Pacific Marine Management Ltd

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Manukau Harbour Port Feasibility Study

Ship Traffic and Design Vessel Assumptions

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The authors of this discussion paper are Mark Oxley and Mick Payze from Pacific Marine Management Ltd. All opinions are theirs. Data sources are stated in the text.

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Executive Summary

Cargo volumes

Existing across NZ

The 2019 statistics from the Ministry of Transports Freight Information Gathering System[1] have been selected as representative trade statistics for New Zealand's seaborne trade. The 2019 volumes closely fit the trends for 2012-2019 and are representative of cargo volumes pre-Covid pandemic. In 2019 seaborne trade totalled 68 million tonnes, distributed through the port network as presented in Table 1.

Table 1: Total seaborne trade volumes in 2019, split by major port and type[2]

NZ port	Total throughput (tonnes (2019))	
	Containers	**Bulk/ breakbulk**
Port of Auckland	3.8	1.9
Port of Tauranga	8.2	11.0
Napier Port	1.7	2.9
CentrePort	0.6	2.5
Port Nelson	0.4	1.4
Lyttelton	2.3	2.9
PrimePort Timaru	0.3	1.1
Port Otago	1.2	1.4
South Port	0.4	2.6
Other ports	0.1	21.2
Total	19.0	49.0

Forecast for a Manukau Harbour port

In the analysis of upper North Island port options, Sapere (2020)[3] analysed cargo growth to assess the capacity of the Port of Auckland and explored alternative options for meeting this future demand. The year 2019 was used as the baseline and forecasts were for 60 years to 2079. The resulting forecast cargo throughputs for a Manukau Harbour hub port are presented in Table 2 for 30 and 60 years from the baseline.

These forecasts were tested with NZ Ports and Shipping lines. We received agreement from Shipping Line participants on the forecast growth rate but caution from one participant at the NZ Port CEO

[1] MoT FIGS https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/trade-trends/

[2] Ministry of Transport FIGS https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/sheet/figs-trade , a total of 64 million tonnes, plus an estimate of 4 million tonnes for confidential items which includes iron sands.

[3] Sapere (2020), Analysis of UNISCS working Group Options – Integrative Report, Section 3, 24 August 2020

Group meeting who considered the forecasts may be high. Details of this engagement are provided in TWP07a – Institutional Knowledge.

Table 2: Forecast trade volumes for a Manukau Harbour Hub Port

Cargo type	Forecast annual throughput by year 2049	Forecast annual throughput by year 2079
Containers	4 M TEU imports/ exports, 1 M TEU feeder ships to/from southern ports	8 M TEU imports/ exports, 2 M TEU feeder ships to/from southern ports
Vehicles	172,500 CEU	345,000 CEU
Dry bulk	2.3 Mt	4.6 Mt
Liquid bulk	Peaks in 2030, then declines to below present levels	7.5 Mt. Assumes Auckland region cargo is imported through Manukau Harbour

Marine traffic

Existing across NZ

New Zealand's container trade is serviced by trade lanes from North Asia, Southeast Asia, North America, Australia, and the Pacific with about 15 ship calls per week in total. Although cargo volumes have increased overtime this call pattern has remained relatively static with ship size increases accommodating the additional demand. In 2010 the average size container vessel to call at New Zealand was a 2,700 TEU and by 2019 this increased to 4,050 TEU. A breakdown of overseas ship visits in 2019 is provided in Table 3.

Table 3: Overseas ship visits in 2019, split by major port and type

NZ port	Vessel type, calls per year					
	Container	**Bulk**	**Vehicle**	**Tanker**	**Cruise**	**Other**
Port of Auckland	589	106	179	20	127	102
Port of Tauranga	759	412	12	95	113	95
Napier Port	295	196		26	71	49
CentrePort	146	118	72	53	111	17
Port Nelson	121	77	49	16	6	18
Lyttelton	315	113	72	99	20	42
PrimePort Timaru	51	114		31	13	23
Port Otago	186	36			100	1
South Port	80	95		49		26
Other ports	94	499	0	265	334	138
Total	**2636**	**1766**	**384**	**654**	**895**	**506**

Forecast for a Manukau Harbour port

Worldwide there are currently few ships in the range 8,000 – 10,000 TEU. Newbuild orders however are mostly for new-Panamax (10,000 – 14,000 TEU) and larger 16,000 – 23,000+ TEU. When these are introduced into the main East-West trade lanes, the new-Panamax size is likely to be brought into the North-South trade lanes, including Australia and New Zealand.

