the necessary handling infrastructure (for example, STS gantry cranes) can be installed. This would likely require a full rebuild of the existing wharves, rendering them unusable for the current trades over the construction period (1-2 years). Rebuilding these functioning wharves before they reach end-of-life would be a loss of the existing investment, costly and essentially uneconomic.
- Either rejecting existing freight types (i.e. logs or other bulk cargo) or requiring vessels to wait at anchor for extended times, severely impacting Northland's economy. The existing storage areas are occupied by existing trade volumes/types and there is no space to provide for freight volume growth or diversification. Increasing container freight volumes would therefore come at the expense of Northport's existing cargo types as the existing footprint is too small to support both logs and bulk cargo, as well as projected growth in container volumes and other freight. With only three berths, Northport is already experiencing very high berth occupancy rates and does not have capacity to accept a significant growth in vessel numbers.

Ultimately, this option was discarded as it would not allow Northport to provide any meaningful additional container freight capacity or diversity in the freight it handles, nor would it allow Northport to handle increasing freight volumes from the Northland region.

9.2.2.2 Existing port footprint including consented Berth 4

Northport holds extant resource consents for the construction and use of an additional 270 liner metres of berth with a depth at CD of 14.5m and a 2.3ha reclamation. Consented in 2004 and yet to be constructed, this option would expand the port's footprint to 50.8ha and extend its sea frontage eastward to 840 linear metres as shown earlier in Figure 1.

The construction of Berth 4 would increase Northport's capacity by one additional vessel berth and the associated reclamation would provide extra freight handling space directly behind the wharf which could be used for container storage. Provided that Northport could reconfigure existing storage areas – which itself is reliant on a downturn of log volumes – the Berth 4 consents would support the development of a c. 10 ha container terminal, likely capable of handling up to 160,000 TEU per annum. This option would *partially* support the objective of diversifying and future-proofing Northport, but only in the short to medium term (i.e. 5-15 years).

There are other practical implications of constructing Berth 4 as a single container berth, including that the wharf would require the use of 50 m of the existing Berth 3, or alternatively would require ships to overhang and be moved during loading/unloading. A viable rail connection with shunt capability in the available space becomes challenging to other port operations.

A container terminal based on the Berth 4 development with a single berth has therefore been discarded for the following reasons:

- The berth does not have the capacity to serve the predicted freight demand, the number of vessels or the volume of containers.
- Northport considers integration of a rail link is critical to Northport's future role in the wider freight network. Without the rail link a greater load would be placed on the road network and the resilience of the transport network would be reduced.
- The land needed would require Northport to repurpose existing land used for other freight tasks, including moving the woodchip operation, which has significant fixed infrastructure. This would constrain the existing trades and limit the ability of Northport to handle growth in those freight tasks.

9.2.3 Extend the port footprint

Northport carefully evaluated how the port could expand to provide the additional space required for a dedicated container terminal.

9.2.3.1 Westward expansion

To the west of the existing Northport facility are ecologically and culturally important areas and habitats, including Blacksmiths Creek and the One Tree Point to Marsden Bay Significant Ecological Area. Beyond that lies the residential areas of Albany Road and Marsden Cove, and Snake Bank. The harbour bathymetry shallows on the western side, with a broad intertidal platform grading down to natural depths (at the berth face) of 5-6m below CD.

Northport considered the practical requirements and constraints for a westward expansion, and then evaluated the design against the project objectives as well as social, cultural, environmental and regulatory factors. A westward expansion was not favoured for the following reasons:

- Because of the depths required to accommodate container vessels, and the required extension to the swing basin, the volume of dredging would be very high. Dredge volumes would exceed beneficial re-use, either within the reclamation or realistic beach renourishment. Further, the cost to dispose to land would likely necessitate an offshore disposal ground, with the concomitant environmental/cultural effects and regulatory challenges.
- The enlarged swing basin would likely interact with the sand bank features in the harbour, particularly Snake Bank and may result in unacceptable changes to coastal geomorphology and hydrodynamics.
- A container terminal operates 24 hours a day, 7 days a week. Noise modelling indicated the resulting noise effects on residential areas would be difficult to manage to acceptable levels.
- A container terminal would require a large rectangular reclamation behind the wharf, likely extending to the beach. Avoiding effects on Blacksmiths Creek and the One Tree Point to Marsden Bay Significant Ecological Area would be difficult and if not avoided would pose a significant regulatory barrier.
- A container terminal would be highly visible to the Albany Road/Marsden Cove residential areas and early consultation indicated that this amenity effect was a concern to those residents.

9.2.3.2 Northward expansion

A northward expansion would involve retaining the east-west extents of the Port but extending the reclamation northwards towards the northern side of the harbour. This was only briefly considered before being discarded for a range of clear practical and operational reasons. These included:

- Northward expansion would protrude into, and potentially compromise safe operations within, the turning basin. Due to the shape of the harbour, and the practical limitations (as well as the likely environmental, cultural and amenity constraints) to extending the turning basin to the north, this was considered unfeasible. Accordingly, any reduction in the size and shape of the turning basin size may result in a lack of turning space for predicted vessel sizes frequenting the Port.
- It would require removal of the existing wharf structures to create reclamation north of the quay line. New wharf structure would then be needed on the new, more northern, quay line. This would be very expensive and render the Port inoperable for many years during construction.
- The reclamation would be technically challenging and require large volumes of fill due to the deep water in that part of the harbour.
- It would not create any additional berth space and not appreciably improve the capacity of the facility.
- The additional space needed would require a significant extension which would likely result in large changes to the coastal geomorphology of the harbour.
- The environmental, cultural and social effects associated with the physical changes necessary would likely be unacceptable.
- The impact on the commercial channel to the lower harbour.

9.2.3.3 Southward (land-based) expansion

Any southward (i.e. land-based) expansion of the Port does not achieve Northport's fundamental objectives. That is, the identified constraint is caused by both insufficient berth frontage, and wharf-adjacent land area for container handling and the range of ancillary operations and support required.

It has been identified earlier in this report that there is underdeveloped commercial, industrial and port zoned land in the Marsden Point area. This land, while owned by third parties, may be beneficial to Northport in that it provides capacity for support facilities such as warehousing, log scaling and handling, and other port-related activities which do not need to be adjacent to a wharf.

However, it is fundamental to port operations that the cargo handling areas need to be physically immediately adjacent to the wharf frontage. It is simply not practicable to transport cargo (including containers) any material distance. The additional cost would make it immediately uneconomic. Accordingly, this option was discarded.

9.2.3.4 Eastern expansion

East of the existing Port lies a sandy beach some 700 m long, with a broad intertidal platform. Beyond that platform the seabed drops sharply into deep water, with natural water depths (at the berth face) of 10-12 m (below chart datum). The Channel Infrastructure jetty lies at the eastern end of the beach and Channel Infrastructure's main fuel storage terminal immediately behind (south) of the beach. To the north, by approximately 900 m, lie the residential neighbourhoods of Reotahi, Darch Point and McLeod Bay.

An eastern container terminal would require an additional 250 m of wharf in addition to the 270 m of Berth 4 and a portion of Berth 3 to create a 700 m long (total) container wharf. Approximately 14ha of reclamation and 2 ha of land area is needed to create the semi-rectangular area behind the wharf to locate the container terminal.

Naturally deep water at the berth face means minimal dredging (<50,000 m^3) is required for the berth area alongside. The existing consented swing basin would require some deepening (to between 14.5m and 16m below CD) for ship manoeuvring. The footprint of the dredging is almost entirely within the area Northport already holds resource consents for dredging. In total, approximately 1.7 million cubic metres of dredging is required. Dredged material would be utilised to supply the fill material for the reclamation.

An eastern expansion was chosen as the preferred option for the following reasons:

- It concentrates the Port development, including visual elements, within the existing industrial setting of the current Northport and Channel Infrastructure facilities.
- Naturally deep water exists at the berth face, minimising dredging requirements. Dredge spoil can be fully utilised in the reclamation, avoiding the need for sea-based disposal.
- Noise sensitive receptors are more distant from the eastern location, minimising noise impacts and making effective noise management more achievable.
- The development can be built without significant disruptions to existing Port operations. This will enable Northport to continuing serving the freight needs of its customers throughout the construction.
- The same quay line is maintained, minimising further protrusions into the harbour with the resulting changes in hydrodynamics and coastal geomorphology, and minimising effects on other harbour users.

10 Proposed Northport container terminal design

As discussed above, a range of broad alternative options were evaluated, with the preferred option an eastward extension of the existing port footprint. Northport developed a high-level concept for the eastern container terminal based on a two-berth wharf with sufficient reclamation to support the wharf. The storage required along with ancillary facilities and a rail connection meant the reclamation needed to infill the entire area between the wharf and the existing shoreline - being a combination of the existing consented Berth 4 (wharf and reclamation) and a newly consented wharf and land reclamation.

Within the container terminal itself, there is a high degree of interdependency across the infrastructure element. These elements must be designed to work in concert with each other to achieve a consistent efficiency and capacity across the terminal. Consequently, the design process is iterative and aims to balance the various components to achieve a cost-effective and efficient terminal.

The key elements that need to be considered and designed for a new terminal are discussed in the following sections.

10.1 Construction design

Any expansion and redevelopment of Northport is required to integrate with existing port operations and surrounding constraints, such as topography and access. Accordingly, the options for construction design are relatively limited. Design solutions required internationally to respond to constraints, such as a causeway and wharf type layout, are not required nor appropriate.

A construction design consideration for Northport was whether to undertake reclamation, or to construct a piled wharf. Northport commissioned WSP to provide initial, high-level advice on this question. That advice was that reclamation is the only practicable option, including for the following reasons:

- Reclaimed ground can be improved through densification and compaction to allow support of substantial imposed loading typical of marine operations including bulk cargo, containers and associated lifting and handling plant and machinery.
- Exceedance of the geotechnical capacity of a pile supported deck could lead to settlement of piles and damage to deck slabs.
- Reclamation is a more resilient construction form. Reclamations requires little to nil maintenance and are not vulnerable to section loss or decay.
- While concrete decks and supporting piles can be designed and constructed to meet durability demands, it is to be expected that the structures will require inspection and maintenance (which can be difficult) with significant intervention towards end of life. The operational cost of a suspended deck structure in the longer term is therefore expected to be very high per unit area than compared to reclaimed land.
- Reclamation offers better resilience to earthquakes. The timeframe and cost for a return to operations following a seismic event is significantly lower for a reclamation as compared to a suspended (piled) deck structure. This is because ‘damage’ to the reclamation would take the form of settlement of pavements, which could feasibly be repaired by filling and resurfacing works; whereas damage to a pile supported structure will be concentrated at the pile head to deck connection, requiring concrete repair to the top of piles with potential reconstruction of the pile/deck joint.

For comparison, high level costings were reviewed by WSP. Construction costs, not including the full life costs, for each option were calculated as roughly:

- Reclaimed pavement – approx. $2600 / m²
- Piled Structure – approx. $7000 / m²

For the proposed 11.7 ha of reclamation required for Northport, this equates to:

- Reclaimed pavement - $300M
- Piled Structure - $820M

The increased cost of a piled structure over reclamation is therefore roughly $520M, or a 270% increase.

For completeness, causeways from landside to a reclamation/piled berth were considered unsuitable, including for the following reasons:

- Lack of available and suitable land-side land owned by Northport;
- Creation of a lagoon type beach behind wharf structures;
- Significant accretion;
- Split storage capability and multi-movements required;
- Costly causeway/bridge structures capable of wheel loadings.

10.2 Wharf infrastructure and design

A container wharf must have sufficient length to serve the expected container vessels. Required wharf length is based on the expected mix of container vessel sizes, the frequency of calls, and how long they will spend at the berth.

The wharf must also have sufficient structural capacity to accommodate the necessary infrastructure, particularly the large and heavy cranes.

Northport has commissioned WSP to prepare a concept design.[18] This records the user requirements, constraints, selection criteria and identifies the proposed construction methodology for the indicative wharf design.

Detailed design will be undertaken prior to construction.

10.2.1 Wharf design criteria

Various criteria were considered when arriving at a proposed concept design solution. The establishment of the criteria, and the assessment against them, is described in the WSP Concept Design Report. In summary, they include:

- Large axial load demands arising from crane loading.
- Structural form to offer displacement capacity, resilience and post seismic event functionality.
- An acceptable programme and a limited period of exposure to construction noise with a focus on driving resistance and pile type.
- The ability to select the construction form and methodology to manage environmental, social and cultural considerations while also targeting construction cost optimisation.

[18] WSP, *Northport Eastern Extension (Berth 5) Concept Design Report*, 2022.

- Workable construction sequencing including use of floating platforms and divers.
- The benefits of repurposing the dredged fill from the vessel turning area into the reclamation.
- The availability of rock/gravel from nearby quarries and optimising use of construction materials.
- Consideration of contractor capability including labour and plant required.
- The extent of ground improvement required.
- Optimising materials required.

10.2.2 Preferred wharf design option

Based on the above criteria, an open piled marginal wharf with rock revetment was the chosen option (refer the concept sketch in Figure 38), including for the following reasons:

- Provides the structural and geotechnical capacity to support the crane demands.
- Has displacement capacity to offer post seismic event functionality.
- The geometry can be adjusted to respond to minor changes in user requirements without necessitating a complete change in construction form.
- A bulkhead structure can be constructed on the corner to tie into the intersecting rock revetment.
- Durability requirements can be readily addressed using proven technologies.
- Provides for a large load capacity concrete deck without significant settlement concerns.
- Has very simple construction procedure.
- Ground improvement is expected to be straight forward. There is flexibility in the selection of a ground improvement technique.

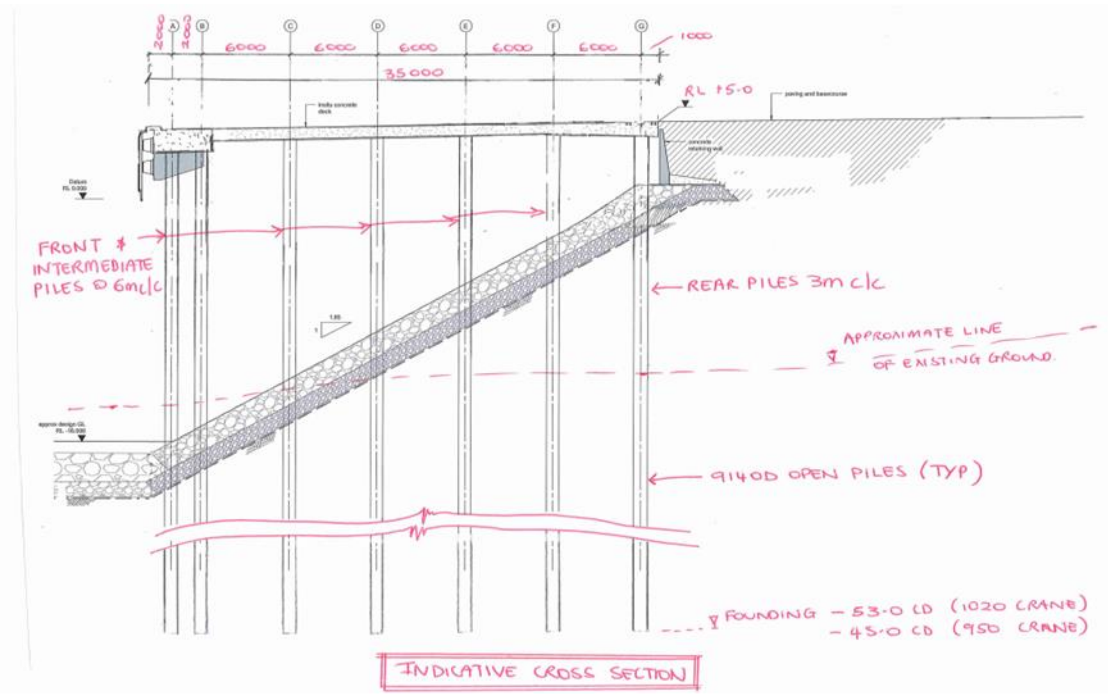


Figure 38: Concept cross section of open piled marginal wharf with rock revetment

10.2.3 Other wharf design options considered and discounted

1. **'Hybrid' wharf**: would result in two legs of container cranes being supported on the piled portion of the wharf and two legs being supported on the backfilled backlands. This not only has a day-to-day operational risk if the landward crane rail settles relative to the seaward crane rail, but the piled portion will respond differently during seismic events than the backfilled portion resulting in differential movement damage to the wharf and increase in rail gauge as tie rods to the landward rail stretch under load. Higher levels of damage and longer operational outage times would be required compared to the marginal piled wharf option.

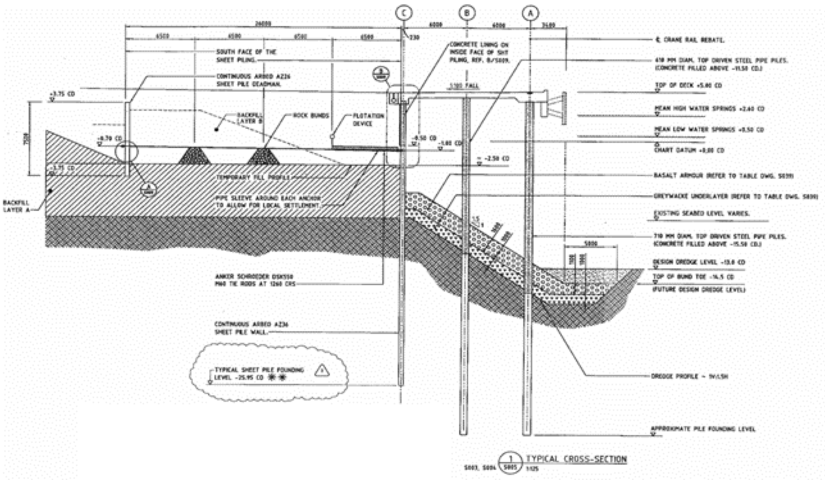


Figure 39: Concept 'hybrid' wharf (WSP Concept Design Report, 2022)

2. **Diaphragm wall with tie backs**: has less deformation capacity in seismic events compared to a piled marginal wharf and would therefore require more extensive, and expensive, ground improvement to achieve the required level of seismic performance. Rail gauge will be more readily compromised. Repair of the diaphragm wall option will be more challenging than the marginal piled wharf option with a higher risk that the diaphragm wall option would need to be demolished and rebuilt following a major seismic event.

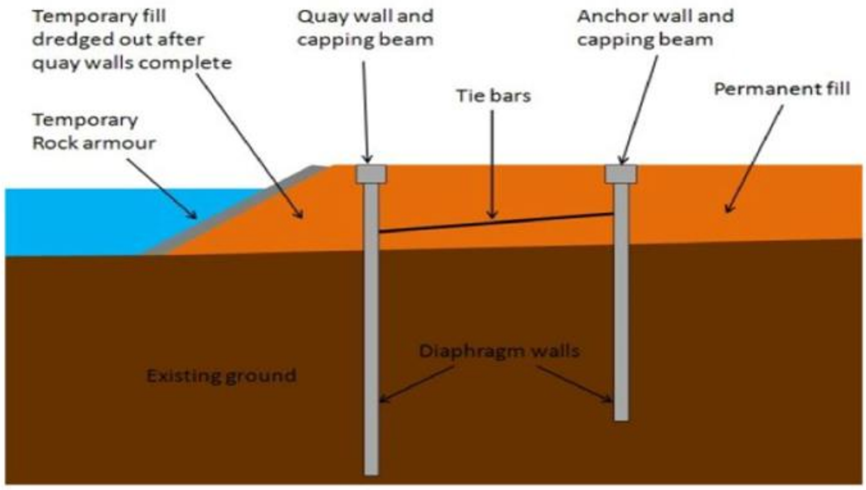


Figure 40: Concept diaphragm wall with tieback anchors (WSP Concept Design Report, 2022)

3. **Interlocking circular caissons with gravel or sand infill**: expensive, and particularly with the added pricing volatility that exists for steel in the global market at present, the potential for cost increases is significant.

Figure 41: Concept interlocking circular caissons with gravel or sand infill (WSP Concept Design Report, 2022)

4. **Single combi-pile wall with tie back anchors**: significant and expensive ground improvement that would be required to the reclamation to enable this option to achieve the seismic performance requirements. Rail gauge will be more readily compromised.