Using the cargo forecasts for the upper North Island, we estimate the marine traffic for a Manukau Harbour port to comprise 4,000 visits per annum by 2079, with split by vessel type presented in Table 4.

Table 4: Forecast marine traffic for a Manukau Harbour Hub Port

	Low growth	Medium growth
Bulk	160	270
Container		
Overseas Container Ship	750	750
Coastal Feeder	350	350
Other	107	104
Reefer	25	25
Tanker	74	89
Vehicle	288	288
Domestic shipping		
Fishing vessels	1,460	1,460
Service craft	700	700
Grand Total	**3,914**	**4,036**

Design vessels

The percentage increase in containerised cargo volume correlates closely to the percentage increase in containership *size*, whereas the *number* of ships for the bulk and breakbulk trades (including vehicles) is expected to grow in line with trade growth. This, along with the makeup of the marine traffic to service the cargo forecast and future trade patterns have been used to define a range of design vessels for consideration for a Manukau Harbour port. These are projected to the same design horizon as the cargo volumes i.e. year 2079. A summary of key parameters of the design vessels are provided in Table 5.

Table 5: Select design vessel parameters for a Manukau Port

	Container			Bulk	Vehicle	Tanker	
	15,000 TEU[1]	**10,000 TEU[2]**	**7,000 TEU[2]**	**50,000**	**8,500 CEU**	**LR2[3]**	**MR**
Deadweight (t)	200,000	125,000	81,000	40,000	41,250	110,000	50,000
Length overall (m)	365	351	272	195	230	260	210
Beam (m)	53.6	45.8	42.8	29	40	45.0	32.2
Max draft (m)	16.0	15.0	15.0	11.5	11.5	15.5	12.6
Load factor	67%	90%	90%	100%	85%	100%	100%
Operational draft (m)	12.4	14.2	14.3	11.5	10.2	15.5	12.6
Air draft (m)	59	53.2	49.3	38.5	49.8	39.5	31.4

Notes:

1. The 15k TEU container vessel is the widest design vessel and used to determine the channel width.
2. The 7k TEU and 10k TEU ships have the largest operational draft and are used to determine the minimum required channel depth. Container vessels usually call at ports on a schedule, which is independent from the tide, therefore all tide access for container ships is assumed.
3. The LR2 tanker is assumed to use high water to enter the port, therefore its draft is not used to determine the required channel depth. This is based on its infrequent call pattern.

1 Introduction

Te Manatū Waka / the New Zealand Ministry of Transport has appointed Tonkin & Taylor Ltd and their subconsultants (Royal HaskoningDHV, MetOcean Solutions, Pacific Marine Management, the University of Auckland, Discovery Marine Limited, and RMA Science) to undertake a feasibility study to understand whether it would be technically possible to locate a port in the Manukau Harbour from a navigation and operational reliability perspective.

The Manukau Harbour has previously been identified as a potential port location, however there are unanswered questions around the technical feasibility of this given the complex and dynamic nature of the harbour entrance along with other factors associated with greenfield port development. This is an engineering study, and environmental, social, and economic factors are not part of the current scope of work.

1.1 Purpose of the document

This projected ship traffic and design vessel assumption technical working paper (TWP) was prepared by Pacific Marine Management and accompanies the study report.

The aim of this TWP is to establish future shipping traffic density and design ships that a port in the Manukau Harbour be required to accommodate. The findings are used as inputs into the analysis of navigability and required channel dimensions (refer Technical Working Papers 04 and 05). This paper builds on previous studies by others, particularly the Sapere Upper North Island Supply Chain investigation[4] and MoT's Freight Information Gathering System (FIGS) and National Freight Demand Study 2017/18.

1.2 Methodology and Assumptions

This working paper provides fundamental inputs to the rest of the study; freight task, vessel traffic and design vessel dimensions. We have chosen conservative (i.e. upper bound) cases. For example, freight projections in previous studies show a wide range of growth rates, and ship size is not always directly related to trade growth. We have deliberately chosen the one of the highest of these projections – high trade growth and ship size increasing in line with that growth- rather than risk specifying a mid-range trade volume or a ship size that may be exceeded. Nevertheless, even greater trade quantities or ship sizes may of course eventuate over the 60 year period being considered. We have therefore looked at the sensitivity of these on ship size and traffic numbers and their consequences for channel dimensions.

We acknowledge that at the next stage of design, when the trades that are to be facilitated are better known, the design ship and resulting channel assessment will need to be redone.

[4] Sapere (2020), *Analysis of UNISCS Working Group Options – Integrative Report,* 24 August 2020

2 New Zealand's Seaborne Trade

2.1 Total Seaborne Trade

In 2019 New Zealand's total seaborne trade was 68 million tonnes (m tonnes), split 25 m tonnes (37%) imports and 43 m tonnes (63%) exports.[5] The containerised/ bulk cargo split for imports was 7 m tonnes containerised and 18 m tonnes bulk. The exports split was 12 m tonnes and 31 m tonnes respectively. Overall, by weight 19 m tonnes (28%) of seaborne trade were containerised, 49 m tonnes (72%) were bulk. See Figure 2-1 for an overview and Table 2-1 for split by main ports.

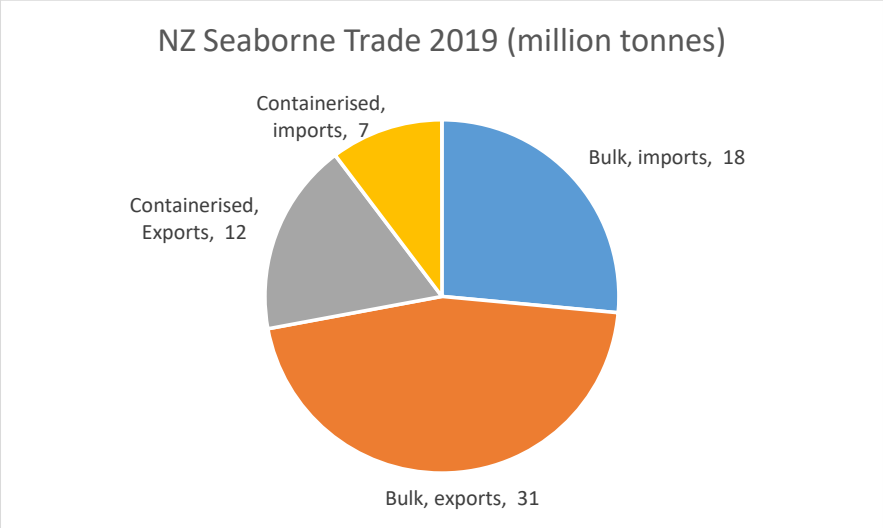

Figure 2-1: NZ's seaborne trade (source: MoT Freight Information Gathering System (FIGS))

Table 2-1: Total seaborne trade volumes in 2019, split by major port and type

NZ port	Total throughput (tonnes (2019))	
	Containers	Bulk/ breakbulk
Port of Auckland	3.8	1.9
Port of Tauranga	8.2	11.0
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Port Otago	1.2	1.4
South Port	0.4	2.6
Other ports	0.1	21.2
Total	19.0	49.0

[5] MoT Freight Information Gathering System (FIGS) data https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/figs-trade/.

We have chosen 2019 as a recent, representative year for trade statistics. Since 2019, trade has fluctuated as a result of the Covid pandemic. 2019 volumes closely fit the trends for New Zealand trade over the period 2012 to 2019.

The total **container terminal throughputs** in 2019 were 3.2 million teu (m teu). Of this, 2.3 m teu were imports and exports, 0.6 m teu were domestic cargo and empty repositioning, and the remainder 0.3 m teu were transhipments of imports and exports between NZ ports.