Figure 42: Concept single combi-pile wall with tie back anchors (WSP Concept Design Report, 2022)

5. **Twin combi-pile wall structure**: similar issues as the hybrid option discussed above. The landward and seaward crane legs would be supported on structural systems that would respond differently in a seismic event. Rail gauge would be more readily compromised. The outage times following a seismic event are expected to be considerably longer with more

expensive repairs compared to a marginal piled wharf solution.

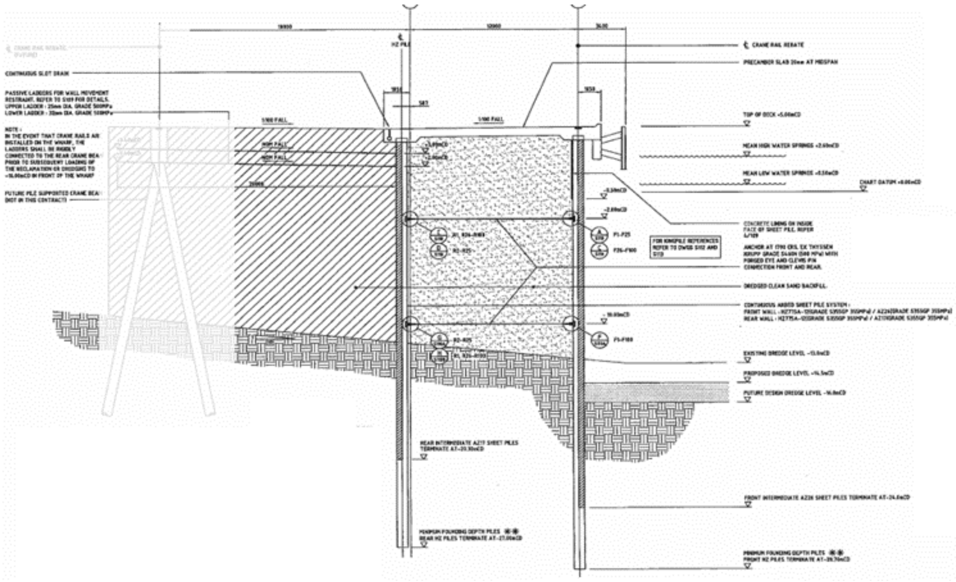


Figure 43: Concept twin combi-pile wall structure (WSP Concept Design Report, 2022)

10.3 Operational aspects

10.3.1 Quay cranes

Large cranes are needed to load and unload containers. Quay cranes come in two broad types, Ship-to-shore (STS) cranes and mobile harbour cranes (MHCs). Examples of STS and MHCs are shown in Figures 44 and 45 below (see also the images in the glossary of terms at section 1). MHCs are very versatile and can be used for a range of cargo tasks (for example loading logs and bulk cargo) not just container handling. They are wheel mounted so can be located anywhere on port. Their lower cost and flexible use mean they are particularly useful in smaller mixed cargo ports. MHCs swing the cargo off the ship in an arc, so require room to perform this manoeuvre.

STS cranes are much larger than MHCs and place significant loads on the wharf structure. STS cranes are rail mounted, so only operate up and down the wharf face. Containers are picked and placed onto the wharf without any rotation of the crane so STS cranes can operate close to other STS cranes. Typically, STS cranes have a faster crane rate than MHCs and can lift heavier loads. STS cranes are specifically designed for lifting containers and are not typically used for any other cargo task. Wharves must be specifically designed for STS cranes, with structural capacity for the cranes' weight, the appropriate width and the supporting infrastructure (i.e. rails, power supply etc). STS cranes are significantly more expensive than MHCs and so their installation requires careful consideration of the capital cost involved.

Northport currently has two MHCs which service the existing container trade and assist with general and project cargo.

Figure 44: Gantry STS crane (Source: www.liebherr.com).

Figure 45: Simulated image of mobile harbour cranes (MHC) operating a vessel (Source: Build Media Ltd).

10.3.2 Mobile container handling equipment

Containers need to be moved from the cranes to the storage area, and then from the storage area to the trucks/trains. A range of mobile units can be used for this task, including straddle carriers, trucks, fork hoists, automated guided vehicles (AGVs), rubber-tyred gantry cranes (RTGs) and reach stackers (RS).

Northport currently use a combination of trucks and RS for their existing operation, with a view to moving into RTGs as the volume of cargo increases

10.3.3 Location and layout of the container yard

The container yard includes the container storage area, associated circulation routes and other associated facilities. The storage area serves two purposes: it provides a place to store import containers whilst they await loading onto road/rail transport, and it provides a place to amass export containers so they can be quickly loaded onto a vessel. The storage area must be located directly adjacent to the berth. Storage areas distant from the wharf significantly reduce a terminal's efficiency and are not viable.

The size of the container storage area is dependent on the container volumes and the equipment used to stack the containers. Equipment that places containers in high, dense, stacks require a smaller storage area than equipment that stacks in low, less dense stacks.

As high-density stacking equipment requires significant capital investment, many new terminals commence operations with lower cost, low stack height equipment. When container volumes increase to a point, higher density stacking equipment can be phased in to increase the capacity of the terminal without the need for additional land.

Low stack equipment includes:

- RS: These stack 4-5 full containers high and up to 6 empty containers high, in rows 2-6 containers wide, with at least 18 m between each row.
- Straddle carriers (used in most NZ ports): These stack up to 3 high with 1.5m between each row of one container wide.
- Fork hoists/masted container handlers: These stack up to 4-5 full containers high and 2 containers wide, with at least 18 m between each row.

*Figure 46: Top left - simulated image of a reach stacker (Source: Build Media Ltd); Top right - s*traddle carrier (Source: *www.konecranes.com*); Below - *empty container handler (Source: www.hyster.co.nz)*

Higher stacking equipment includes:

- Rubber tyre gantry cranes (RTGs): These stack 6 containers high in dense blocks up to 8 containers wide.
- Rail-mounted gantry crane (RMGs): These stack 5 containers high in dense blocks up to 12 containers wide.
- Auto stacking cranes (ASCs): These stack container in long dense blocks.

RTGs, RMGs and ASCs can be designed to load/unload trucks directly, avoiding the need for mobile plant to shift containers from the stack area to the truck/train loading site.

Figure 47: Top - simulated image of RTG (Source:Build Media Ltd); Middle - RMG (Source: www.Liebherr.com); Below - ASC (Source: www.worldcargonews.com)

10.3.4 Ancillary infrastructure and facilities

A range of ancillary infrastructure and facilities are required in the terminal to support container operations. These include:

- Exchange lanes to load and unload trucks
- Rail siding(s) to load and unload container trains
- Mechanical workshops to service the terminal equipment
- Lighting towers/electrical substation
- Buildings to house administration functions, terminal control facilities, staff amenities and customs/biosecurity staff
- Container wash facility
- Security fencing and access gates (with security access control)
- Reefer (refrigerated container) storage infrastructure (electrical connections and access facilities)
- Pre-trip facilities
- Empty container storage with dedicated exchange lanes
- Internal roadways
- Laydown for handling equipment
- Refuelling facilities (including EV battery charging stations)

10.3.5 Proposed yard areas

As outlined in section 8.2, the total yard area required can be calculated by $A\mathit{T} = A\mathit{PY} + A\mathit{CFS} + A\mathit{EC} + A\mathit{ROP}$. The indicative figures below demonstrate that the space utilisation for the proposed expansion sits comfortably within (i.e. corresponds well with) the standard industry figures outlined in section 8.2.

Component	Component description	Typical industry figure	Figure for proposed Northport expansion
Area	The area required for a container terminal is between 10 – 100ha / berth	**Northport container terminal designed for 2 berths – 20–200ha**	**18.7ha**
Depth of Yard	The depth of the yard from behind the wharf apron should be at least 300m, with a modern container terminal up to about 700m	**300 – 700m depth**	**>350m (on average, due to angled rear boundary)**
A*PY*	The primary yard area or container stacking area.	**50-70%**	**58%**
A*CFS*	The container freight station (CFS) with an area for stuffing and stripping etc.	**15-30%**	**22%** **(this concept area may conflict with other port use, therefore may be reduced)**
A*EC*	The area for empty containers, container maintenance, and repair area, etc. Generally, in modern container terminals, empty containers are stored and repaired outside the terminal area, if possible.	**10-20%**	**7%**
A*ROP*	The area for the entrance, office buildings, customs facilities, parking, etc.	**5-15%** (approx.)	**14%**

As identified above in 8.2, to appropriately provide for future expansion the storage area should have an additional area of 25-40% as reserve capacity.

The area calculated for the proposed terminal is 18.7ha. This falls below the 'Port Designer's Handbook'[19] guidance that the area should be in the range of 20 – 200ha for a 2-berth container terminal. The depth of the yard is also only marginally larger than the least depth of 300m, averaging around 350m.

11 Summary

This report outlines the wide range of considerations (including those matters addressed in the TBA Group report at **Appendix A**) that have informed the area and design proposed in the present resource consent applications.

[19] *Port Designer's Handbook*, Thoresen C, Third ed 2014.

12 Appendices

Appendix A: TBA Group report

T|B|A®
Simplifying your operation

Northport Conceptual design study

High level Conceptual Development Plan & Summary

Mahim Khanna, Jeroen Kats | August 2021

Simplifying your operation

Contents

- ✔ | Quick introduction to TBA
- ✔ | TBA study objections & approach
- ✔ | Berth simulation#
- ✔ | Yard development options & development trajectory#
- ✔ | Conclusion

✔ | # berth simulation & yard development covered in brief in this PPT

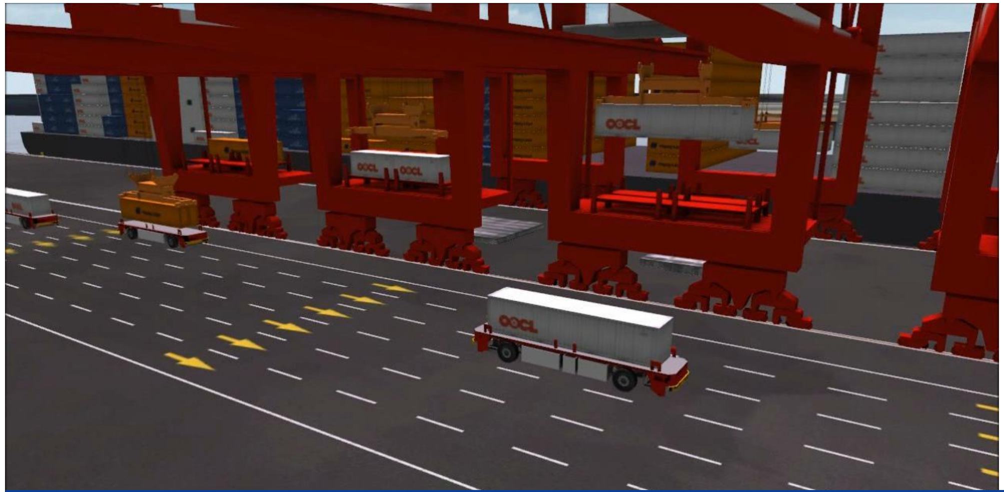
Northport
Introduction - TBA Group (Part of the Konecranes)

Design Expertise & Tools

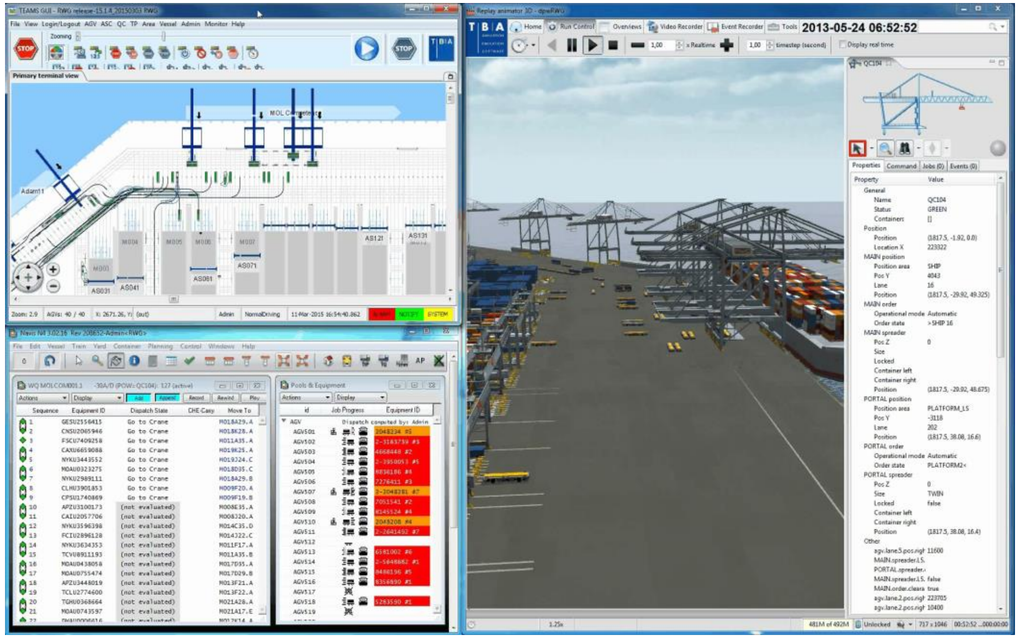
- TBA – Globally a recognized leader in terminal design, simulation, operations & terminal automation.
- 9 of top 10 largest global operators use TBA services including, DP World, AP Moller terminals, PSA, Hutchison etc.
- TBA has worked on many of the cutting edge & most innovative terminals.APMT Maasvlakte II, Rotterdam World Gateway, Long Beach Container Terminal, Euromax, London Gateway, Yang Shan, Tuas, Boxbay, Neom etc.
- Oceania – TBA regular customers include Auckland, Tauranga, DPW, Patrick, Qube, Otago, NSW Ports, Fremantle, Adelaide, Pacific National, Lyttelton etc.

Operation & software

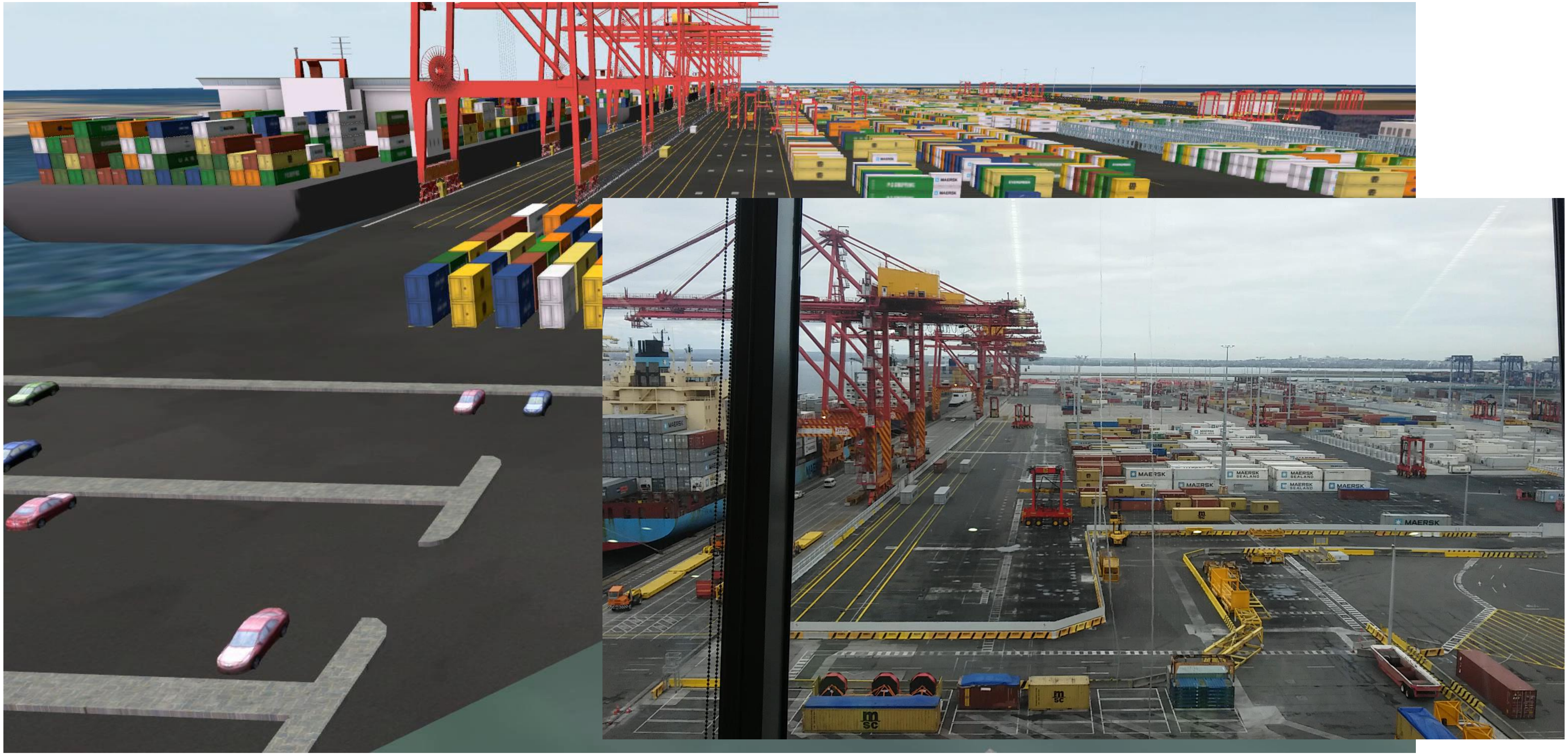
- TBA operational & TOS expertise –terminal hands-on operations, terminal optimization & training experience. (Including web training portal – DPW, APMT, ICTSI)
- Automation Equipment Control System (ECS) is controlling majority of the AGVs operating in fully automated container terminals.



Long Beach Container Terminal – controlled by TBA TEAMS



Port Botany – Fully automated facility
Simulation 2010 Vs. Live operation 2015 – Port Botany



- Videos are from Control tower. (quality of simulation video is much improved now as compared to 2010)
- Simulation is with 6 QC, but live operation is 2 QC only

Northport Study

Objective, scope & approach

Study Task & Scope - Container yard

Key objective

- Develop a high-level conceptual design and yard footprint for the container facility that offers an appropriate balance between capacity, yard & operations for Northport for supporting + ~ 500,000 - 650,000 TEUs.
- Conceptual plan to be provide a framework & development pathway, detailed planning, development & investment will be committed based on demand in a phased manner.