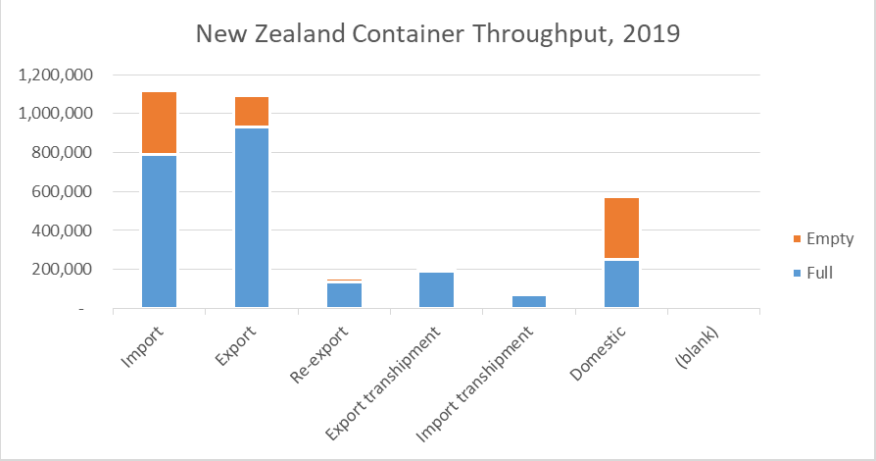

Figure 2-2: NZ container terminal throughput, teu (MoT FIGS)

Auckland and Tauranga alone capture the majority share of container trade (68%) making them the major container ports for the country. Another 25% is taken up by Lyttelton, Napier and Otago. The final 7% is distributed to the remaining four ports that regularly handle containers.

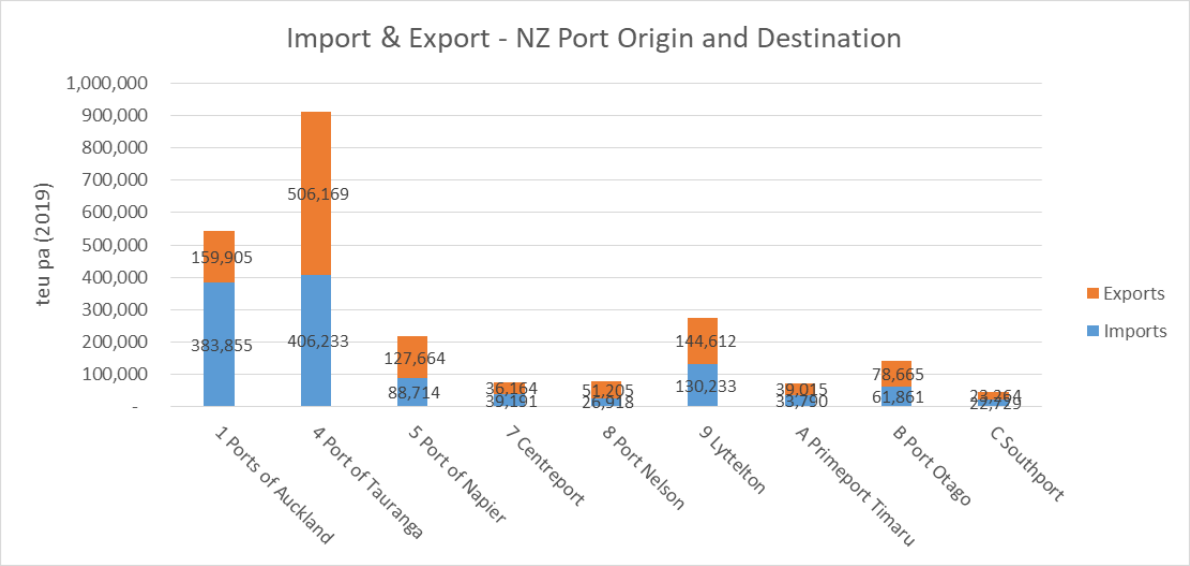

Figure 2-3: NZ containerised imports & exports by port (full & empty) (MoT FIGS)

Bulk exports were dominated by logs, 22 million tonnes (m tonnes) (71%) out of the total 31 m tonnes. Other significant bulk exports were Methanol (1.8 m tonnes), coal (1.4 m tonnes), crude oil (0.9 m tonnes), wood chips (0.6 m tonnes), iron and steel, aluminium, wood pulp, sawn wood and fruit.

Bulk imports include fuels (7.9 m tonnes), coal (1.1 m tonnes), fertilizers (0.6 m tonnes) and motor vehicles. New Zealand's largest bulk handling port is Tauranga, 12.5 m tonnes in 2019, 32% of the total bulk cargoes. The remaining 68% was spread more or less evenly around the other 10 ports.