Scope

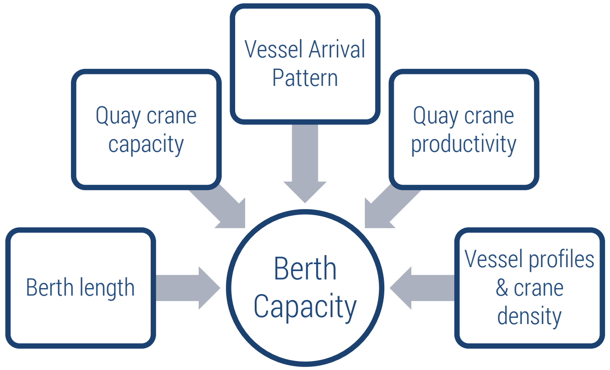
- Review and validate the existing development plan
- Create a high-level conceptual plan for Northport container operation for handling 450-650 K TEUs.
- Establish berth capacity & yard area requirement to support container operation
- Terminal development trajectory & high level transition plan

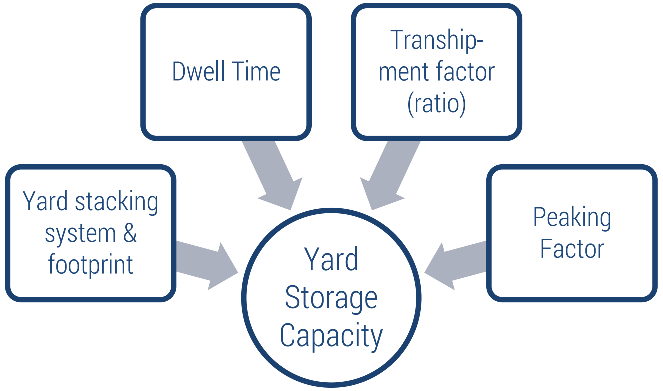
What is not covered by TBA scope

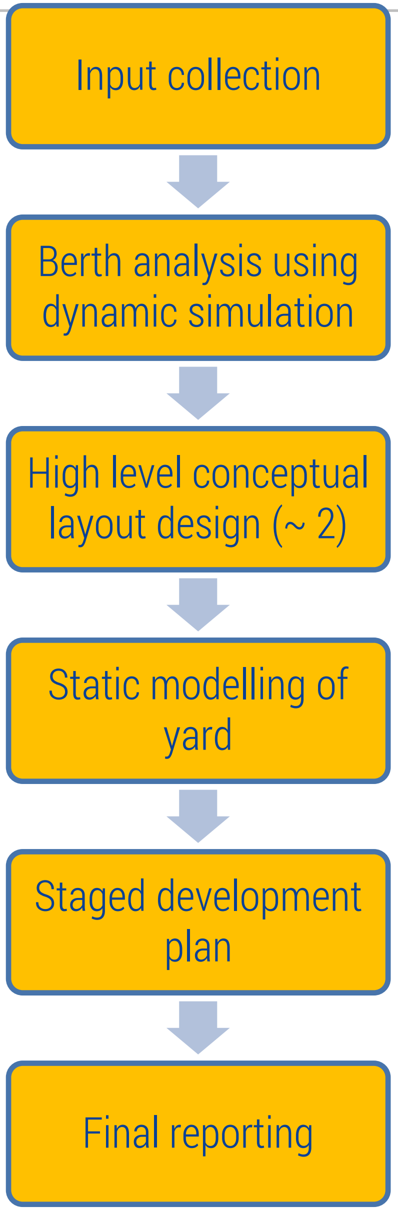
- Bulk & breakbulk operation
- Navigational & port entry limits

Approach & key steps

- Input & assumptions
- Detailed container berth analysis
- Yard alternative layout & selection
- Development trajectory
  - Balancing handling capacity, storage costs & the financials
- Summary Final Reporting



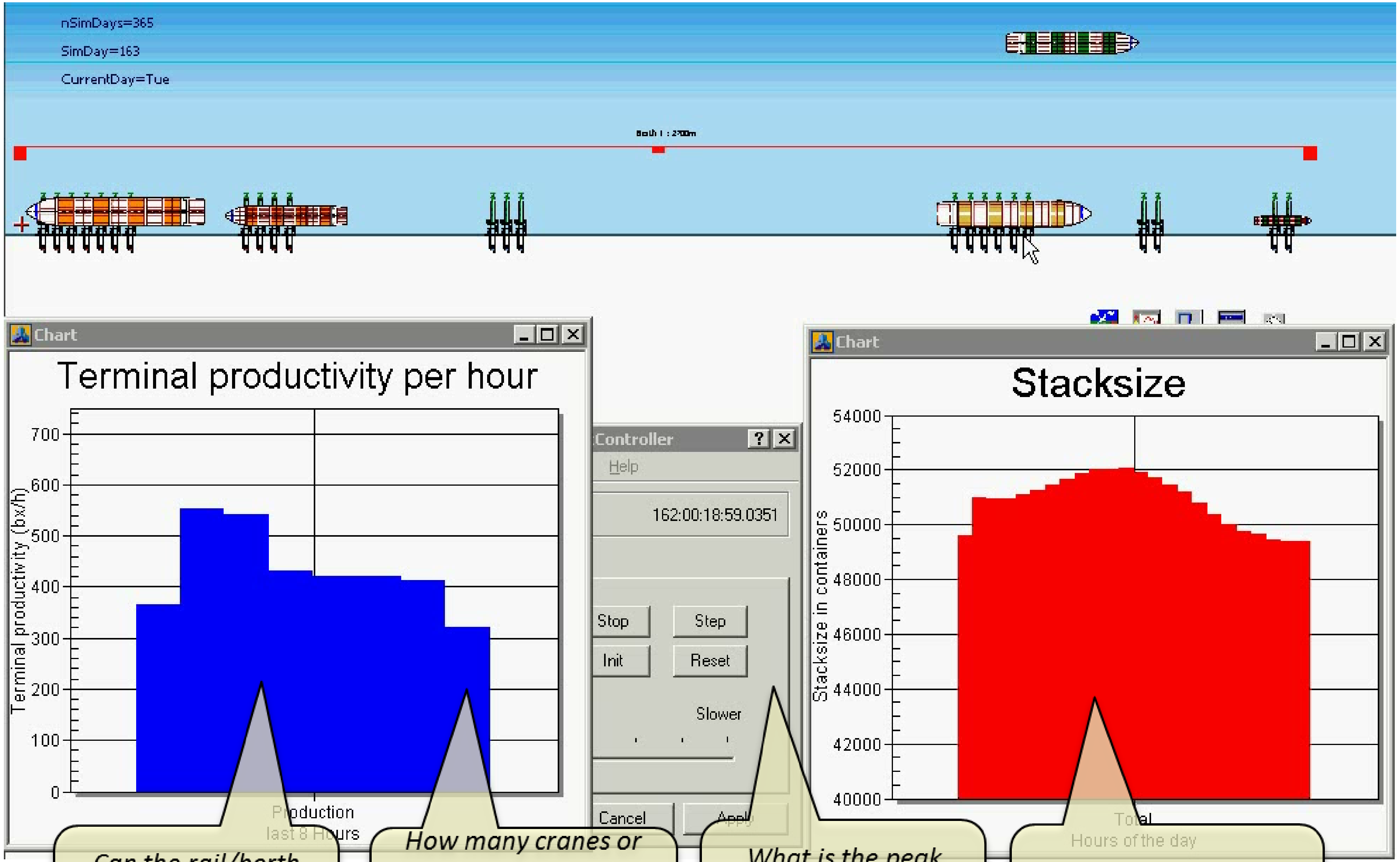




Berth Simulation

Key Inputs & findings

Demonstration of the simulation



Can the rail/berth handle the targeted volume?

How many cranes or tracks are required. What is impact of call size changes

What is the peak handling demand on the yard?

What is the yard inventory over time?

Berth Capacity Evaluation using Dynamic Simulation Methodology & Model Output

- TBA used a dynamic berth simulation model to evaluate berth capacity. This gives a more accurate assessment of berth capacity and shipping service outcome than using industry benchmarks/thumb rules.

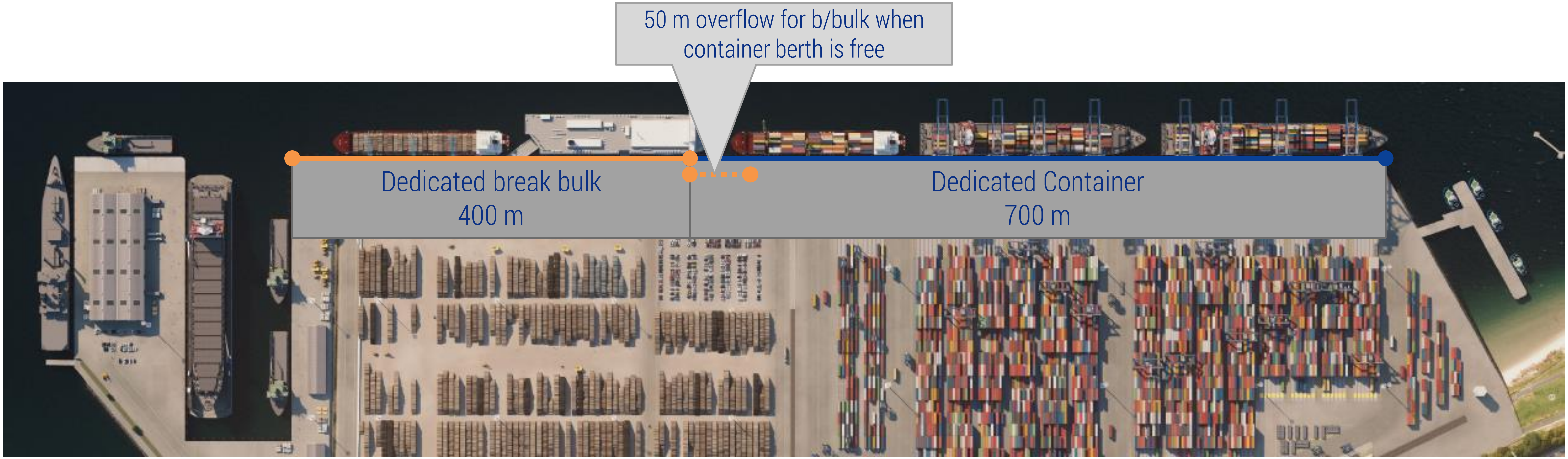
- How the simulation model works ?
  - Simulation model runs for full 12 months period under various test conditions;
  - Test conditions include anticipated weekly vessel arrival pattern, draft constraints, arrivals delays & crane productivities;
  - Model allocates berths and cranes to arriving vessel;
  - Priority of vessels, maximum crane allocations, service requirements berth, draft & other restrictions

- The model measures KPIs & berth performance which are used to assess maximum capacity:
  - Berth occupancy;
  - Crane utilization;
  - Vessel waiting times for berth;
  - Vessel turn around times;
  - Berth productivity.

Quay division

- The quay will be used for different cargo types.

- The following division were investigated :
  - 700 m for container operations
  - 400 m for Break bulk operations + 50 m overflow when container berth is free



TBA Simplifying your operation

Proposed vessel classes

- For the future the expectation is that the container vessel sizes are going to increase.
- Based on the regional trends there have been 8 vessel classes defined with a maximum length of 370 meter.
- The call sizes can go up to 3000 boxes on average.

Vessel type	Vessel length (m)	Mooring margin (m)	Draft (m)	Call size (box)	Call size variation	Call size (TEU)	Capacity (TEU)	Call size (%)
FD1	150	10	7.0	500	0.20	825	850	97%
MS1	190	10	8.0	500	0.20	825	1,100	75%
MS2	220	10	10.0	1000	0.20	1650	2,500	66%
MS3	240	15	12.0	1200	0.20	1980	3,500	57%
MS4	270	15	12.0	1600	0.20	2640	4,200	63%
MS5	300	15	12.0	2000	0.20	3300	5,000	66%
LS1	330	15	14.0	2400	0.20	3960	9,000	44%
LS2	370	15	14.0	3000	0.20	4950	14,000	35%

Vessel combinations

- With a container quay length of 700 meter, not all combinations of 2 vessels will fit. Below an overview is shown of the combinations that are possible.

- Vessel combinations possible
  - 270 m + 366m (ultra large + small sized)
  - 300m + 330m

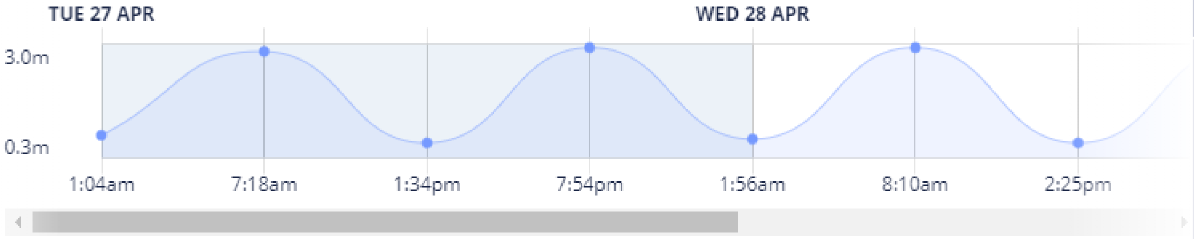
- Vessel combinations not possible
  - 330 m + 330m (2 large size)
  - 366 m + 300m (ultra large & mid do not fit)

Vessel combinations allowed										
Vessel type	Mooring margin (m)	Vessel length (m)	150	190	220	240	270	300	330	366
FD1	10	150	340	380	410	440	470	500	530	566
MS1	10	190	380	420	450	480	510	540	570	606
MS2	10	220	410	450	480	510	540	570	600	636
MS3	15	240	440	480	510	540	570	600	630	666
MS4	15	270	470	510	540	570	600	630	660	696
MS5	15	300	500	540	570	600	630	660	690	726
LS1	15	330	530	570	600	630	660	690	720	756
LS2	15	366	566	606	636	666	696	726	756	792

Port entry & departure restrictions

- At Northport there are 2 high tides & 2 low tides a day.
- The operating rules are shown at the right.

Marsden Point 3 Day Tides



Rule	Displacement	Draft	LOA	Tidal Limit	Wind Limit
1	< 45000 T	< 11.8m	< 235m	Berth and depart any time	30 kts normal 25 kts high sided*
2	>45000 T	11.8 – 12.9m	200 – 235m	Berth on Ebb Tide only 1 hr before HW to 1hr before LW. DUKC restricted >11.8 m draft. Depart Slack water or flood tide only.	30 kts normal 25 kts high sided*
3	>45000 T	< 12m	235 – 300m	Berth slack water ± 1hr DUKC restricted >11.8 m draft. Depart slack water or flood tide only	20 kts high sided
4	>45000 T	< 12m	300m +	Berth slack water HW DUKC restricted>11.8 m draft. Depart HW-1 hr to HW.	15 kts high sided
5	All ships	>13m	200 – 235m	Berth and depart 1 hr before HW only. DUKC restricted >11.8 m draft	25kts normal
6	All Ships	>12m	235m - 300m	Berth and depart Slack water HW only. DUKC restricted >11.8 m draft	20 kts high sided
7	All Ships	>12m	300m +	Berth and depart Slack water HW only. DUKC restricted>11.8 m draft	15 kts high sided

* High sided ships include containerships, car carriers, cruise ships and woodchip ships

Tidal sailing windows

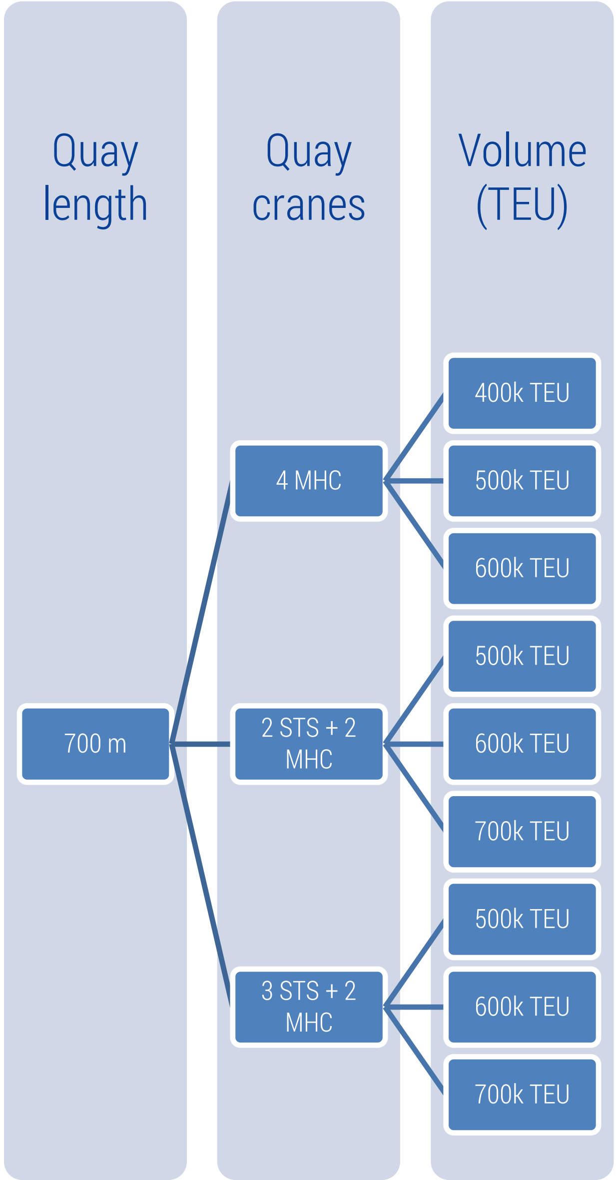
- Tide is applied in berth simulation model based on the 2 high & 2 low tides a day.
- To simplify the pattern a bit the tidal day is rounded to a cycle of 25 hours.
- The entry and departure windows durations per day are shown below. The 'Rule' ID refers to the specified rule on the previous slide.

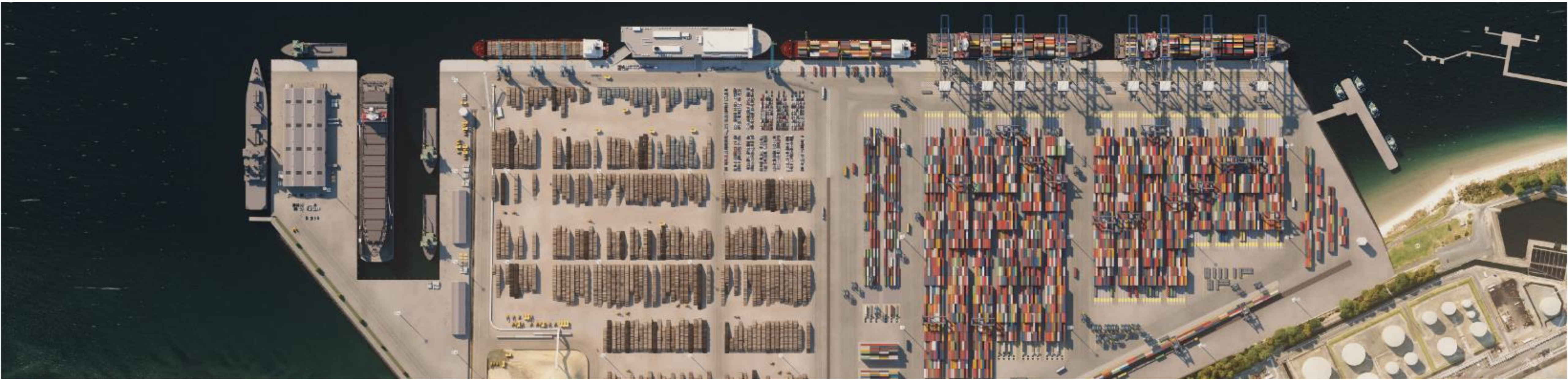
Container vsl type	Length	~ Draft	TEU	~ Displacement	Rule	Entry hours / cycle	Departure hours/cycle
FD1	150	7	850	12,000	1	25 hours	25 hours
MS1	190	8	1100	15,000	1	25 hours	25 hours
MS2	220	10	2500	34,000	1	25 hours	25 hours
MS3	240	12	3500	47,000	3	8 hours (2+2+2+2)	16 hours (2+6+2+6)
MS4	270	12	4200	55,000	3	8 hours (2+2+2+2)	16 hours (2+6+2+6)
MS5	300	12	5000	64,000	3	8 hours (2+2+2+2)	16 hours (2+6+2+6)
LS1	330	14	9000	107,000	7	4 hours (2+2)	4 hours (2+2)
LS2	366	14	14000	154,000	7	4 hours (2+2)	4 hours (2+2)

~ approximate

Simulation Experiment overview

- The experiments that are shown at the right were conducted.
- For the base case a quay of 700 m was investigated which will be dedicated for the container vessels.
- There are different number of Mobile Harbour Cranes (MHC) and Ship To Shore cranes (STS) tested. The following configurations was investigated:
  - 4 MHC
  - 2 STS + 2 MHC
  - 3 STS + 2 MHC
    - STS and MHC operated at 25 & 20 mph
- In the simulations the tidal constraints are considered. the influence of wind is, however, not taken into account.
  - (usually shipping lines appreciate impact of wind on port entry & departure and in TBA experience only seldom and in exceptionally circumstances is wind factored in berth simulation)



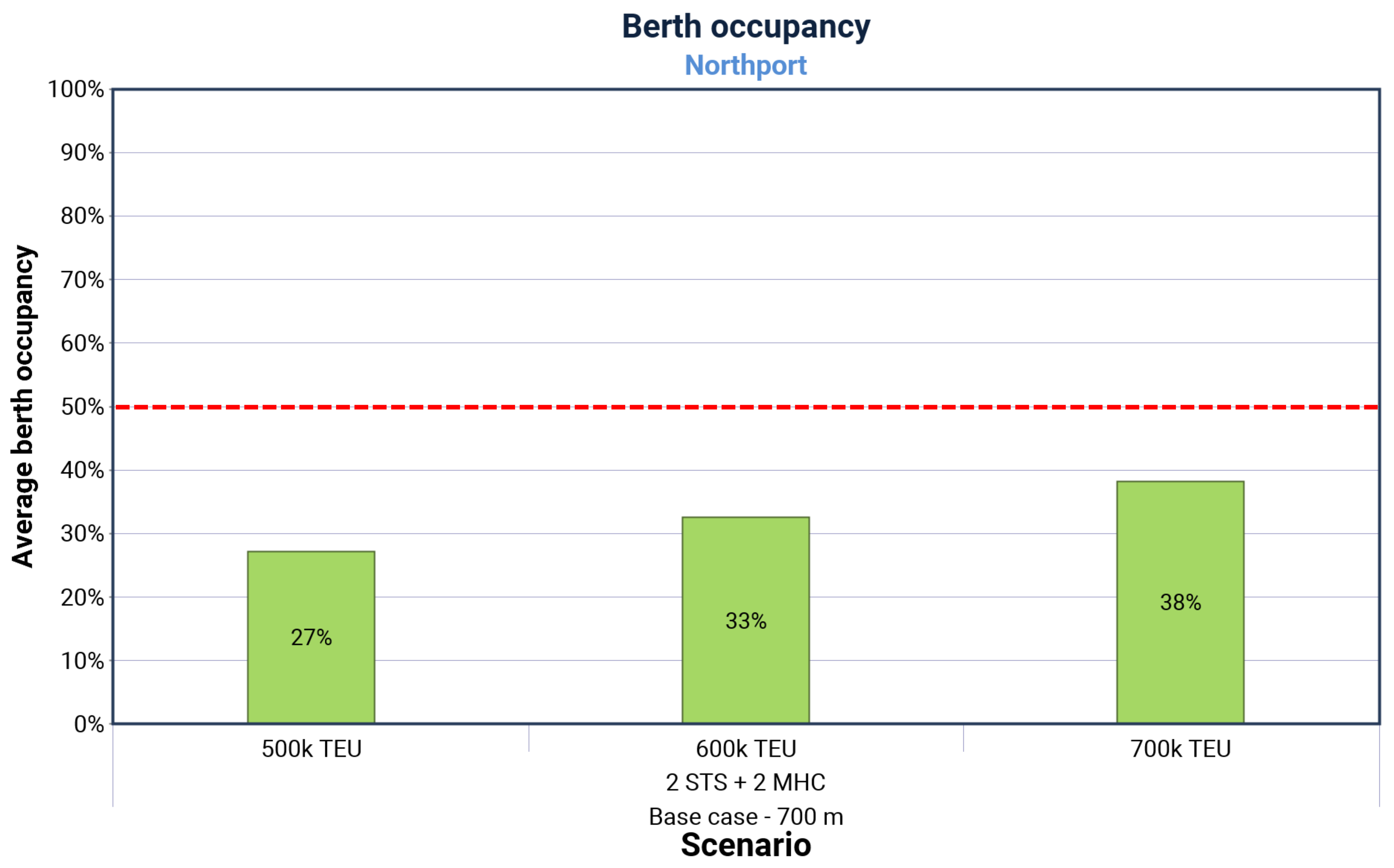


Simulation results for 2 STS + 2 MHC

Only a key simulation run – KPI Results

Conclusions

Berth occupancy

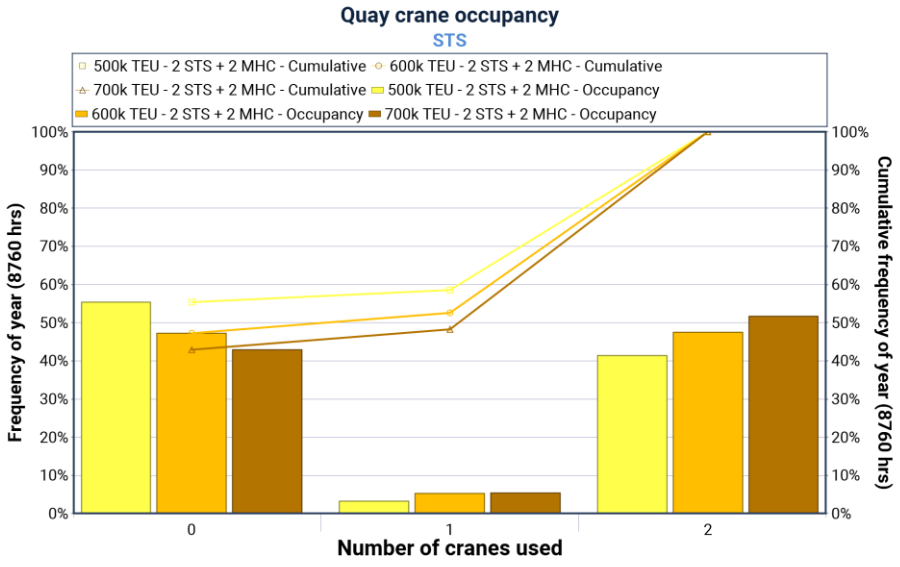


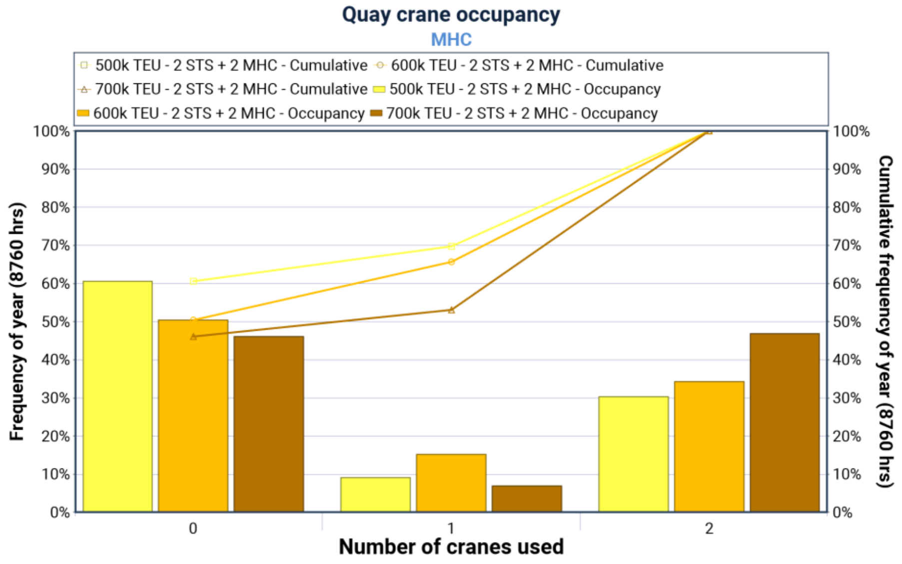
- With a combination of MHC and STS the berth occupancy can be decreased, due to a higher productivity.
- This would result in a better service level.

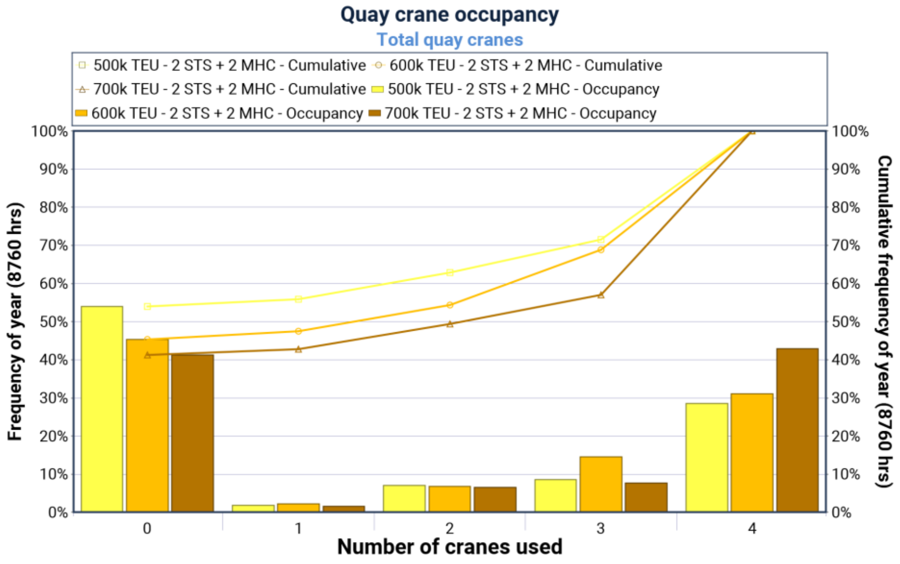
QC utilization

- The simultaneous usage of cranes of the following groups is shown:
  - MHC
  - STS
  - MHC + STS (Total)

- The total usage shows that all 4 quay cranes are used for about 30-40% of the time, which shows that all 4 quay cranes are used often.

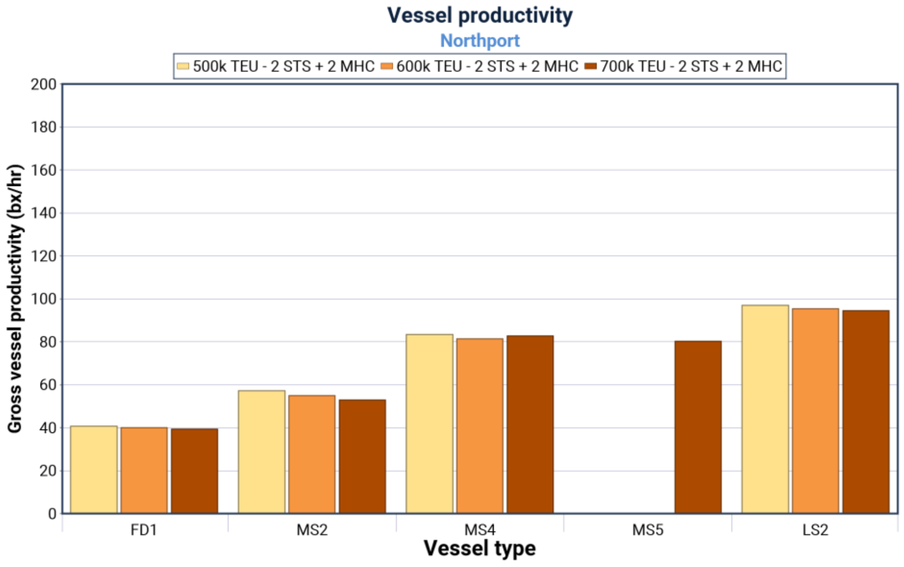


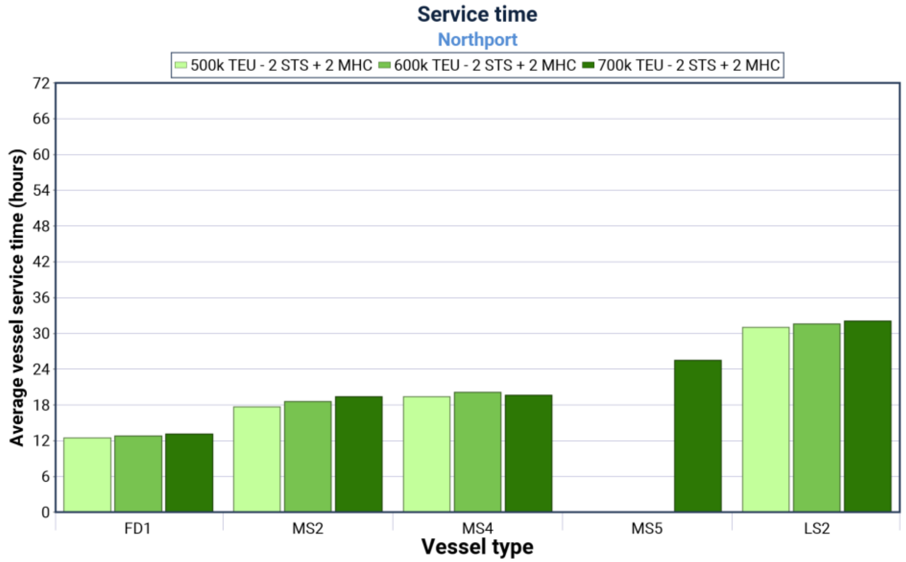


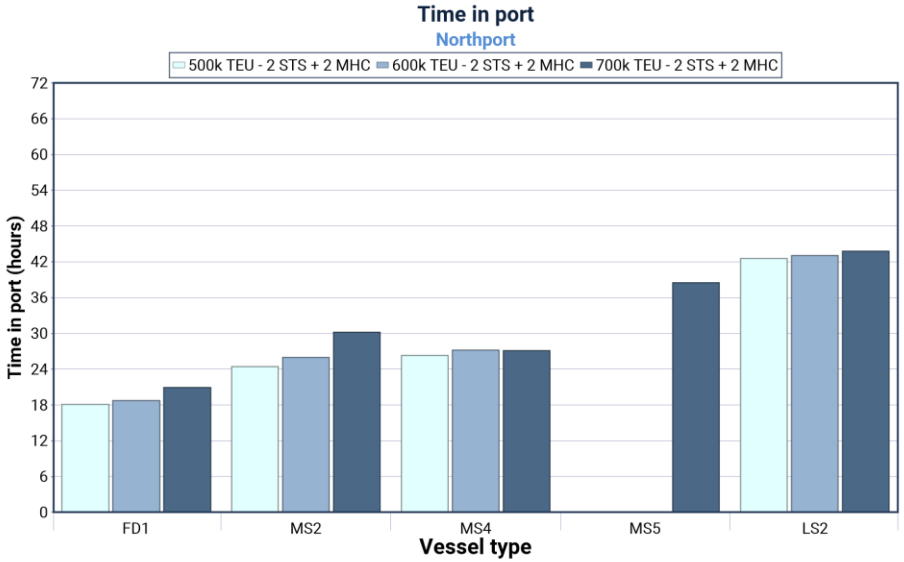


Vessel performance

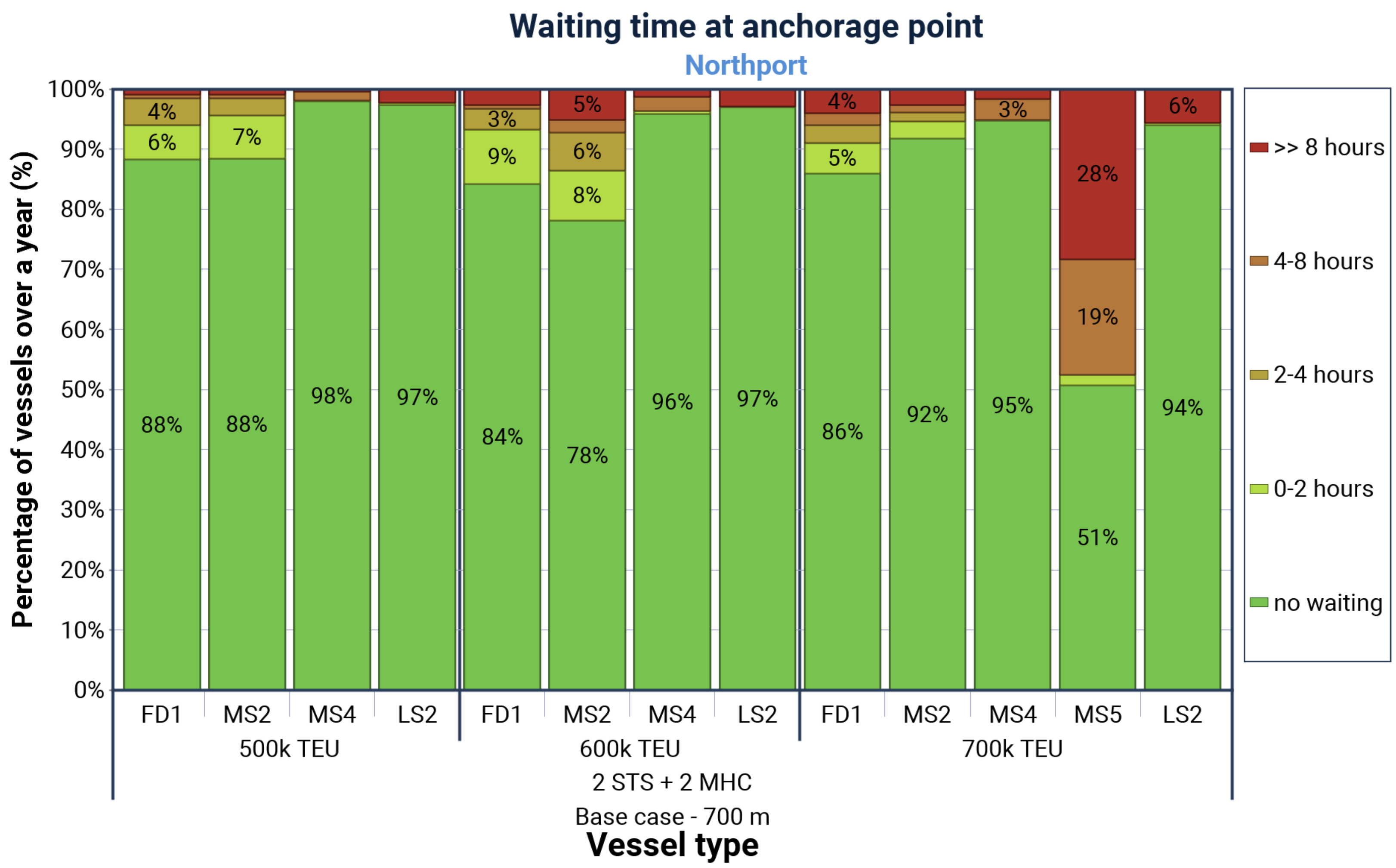
- With a combination of STS and MHC the maximum vessel productivity is increased to about 100 gmph on the large vessels.
- In this case the turnaround times can be reduced to less than 2 days.