2.2 Growth in cargo volumes

In its analysis of upper North Island port options, the Sapere (2020) Report provided an outlook for the growth in freight volumes to inform conclusions about the capacity of POAL and the infrastructure capacity needed for other options to accommodate the future freight task. [6]

The Sapere forecasts contain three growth rate forecasts for **containers** for POAL, based on the Ministry of Transport freight model, as updated for the 2019 National Freight Demand Study. Our assumption is that it is likely that the growth at Auckland will be reflected at Tauranga and throughout other New Zealand's ports. The Sapere forecast shows increases over 60 years for Ports of Auckland, and by extrapolation the Upper North Island (UNI)[7] of:

- Higher growth 4.43 times (2.51% cagr[8]) POAL: 4.3 m teu UNI: 8.6 m teu
- Medium growth (calibrated forecast) 3.82 times (2.26% cagr) POAL: 3.8 m teu UNI: 7.6 m teu
- Low growth (officials' forecast) 1.57 times (0.75% cagr) POAL: 1.5 m teu UNI: 3.0 m teu

It is important to note that these throughputs do not anticipate a major change to increased use of ports within New Zealand as hub port(s) with feeder services to other ports. If this were to occur, the throughput of the hub port(s) would markedly increase as a result of the double handling of transhipped cargo.

[6] Sapere (2020), Analysis of UNISCS working Group Options – Integrative Report, Section 3, 24 August 2020. Sapere were commissioned by MoT to look at options in relation to the Upper North Island Supply Chain. It was their work that recommended further investigation, resulting in this technical feasibility study.

[7] Sapere assumes 2019 throughputs through POAL of 1.0 million teu (imports, exports, tranships and domestic). In 2019, the total throughput of POAL and Tauranga was twice that. Our extrapolation is based on UNI throughputs being twice the POAL forecast volumes.