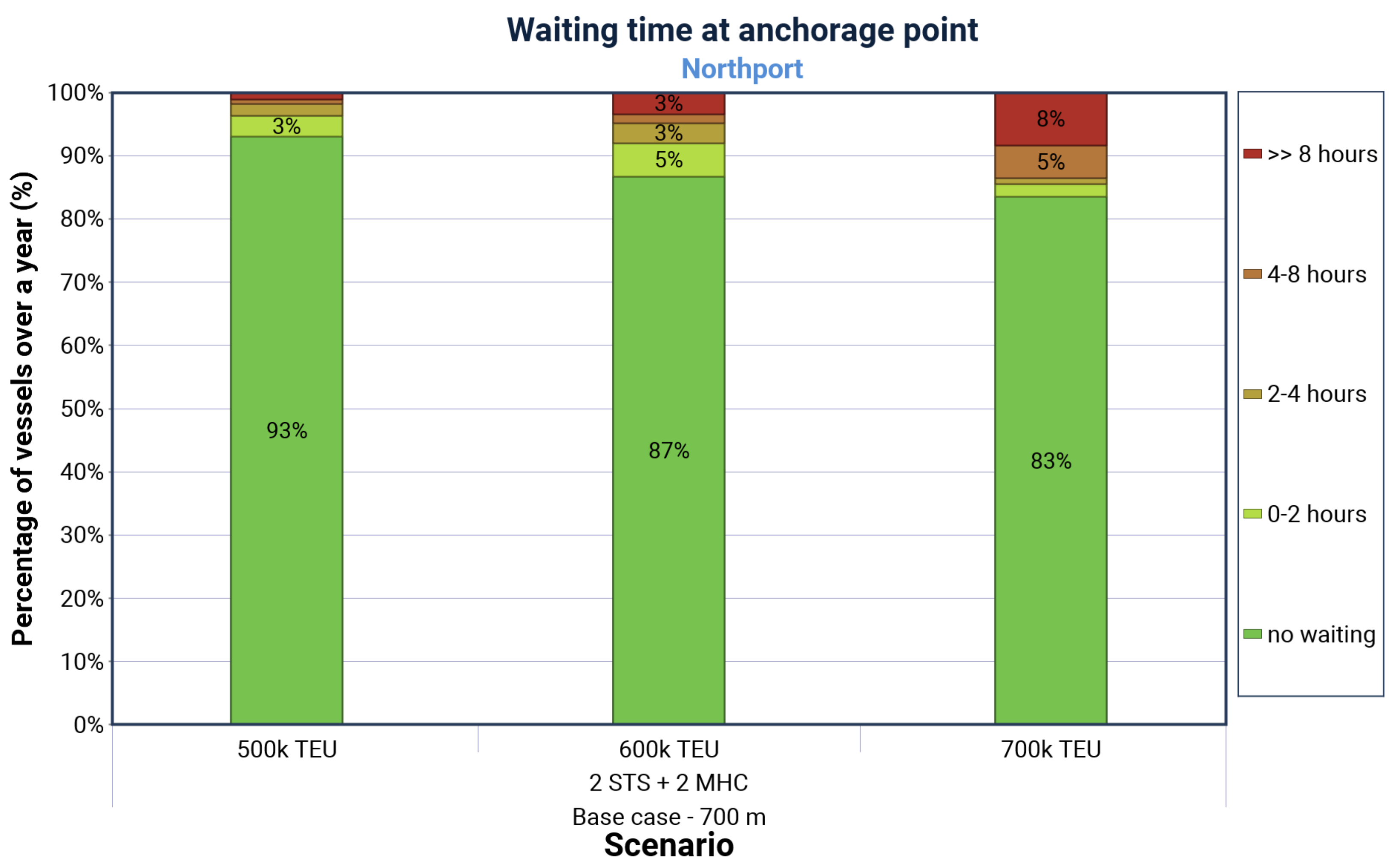


Waiting time at anchorage point



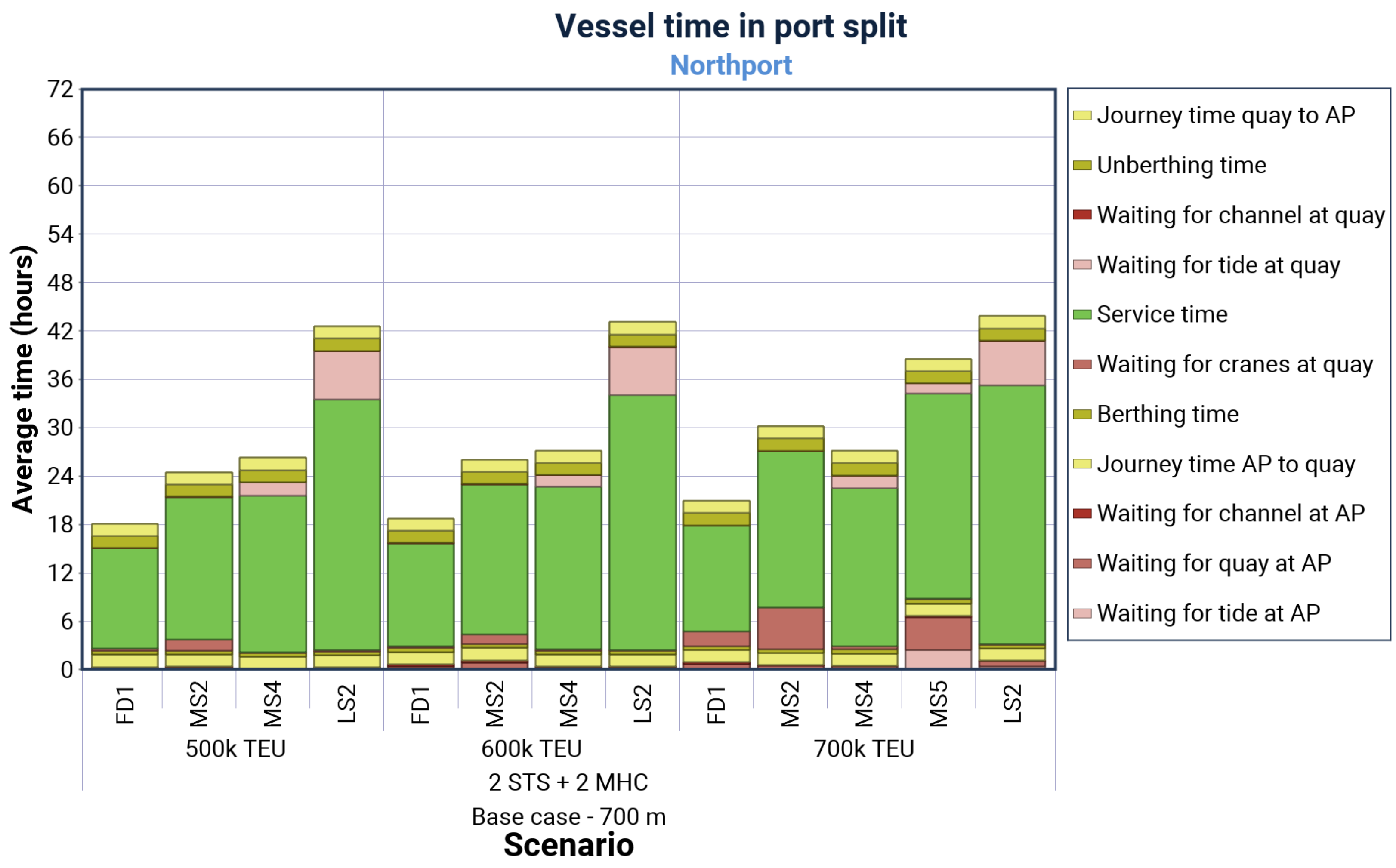
- When the volume increases the waiting times are starting to increase.
- When the volume grows and more services are calling the terminal, the limited length of 700 meter will result in waiting times.
- A volume of 700k TEU shows that the combinations of a Mid size and Large size vessel will result in significant waiting times.

Waiting time at anchorage point



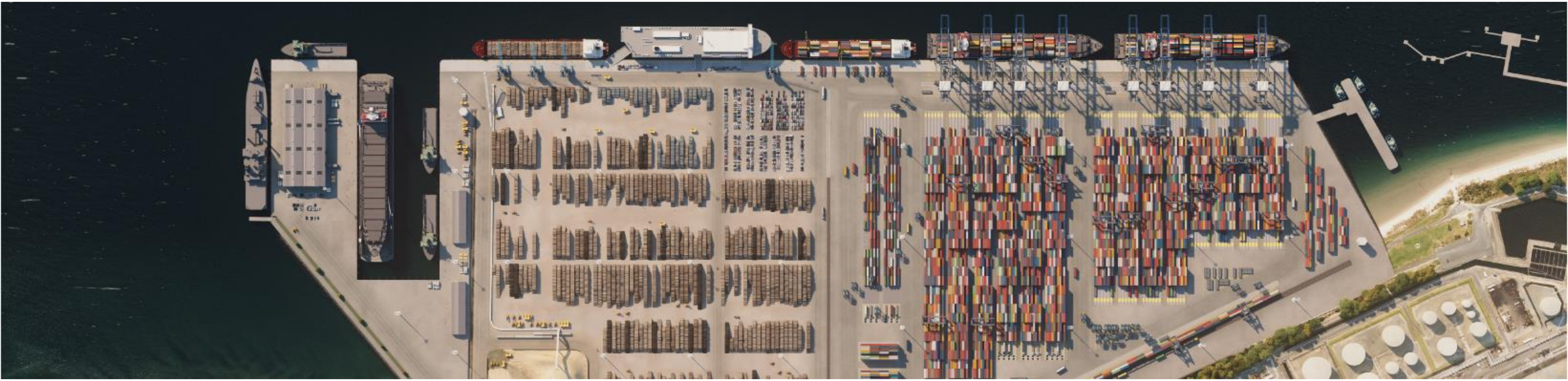
- With a benchmark of maximum 5% of the vessels waiting for more than 8 hours, the capacity for this terminal can be estimated at about 650k TEU with 2 STS and 2 MHC.
- However, the capacity will also be influenced by the tidal and wind restrictions.

Vessel time in port



- With the use of 2 Ship To Shore cranes the turnaround times for the vessels is reduced 43 hours with 4 MHC it was + 52 hours

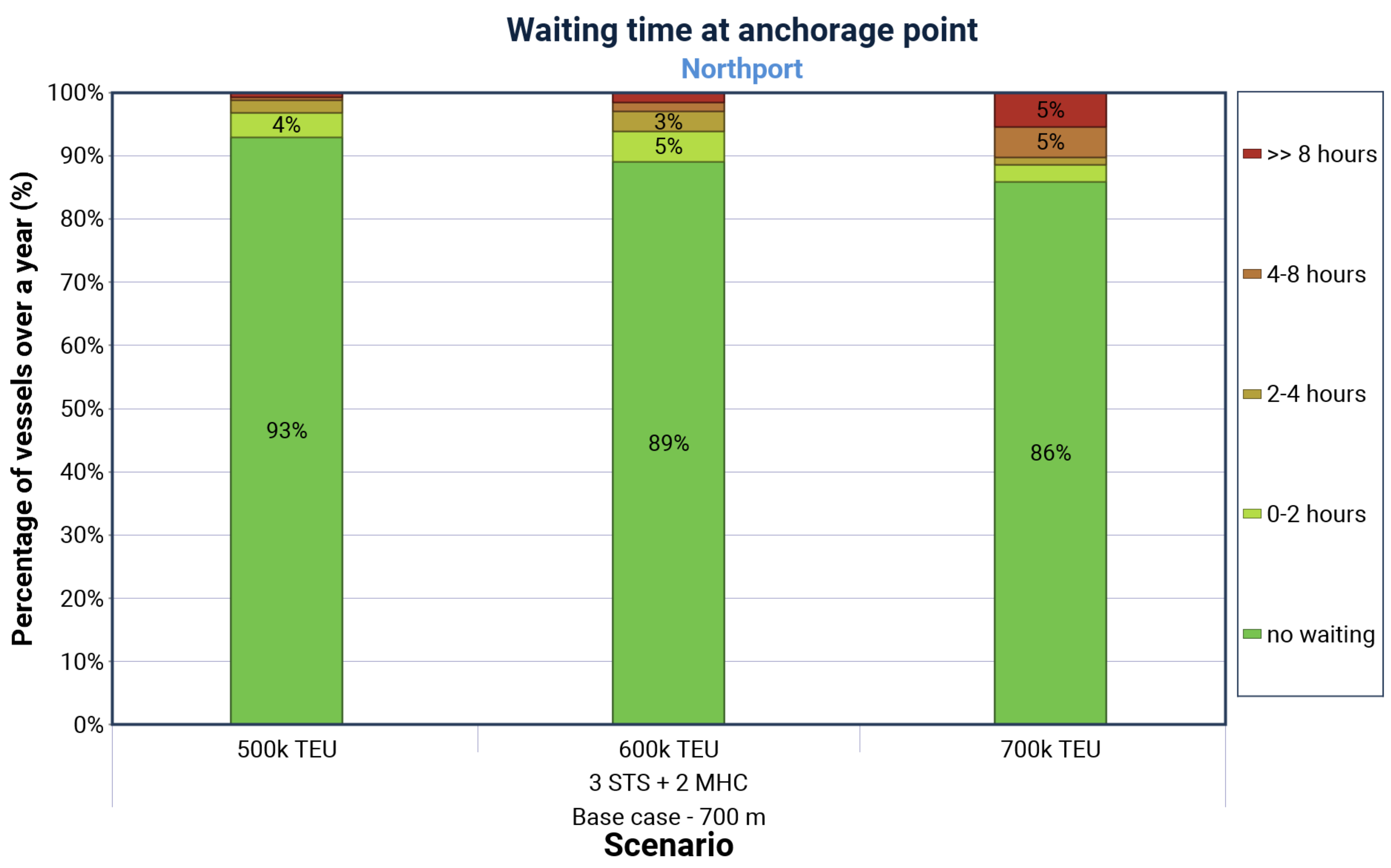
- 2 STS + 2 MHC would give the possibility for the terminal to increase the capacity and create a more competitive service level.



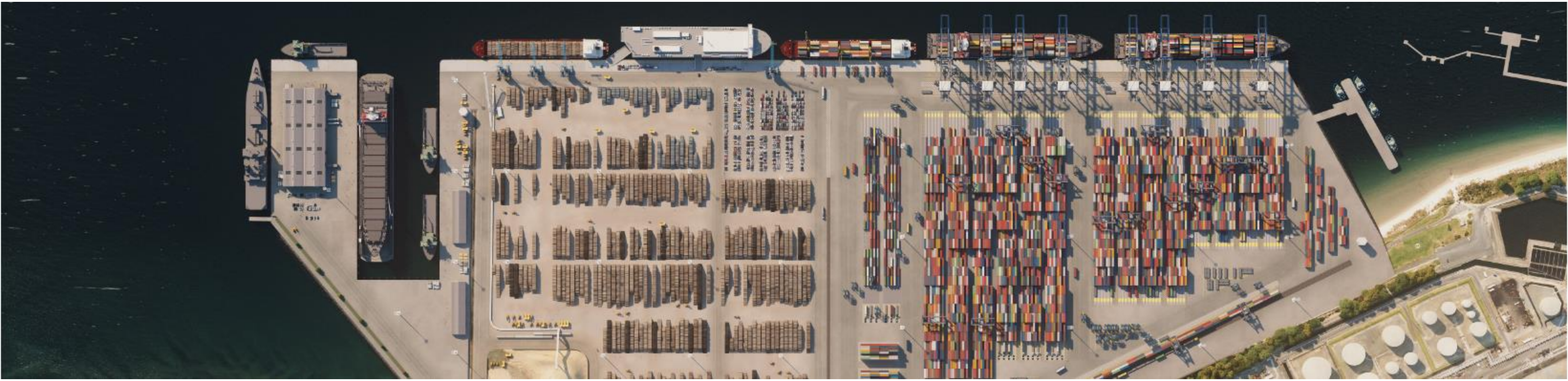
Simulation results

3 STS + 2 MHC

Waiting time at anchorage point



- With a benchmark of maximum 5% of the vessels waiting for more than 8 hours, the capacity can be estimated at 700k TEU for 3 STS and 2 MHC.



Berth Simulation conclusion and recommendations

Preliminary conclusions and recommendations

- The current tidal entry & departure restrictions have been applied; berth capacity of this terminal is influenced by the tidal restrictions #.

- Berth capacity of Northport 700 m quay is estimated as below
  - ~ 550 K with 4 MHC suitable for ~ 300m/2000 exchange (for large vessel port service time is too long)
  - ~ 650,000 TEUS with 2 STS & 2 MHC

Scenario	Quay cranes #	Berth capacity	Comment
Base case 700 m	4 MHC	550k TEU*	Unsuitable/Poor service – LS (+330m)
	2 STS + 2 MHC	650k TEU*	Preferred, best suited among the scenarios
	3 STS + 2 MHC	700k TEU*	Limited gain for + 1 STS

MHC 20 & STS 25 gmph
* Berth capacity subject to high waiting times for tide being accepted to lines (similarly Tauranga has tidal current restrictions)
* Wind is ignored, but as per current restrictions it will make transit during periods of high wind very challenging. With more experience and use f better tugs these restrictions should reduce

** Quay cranes & quay length
Instead of 2 MHC + 2 STS, if 4 STS are deployed maximum berth capacity will be higher. 2 STS + 2 MHC, however, provides an optimal & efficient balance, it aligns with the target, yard space and provides flexibility for Northport to use MHC for other cargoes during the development

Inputs for yard

Overview & for discussion

Container shares

Align with Auckland

- The container shares per flow and container type are shown at the left.
- The future split of container types will be based on the figures of Auckland for the purpose of future planning
  - Larger import share vs export was reviewed, it was decided by the Port to stary with figures for Auckland

Flow	Container type	Auckland 2020	Tauranga 2020	Northport future
T/ship	Full	3.1%	13.6%	3.1%
	Reefer	0.7%	5.1%	0.7%
	Empty	1.2%	2.6%	1.2%
Export	Full	7.5%	26.9%	7.5%
	Reefer	1.1%	11.7%	1.1%
	Empty	11.8%	3.2%	11.8%
Import	Full	48.2%	16.0%	48.2%
	Reefer	4.7%	2.0%	4.7%
	Empty	1.6%	11.3%	1.6%
Domestic	Full	9.5%	2.6%	9.5%
	Reefer	0.6%	0.3%	0.6%
	Empty	10.0%	4.7%	10.0%
Total		**100.0%**	**100.0%**	**100.0%**

Dwell time

Simplifying your operation

Auckland

- Full Import/export - 3-4 days
- Transhipment 4-5 days
- Empty 10

Tauranga

- Full import 2-2.5 (+ rail)
- Full export 4-5
- Transhipment 4-5 days

Northport –dwell time

- Import/export 4 days
- Import/export 7 days (good service level due to service Auckland hinterland
- Transhipment 4.5 days
- Empty 14 days

Northport 7 days dwell is considered most suitable/competitive. Additionally, in future, more port centric supply chain and shift to r more reliable logistics model is expected

Yard options & layouts

Most suitable options

Yard capacity & cost comparison

Considered yard handling alternatives

RS & Terminal trucks

RTG (manual-Rubber Tired Gantry Crane) + TT

ASC (Automated Stacking Crane) + de coupled TT*

A-RTG (automated-Rubber Tired Gantry Crane) + TT

TBA®
Simplifying your operation

Not considered alternatives

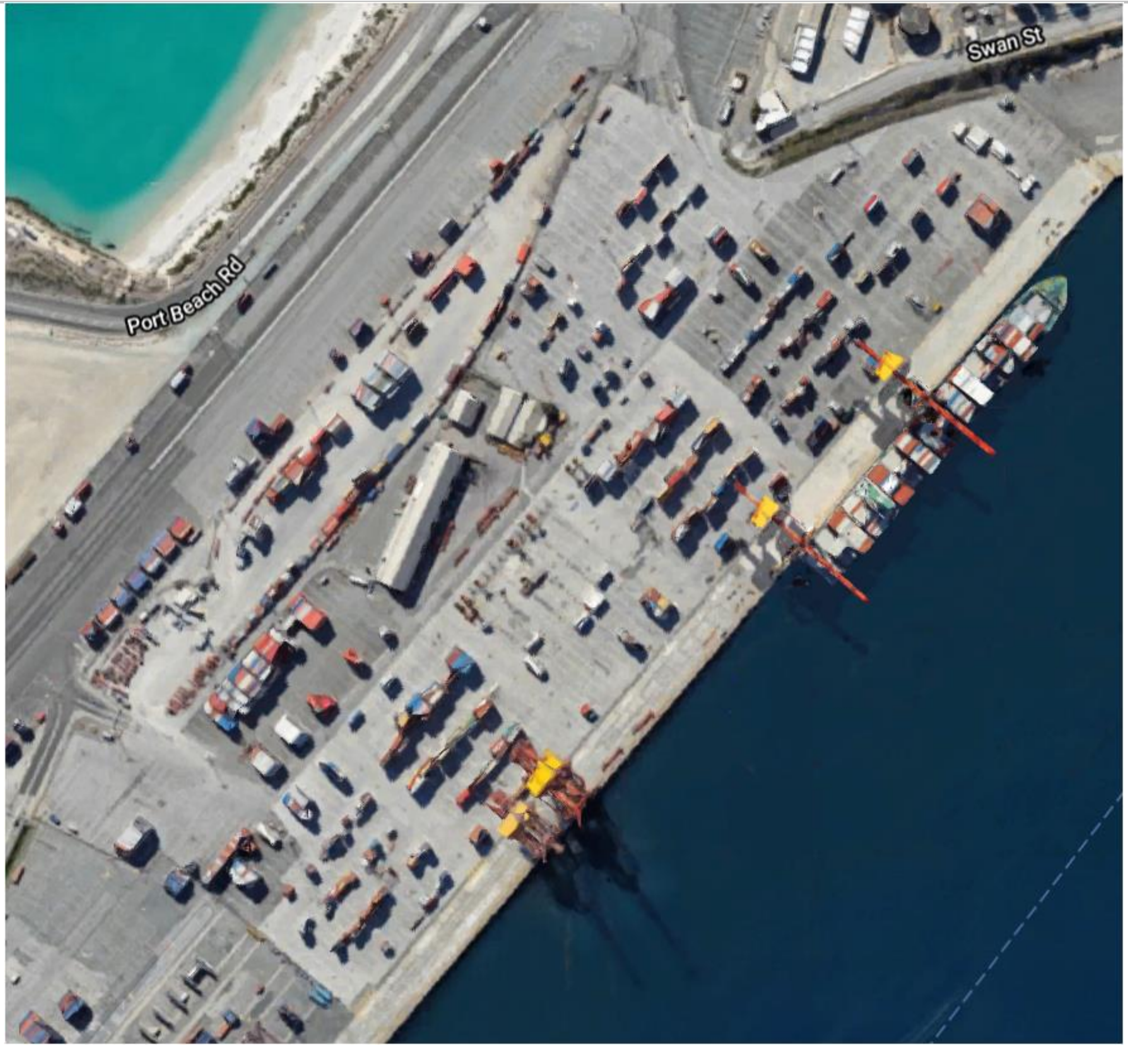
C-RMG (Cantilever-Rail Mounted Gantry Crane) + TT

- Mostly used for transshipment terminals
- high density
- Ability to segregate internal truck & external truck handling sides with dual canti-lever
- High lumpy capex
- It was agreed to disregard this due to lumpy CAPEX

Straddle or Auto Straddle

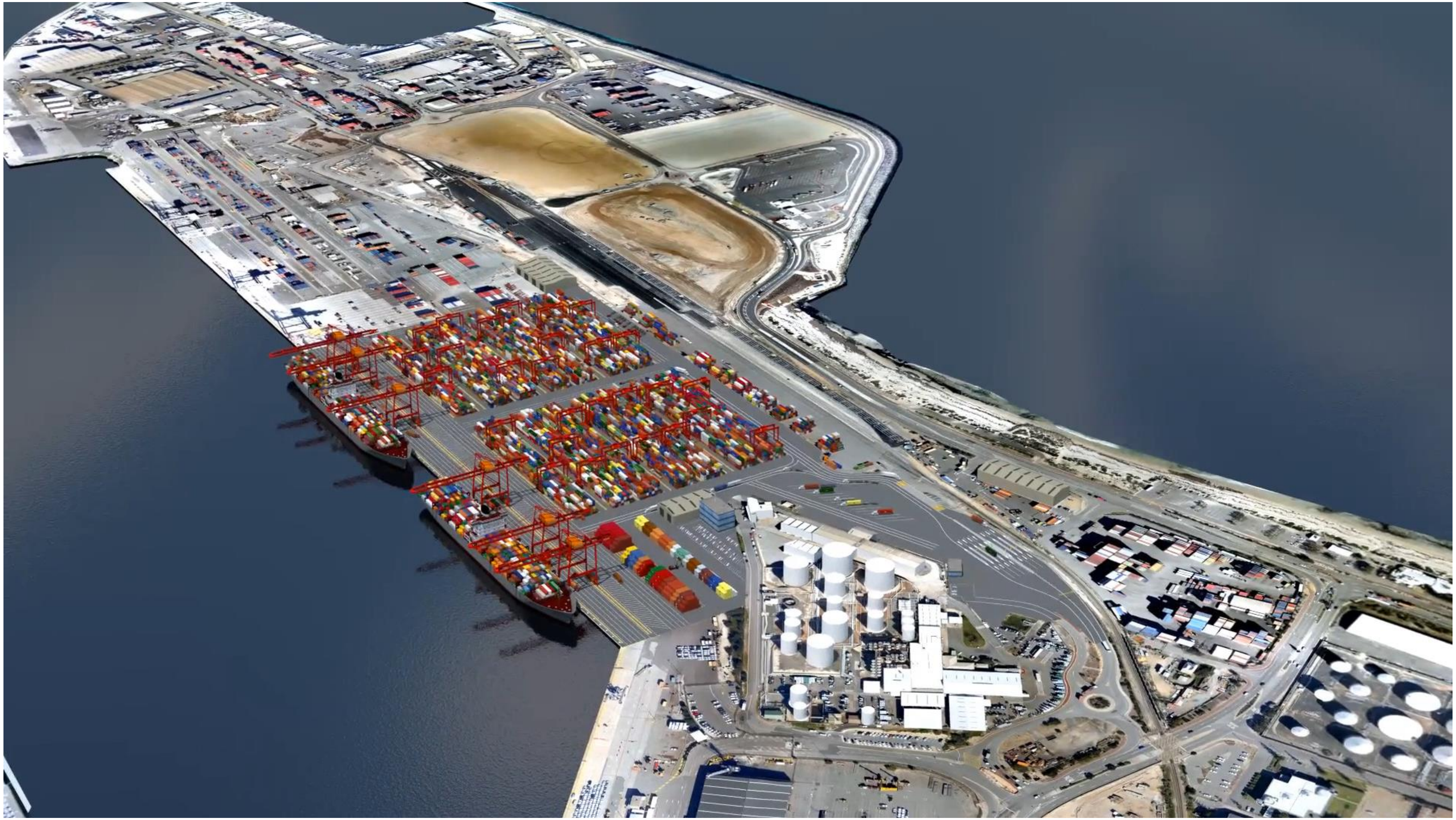
- Low density
- Well suited for progressively increasing volumes by adding SC
- Option for automation
- SC 1 over 3 options
- SC, however do not work well with MHC

Fremantle layout as reference
RS to RTG

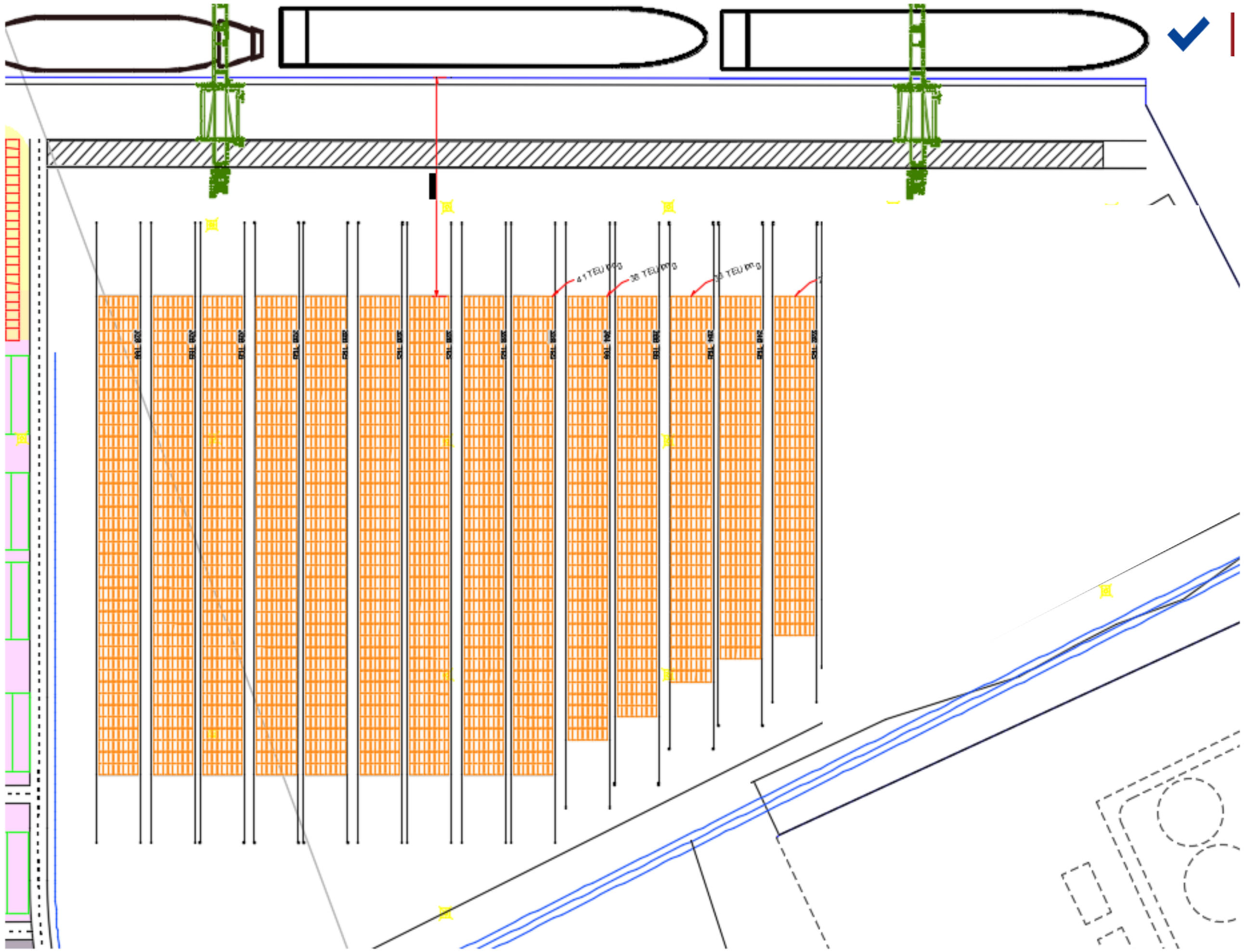


- Longitudinal layout
- Import stacks are 3-4 deep, export & empty stacks 5-6 deeper

RTG movie



ASC perpendicular



- High level ASC layout provided enough storage for 650K
  - Number of blocks required 10 – discussed later

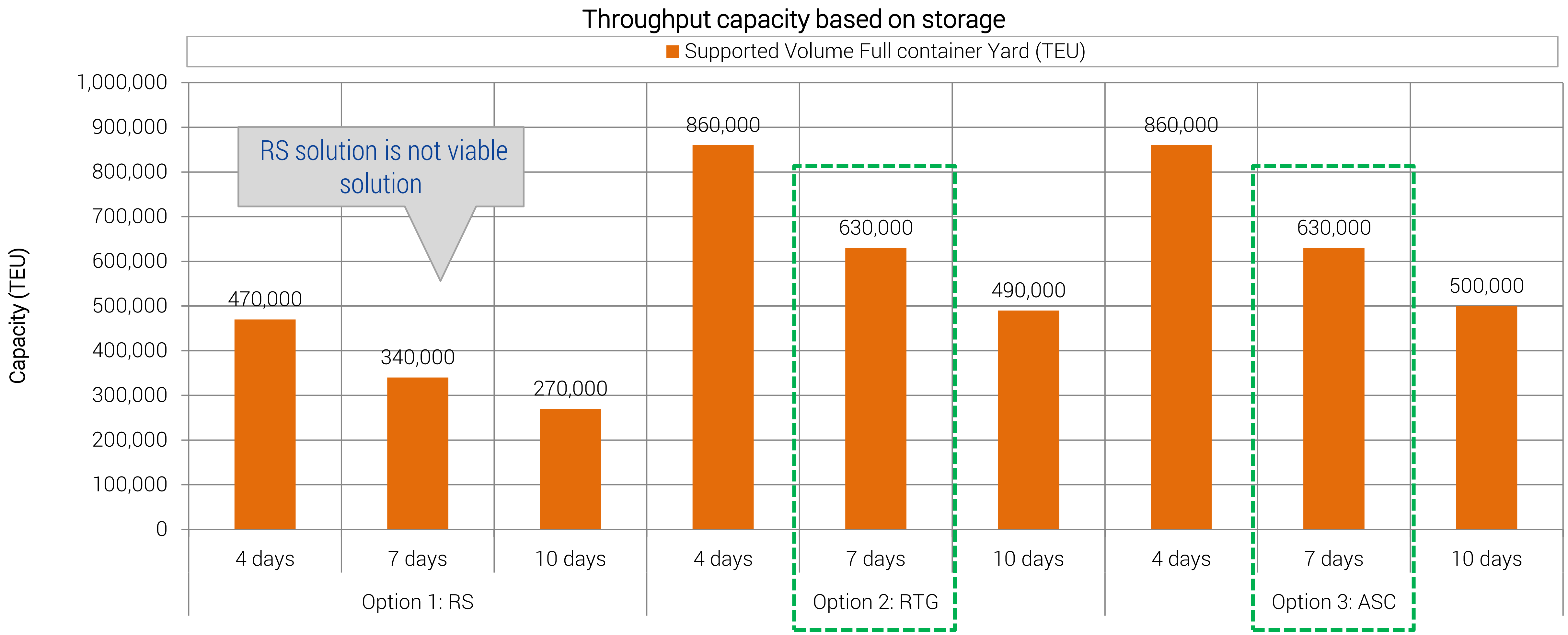
ASC perpendicular

CRMG solution – not considered
High lumpy CAPEX, but high density

✔ | CRMG solution

- High density
- Usually deployed for transshipment terminals
- Main drawback for Northport is that it has the highest CAPEX & capital cost is lumpy. Northport being a low volume port CRMG was disregarded

Storage Capacity



TBA_Cost_Model_Rev1.30_Northport v2.xlsm

- Storage capacity with Impex/Export dwell time of 4, 7 & 10 days is shown. Transhipment & empty dwell time 4.5 & 14 days respectively
- Yard peak level at 25%

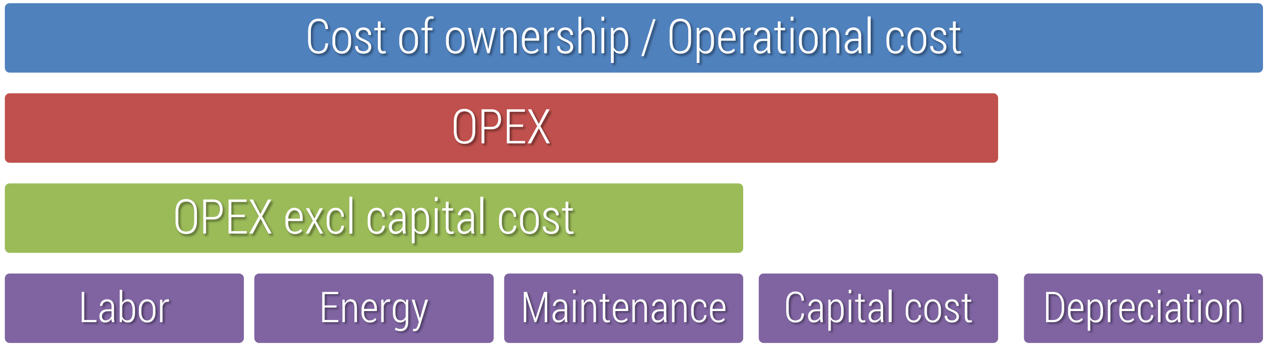
Cost Analysis

Selected yard options

Cost analysis approach (2/2)

Type of cost comparison calculations shown:

- CAPEX versus OPEX:
  - CAPEX costs include key equipment (quay cranes, yard equipment – RTG / C-RMG / ASC / Empty handlers, horizontal transport equipment – Terminal trucks), and infrastructure of pavement and stack support infrastructure (E-RTG beams; RMG rail for ASC and C-RMG option)
  - Direct OPEX costs - labor costs, maintenance and energy costs for key equipment operation;
  - OPEX with capital cost and costs split in depreciation (equipment / lifetime)



  - All the results are expressed in NZD.

High level cost inputs

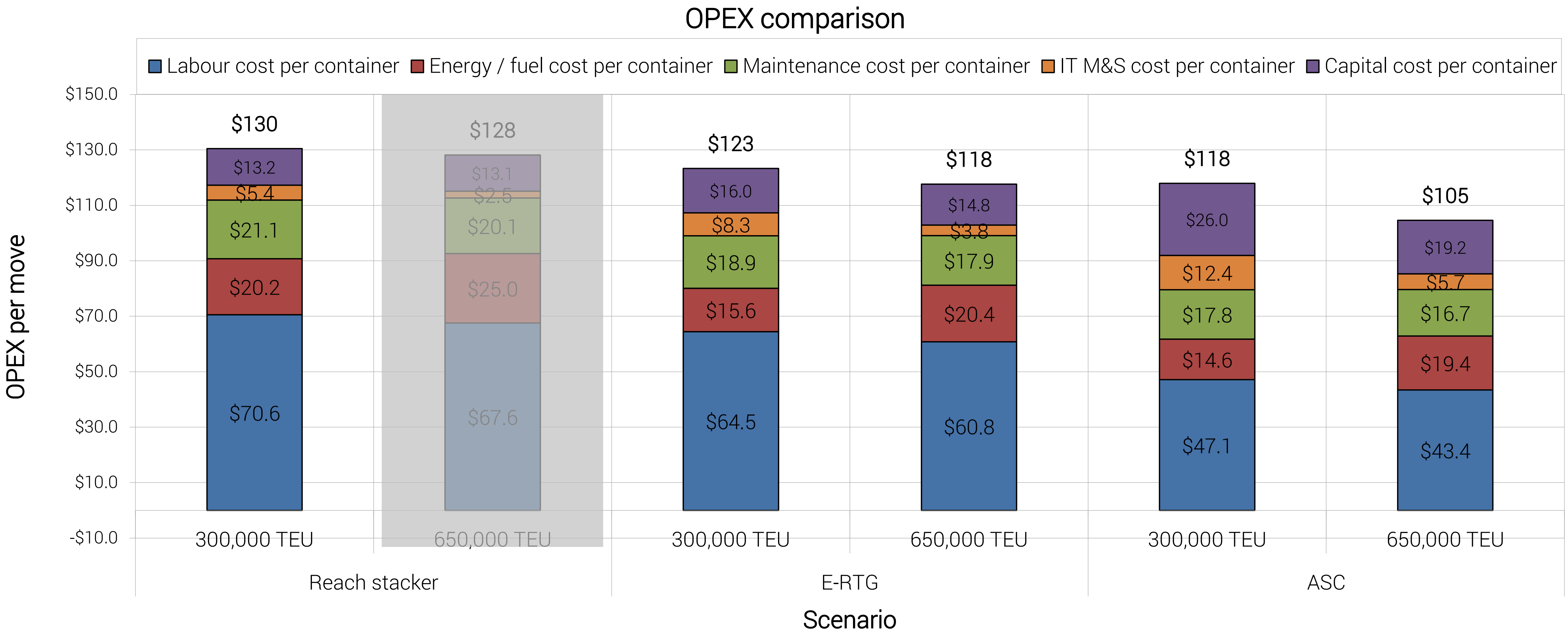
- Fuel cost per liter NZD 1.09
- Energy cost per kWh NZD 0.16
- Labour cost per hour
  - Crane Driver NZD90.0
  - EQU drivers NZD50.0

Equipment	Equipment Price NZD (per unit)	Replacement period (years)	Spare for maintenance
Quay Crane	15,000,000	20	0%
MHC	7,083,333	20	0%
RMG	5,000,000	20	0%
E-RTG	2,916,667	20	15%
Auto-RTG (TT)	3,750,000	20	15%
RS	666,667	10	15%
MT	500,000	10	15%

TYPE OF EQUIPMENT	formula	Cost formula	PRICE
HEAVY DUTY PAVEMENT	m2	NZD / m2	208
ASPHALT LAYER	m2	NZD / m2	125
RMG INTERCHANGE	module	NZD / module	500000
RMG TRACKS	m	NZD / m	3000
L-AGV RACKS	rack	NZD / rack	100000
RTG beams	m	NZD / m	2167
Busbar	m	NZD / m	833

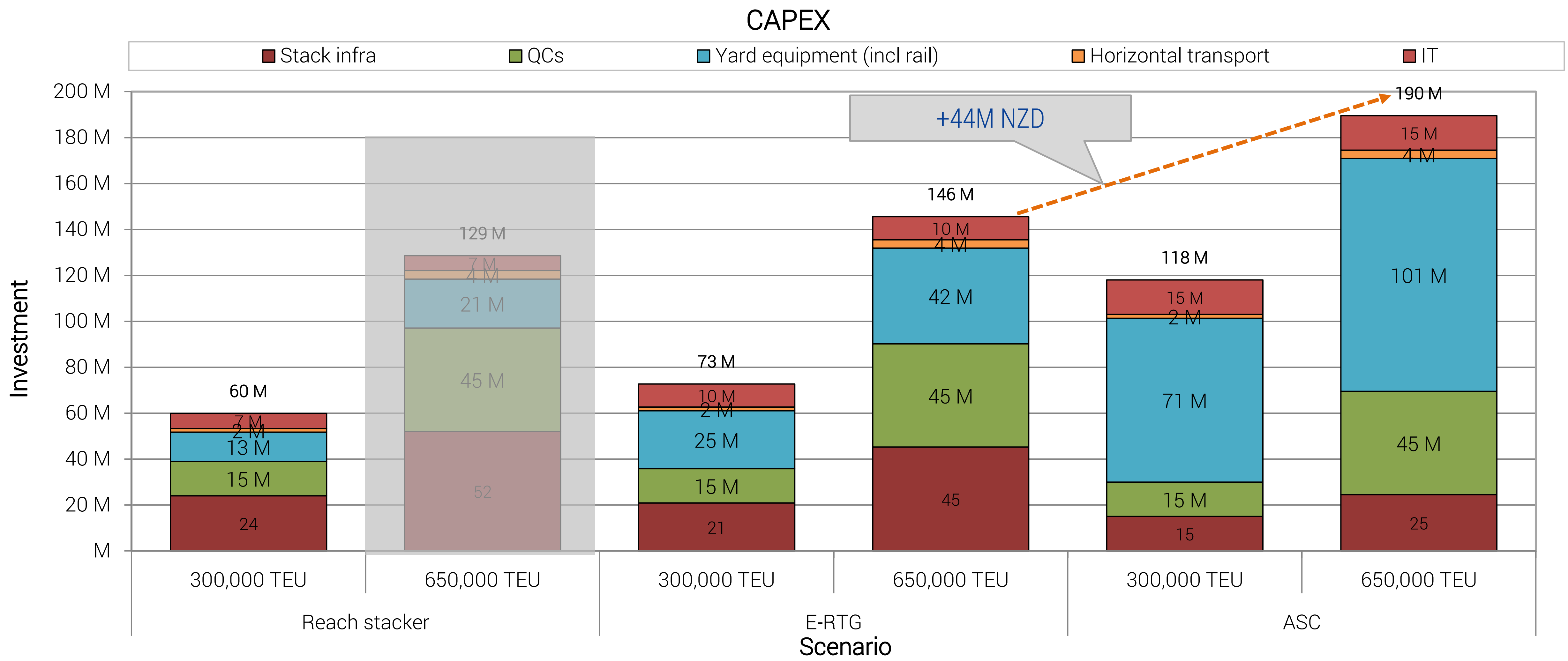
- RTG is upgradable to automated RTG & remote operation

The ASC options offers lower OPEX due to yard automation, however capital costs are high & lumpy due to high CAPEX requirement



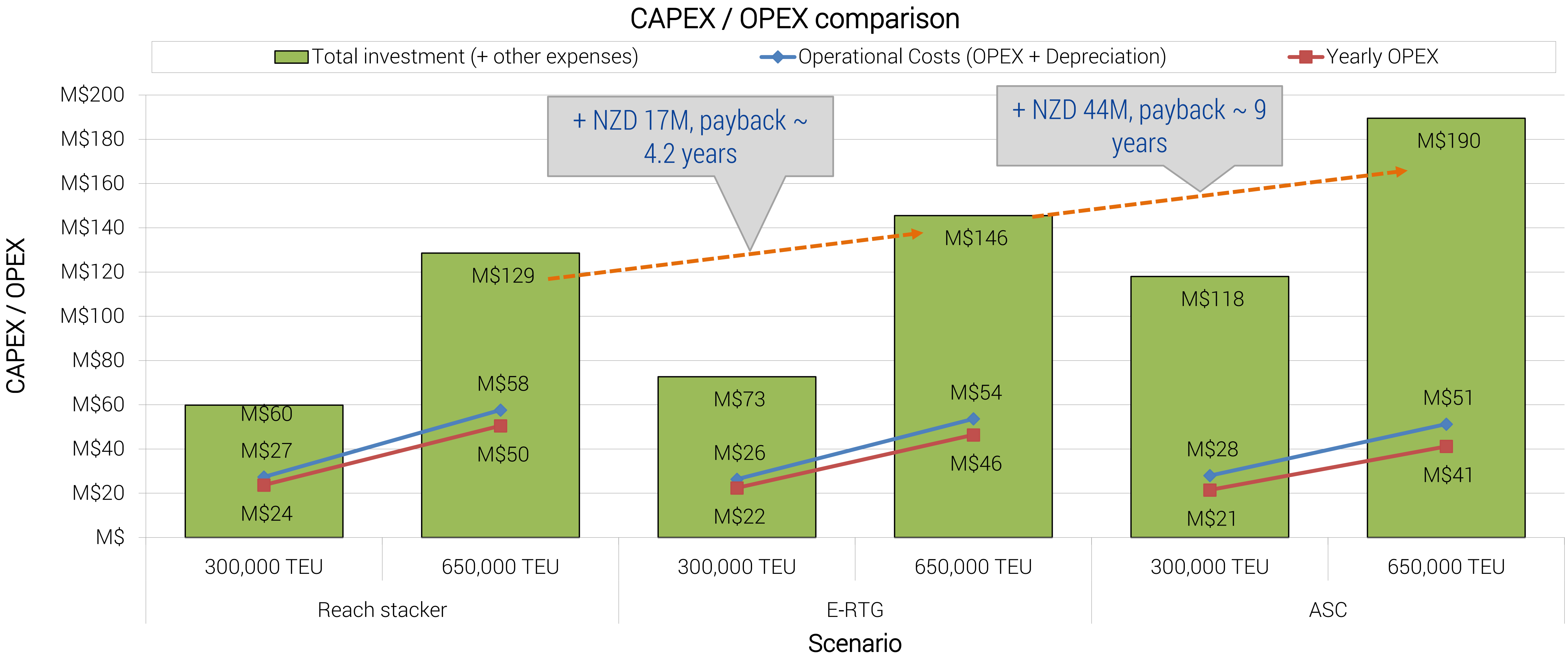
- Reach stacker alone does not work due to storage

CAPEX for ASC is 44M NZD higher than the RTG solution



- ASC are more expensive the RTG. Due to the high amount of landside ASCs required, the overall CAPEX from this solutions is high.
- Stack infra (pavement) for reach stacker is higher than RTG due to heavy duty pavement required for reach stacker operation.
- Note: QCs are assumed to be 2 MHC + 2 STS in the 650,000 TEU scenario. For the 300,000 scenario, 2 MHC are assumed.
- IT cost cover TOS. All costs includes TOS is agnostic without being a system/provider specific,

Payback of RTG is attractive, while the payback for ASC is +9 years



- RTG increases CAPEX by NZD17M, but saves NZD4 M.
- RTGs should be remote supervised and fitted for potential future automation
- RS to RTG transition based on demand is the most suitable option. Yard pavement should however be laid for future RTG option and RTG should be upgradeable to automated RTG in future.

Development trajectory - RS start up to E RTG operation

- E RTG is considered the most suitable yard handling option at the end stage for Northport to support 650,000 TEUs.

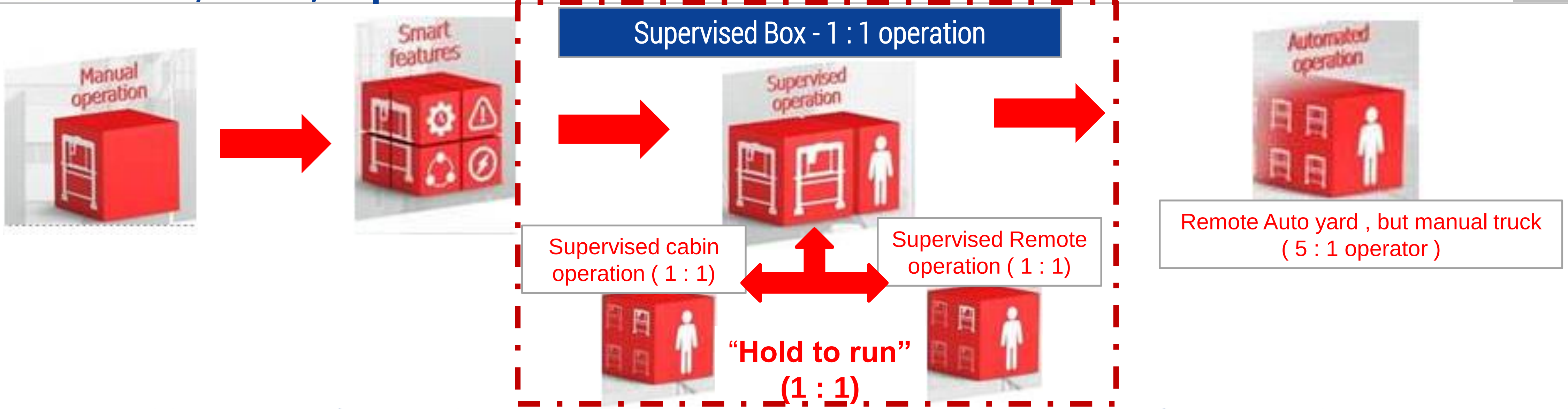
- Various yard handling options incl. : RS + TT, Automatic Stacking Cranes (ASC),E RTG, Straddle carrier & CRMG options were reviewed
  - Straddle Carrier (SC) & CRMG were disregarded as SC do not work well with MHC and SC is a low density option. CRMG is high density, but is high CAPEX, it is not suitable for slow progressive volume growth.

- Reach stacker plus terminal truck, Automatic Stacking Cranes (ASC), E RTG options were assessed in more detail
  - RS Option has the lowest CAPEX, but they can not support the assessed berth volume of 650,000 TEUs. It is a good Step 1
  - ASC option has the lowest OPEX per year, but require + NZD44M CAPEX with unattractive payback of + 9 years Vs RTG
  - RTG provide storage for 650,000 TEUs at 7 days dwell time and have a payback vs RS + TT of only 4.2 years

- RTGs + TT work well with MHC, they are well suited for progressive deployment after starting operation with RS + TT.

- RTG are electric, options for remote controlled, remote supervised and automation options are now available. More advanced RTGs are also 16 wheel which reduces wheel load on the pavement.

RTG development/progression
Manual, Smart, Supervised & Automated



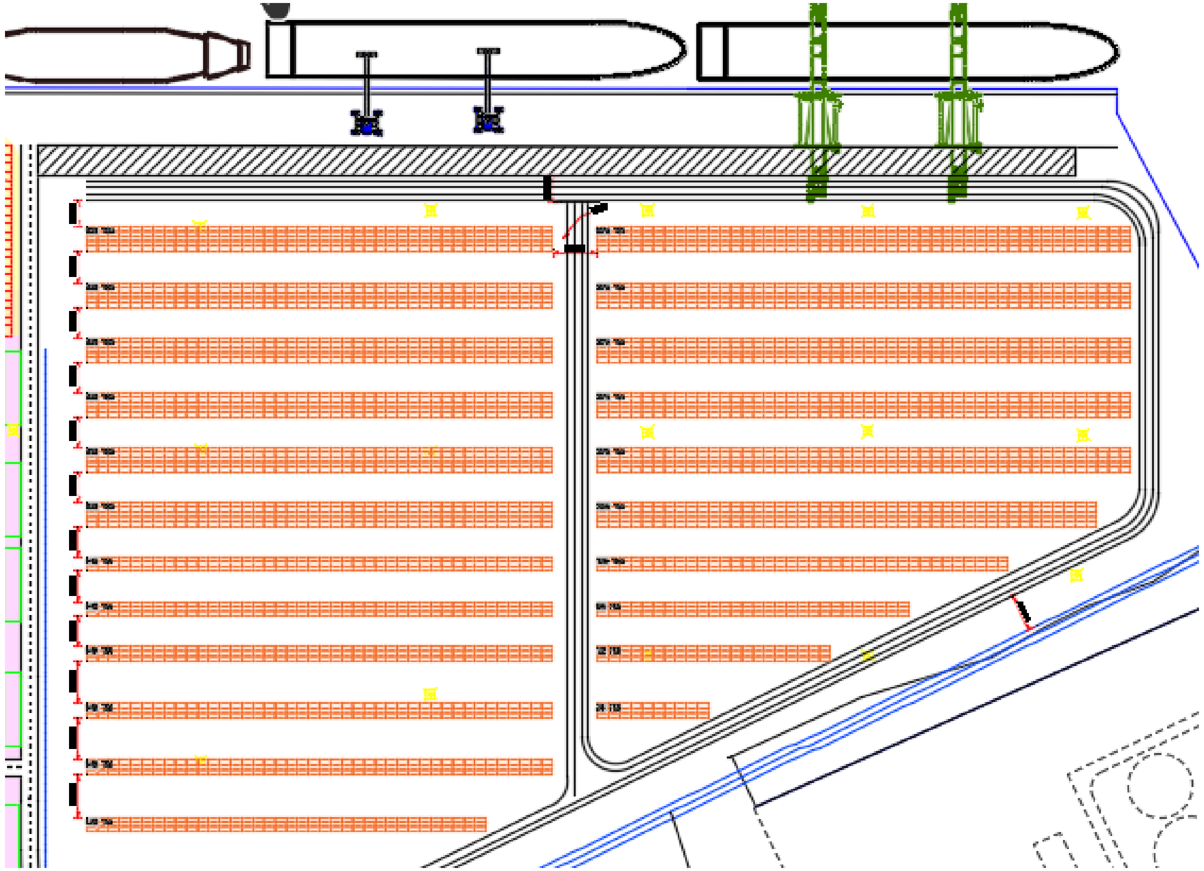
- Manual RTG without smart features is not recommended for fresh start in 2021, smart feature, such as are auto truck positioning, auto steering, auto profiling improve operational efficiency & safety.

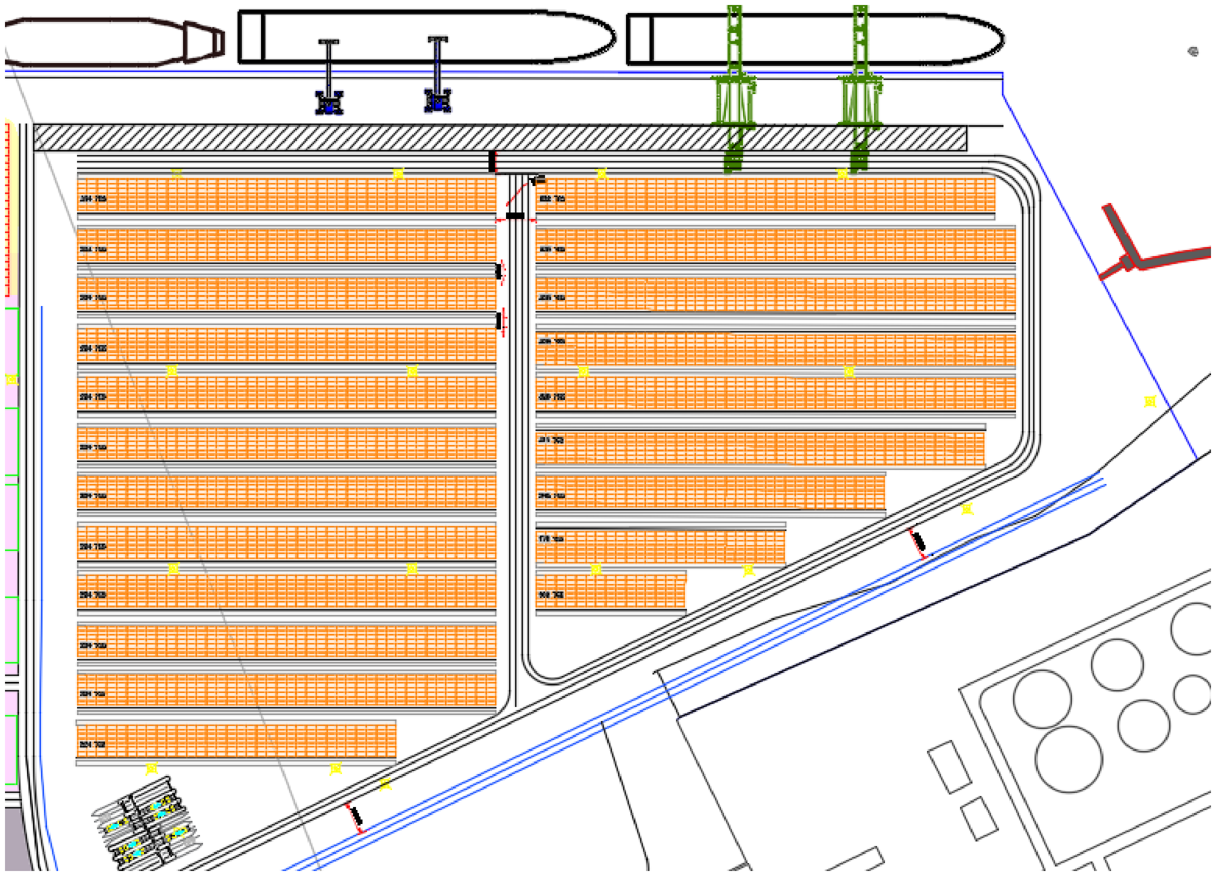
- Next level is supervised operation: the operator is always supervising (1 : 1) from the cabin or from remote screens Operation is "hold-to-run": the operator moves the joystick or pushes a button allowing the crane to move under auto mode.
  - Various levels –gantry "hold to run" with automated trolley or gantry & trolley "hold to run".
  - In supervised operation, the truck gantry lane is without fencing or street boogie as someone is always watching.

- Automated RTG is multiple RTG being controlled by an operator, but truck handling is manual.
  - + 70 A-RTG are operating globally

Preferred yard layout & development trajectory

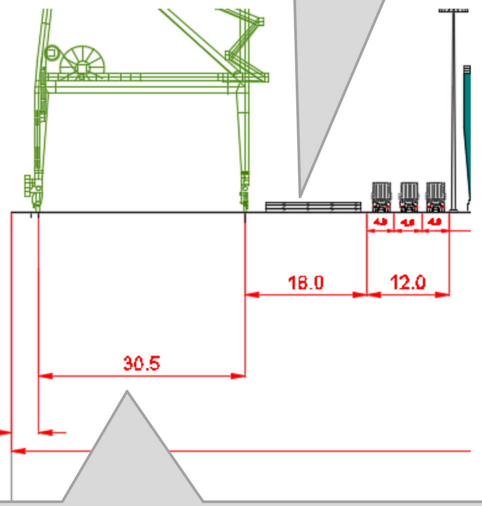
High level layouts
RS & RTG/A RTG



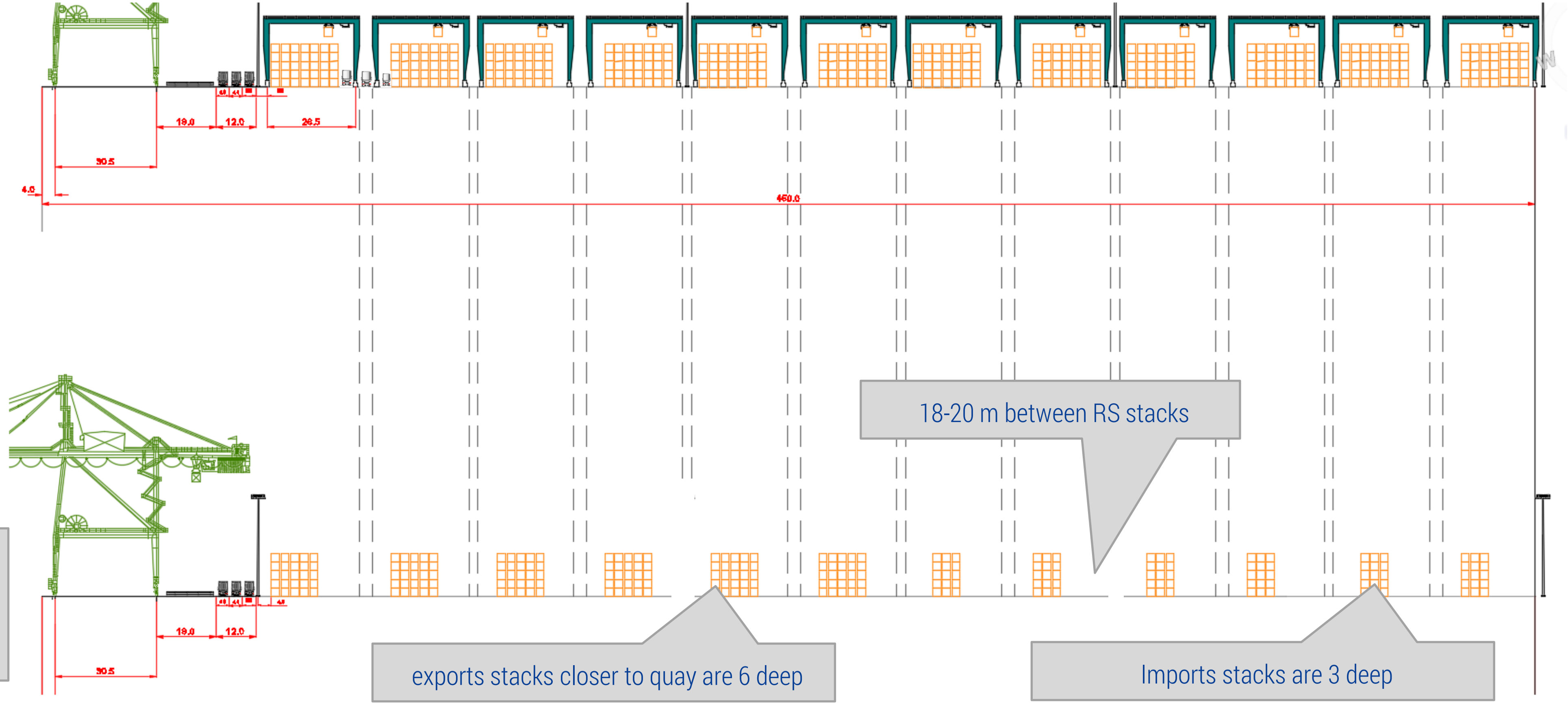


RS to RTG transition
various options, aligning RTG runway can give more options

large hatch cover



100 ft/ 30.5 m gauge to service largest vessels & space for MHC.
Option to add more QCs with better traffic flow with more QC (5+1 twist lock lane)

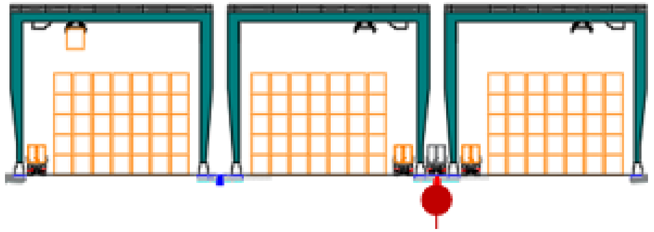


18-20 m between RS stacks

exports stacks closer to quay are 6 deep

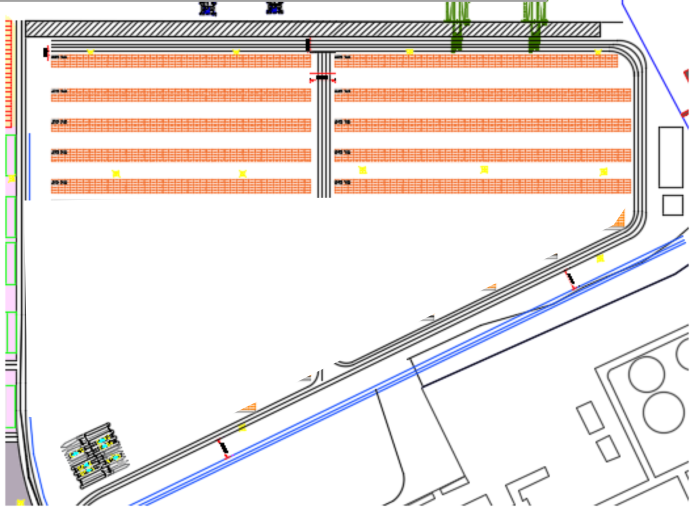
Imports stacks are 3 deep

- ✔ Back to back RTG layout, truck interchange and passing lane aligned to join RS truck interchange



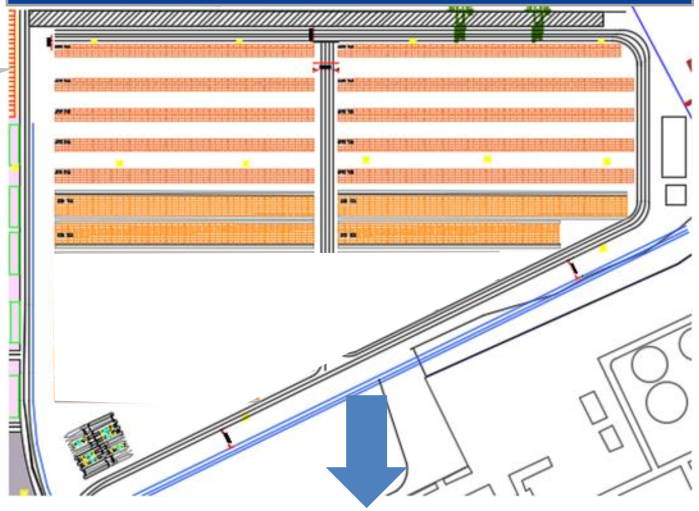
Development Trajectory (Alternative 1) – Various options are feasible
High level volumes

Step 1 - 300,000 TEUs, 4 days dwell



RS closer to the quay minimize distance to quay

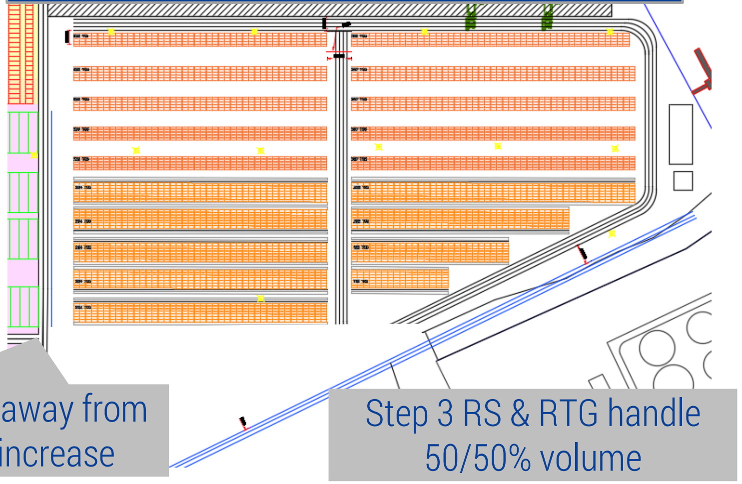
Step 2 - 450,000 TEUs, 4 days dwell



Dwell time for Import/export. Transhipment & empty at 4.5 & 14 days

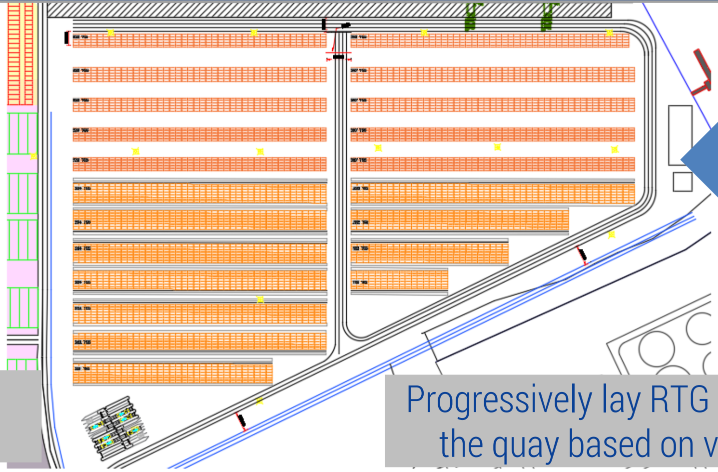
There can be various options which can be aligned with reclamation & civil works

Step 3 - 550,000 TEUs, 4 days dwell



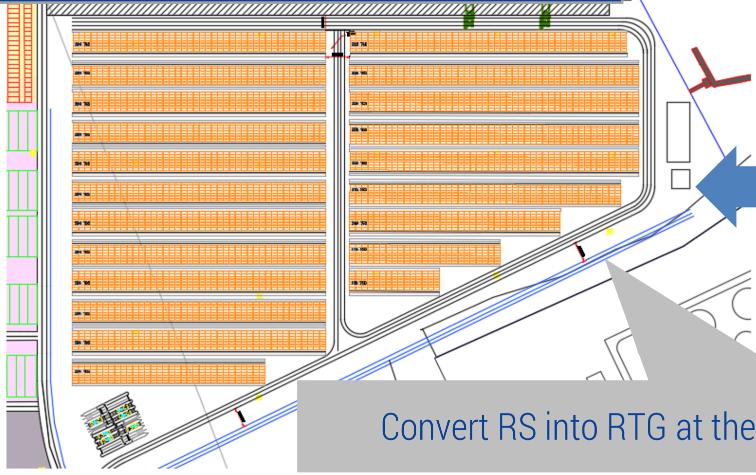
Step 3 RS & RTG handle 50/50% volume

Step 4 - 690,000/500,000 TEUs, 4/7 days dwell



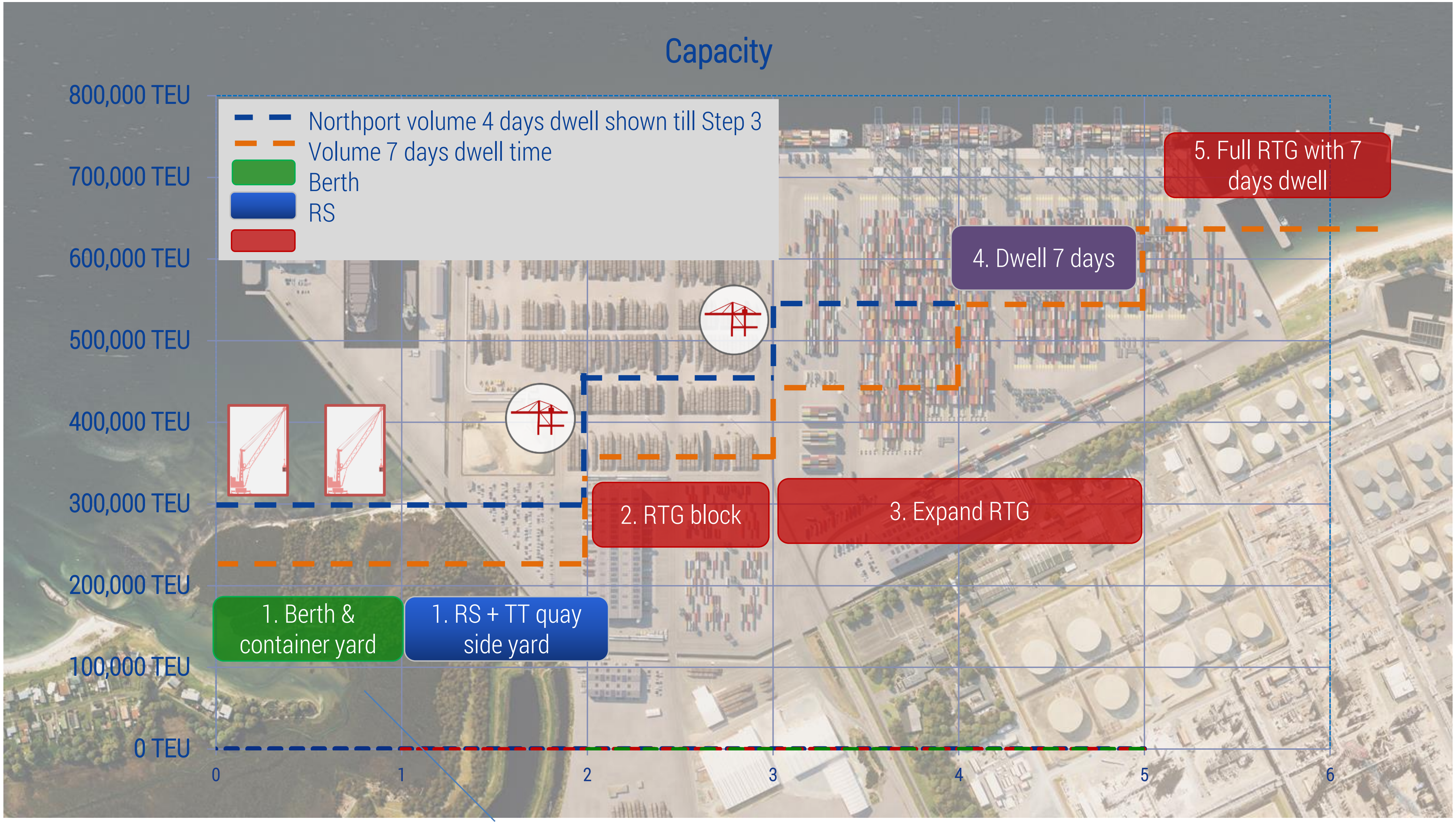
Progressively lay RTG stacks away from the quay based on volume increase

Final - 630,000 TEUs, 7 days dwell

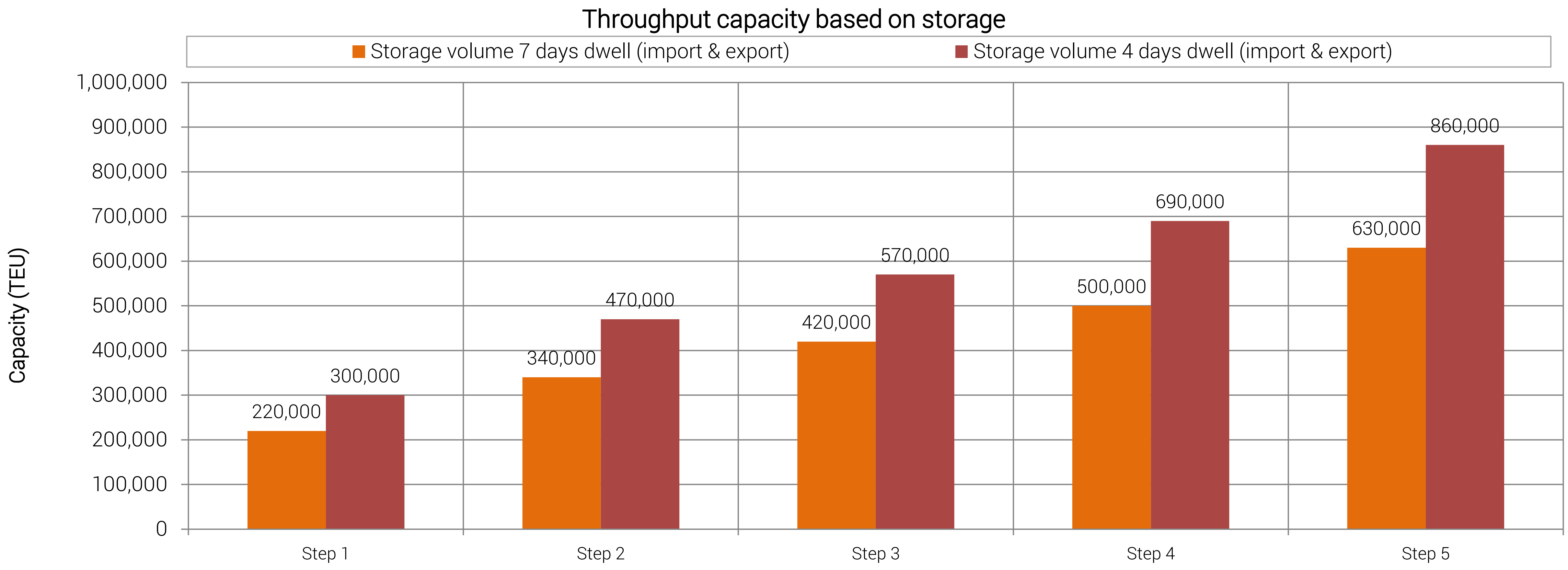


Convert RS into RTG at the end

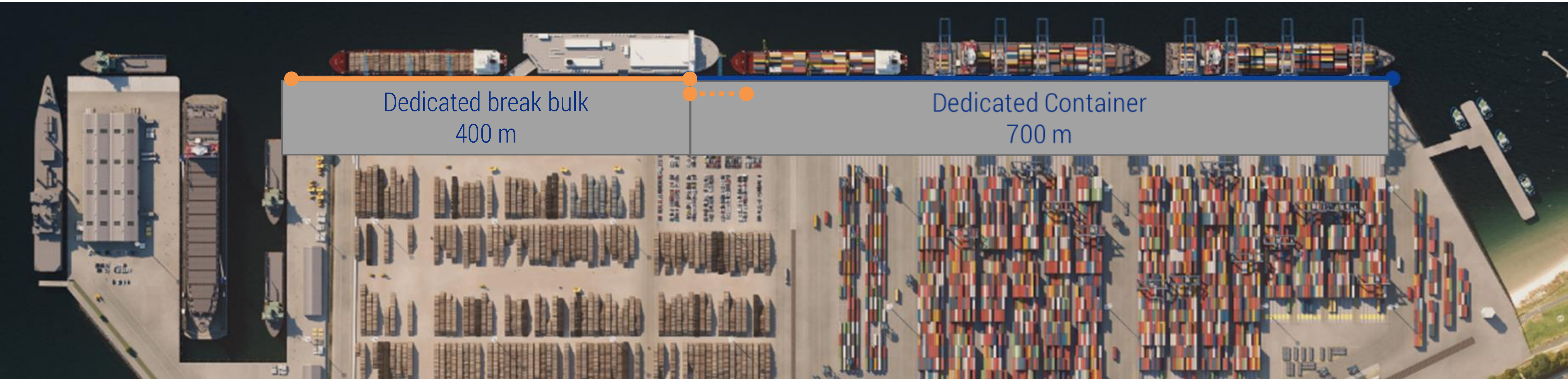
Northport
High level development trajectory



Storage capacity development



- Alternative 1 steps
- Based on import export dwell of 4 & 7 days respectively. Transhipment dwell is 4.5 days & empty dwell is 14 days



Northport container development

RS to RTG transition is considered the most suitable option for Northport Container end phase at a glance

650,000 TEU on 700m container quay to be able to berth 2 vessels together
50m of berth used for overflow for bulk/break bulk when available

2 MHC cranes + 2 STS
- STS productivty of 20 gross moves per hour
- STS productivty of 25 gross moves per hour

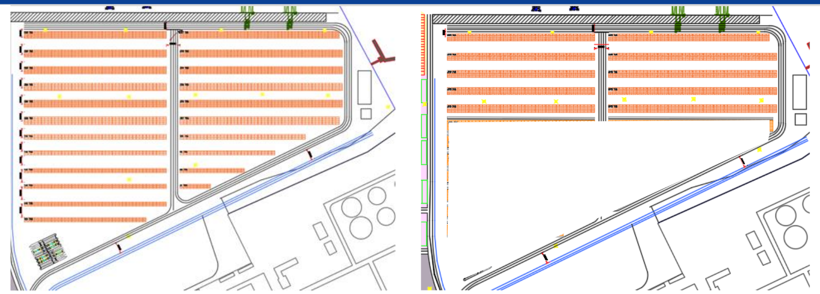
~ 5700 TGS in 12 + 9 blocks for RTG/ A RTG, stacking up to 5 high & 7 wide

20 RTG at full buildout, to support peak waterside and landside handling at 650,000 TEU

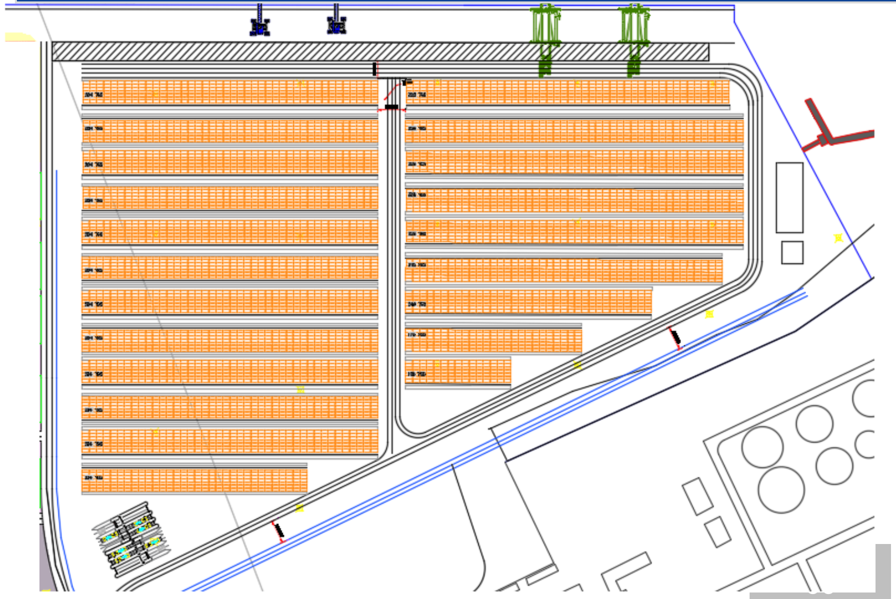
22 ITV used as horizontal transport within th terminal

2 Reach stacker to support MHC and 2 for future rail handling

Start up with RS – 2 options



Container Yard area with RTG or Auto RTGs



T|B|A

Simplifying your operation

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