[8] Cagr: Compounding annual growth rate

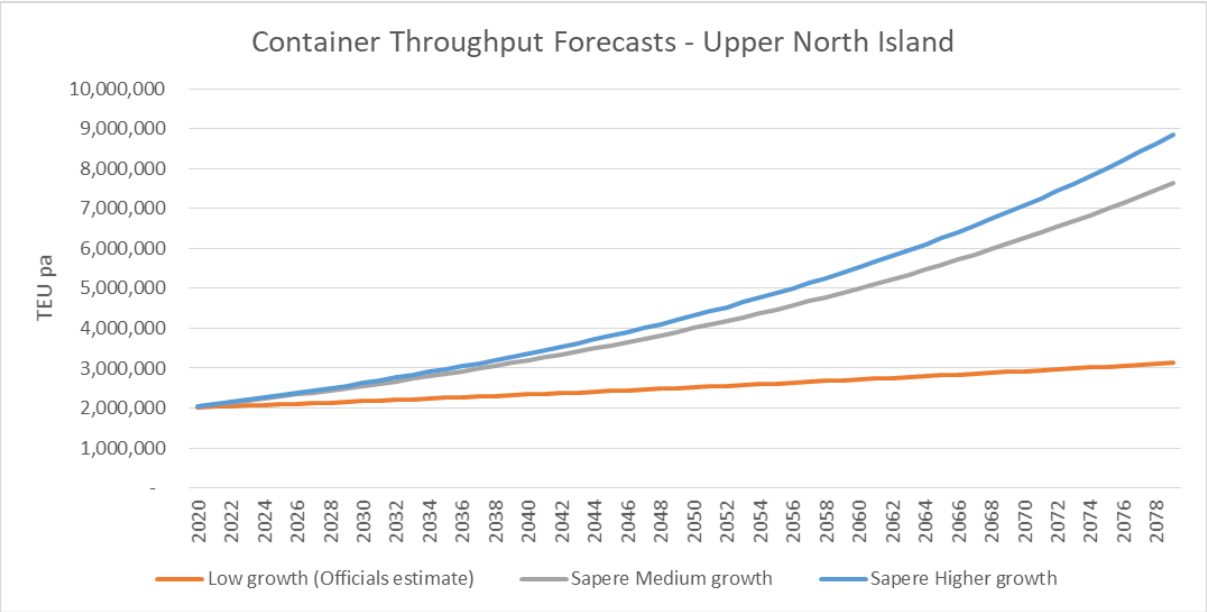

Figure 2-4: Container throughput forecasts, Upper North Island

Sapere (2020) also forecast **break-bulk and dry bulk** cargo growth at similar growth rates. Their forecast for vehicle imports assumed that they grow at the rate they used for container imports. Under the calibrated forecast this reached 1.68 million vehicles in 2079, or 5.3 times that of 2020 (2.82% cagr) whereas under the officials' forecast, it reached 0.48 million, or 1.6 times (0.79% cagr), that is, starting from a base of 0.30 million vehicles in 2020. In fact, at Auckland, the discharge port for the majority of vehicle imports, POAL report that the 2020 vehicle throughput was 0.22 million. In considering likely population growth and trends in vehicle imports over the next several decades, we consider the low growth scenario to be more probable and have based our Auckland vehicle carrier traffic estimates on that growth rate[9], from a base of 0.22 million vehicles in 2020. We have assumed medium growth (calibrated forecast) for other break-bulk and bulk cargoes.

Sapere did not consider **liquid bulk** cargoes (as very few are presently imported at Auckland). A report by BusinessNZ Energy Council in 2015[10] considered future demand which shows that oil consumption should peak around 2030, then decline to about 70% of 2010 volumes by 2050.

[9] Note though, that even at the medium growth forecasts, the resulting additional vehicle ship traffic would not push the channel design from one-way widths to two-way widths

[10] *New Zealand Energy Scenarios,* BusinessNZ Energy Council, 2015. https://www.bec.org.nz/wp-content/uploads/2022/08/BEC-Report.pdf

3 Future demand

3.1 Liner shipping

3.1.1 The nature of liner shipping

New Zealand's trade lanes have evolved over the decades. When the first container terminals were built more than half New Zealand's trade was with the United Kingdom, Northern Europe, and the East Coast of America and thus these prime routes were transiting the Panama Canal. Today, the main trade lanes are to North Asia, South East Asia, North America and Australia, with most of the European trade transhipped through these services. There are also smaller amounts of trade with places around the Pacific.

The nature of trade has changed also – early container services were served with ships that had almost as many refrigerated containers as dry containers, (e.g., NEW ZEALAND PACIFIC had 1,250 teu reefers out of a total 2,400 teu slots) but now that trade lanes are more diverse and focused on Asia, the percentage of reefer cargo has diminished thus giving rise to changes within the required terminal layout configurations.

In liner shipping, a trade lane is typically serviced by three competing operators or consortia. Any more and the competition is too intense, and one service will drop out; any less and there is a gap for a new entrant. Each service is likely to operate a weekly service, resulting in three shipping opportunities a week in each trade lane for shippers. New Zealand's trade lanes can be grouped into the above mentioned five; North Asia, South East Asia, North America, Australia and the Pacific. So, in any given week, about 15 ships are normally on the New Zealand coast.

3.1.2 Size of ships

Although containerised liner volumes have increased, the number of services to/ from any one destination has stayed fairly static over time. As a result, ship sizes have increased, more or less in line with trade growth. In 2010, the average size containership calling at New Zealand was 2,700 teu. The largest was 4,100 teu[11]. By 2019 the average size had grown to 4,050, a growth of 50%, with the sizes ranging from less than 1000 teu to 8000 teu and slightly larger[12]. Container throughputs at Auckland and Tauranga, the two largest container ports, had grown from a combined 1.38 m teu in 2010 to 2.17 m teu by 2019, a growth of 57%, that is to say, at a similar growth rate to ship size[13]. Containerships calling at Australian ports have a similar size range although across the range, ships visiting the Australian eastern seaboard are about 23%[14].

World-wide there are few ships in next size range, 8000 teu to 10,000 teu. The newbuild orders are mostly for the new-Panamax size of 10,000 teu to 14,000 teu, and for larger such as 16,000 teu and 23,000+ teu. When the larger ships presently on order are introduced into services in the main east-west trades, the new-Panamax size is likely to 'cascade' into the north-south trades, including New Zealand and Australia.

[11] *The Question of Bigger Ships,* New Zealand Shippers Council, August 2010

[12] MoT FIGS Overseas ship visits downloaded 28/4/2021, series now discontinued

[13] From POAL and PoT annual reports

[14] BITRE Waterline 68

3.1.3 Combining New Zealand trades with Australia

Neither New Zealand nor Australia can fill these larger ships alone. It is probable trade routes in New Zealand and Australia will be combined in the future (noting that this would replicate the trade patterns of the past). Some operators are already combining the two trades with international services crossing the Tasman, to justify bigger vessels. In other cases, the combination is partial, using a call at Brisbane for instance, to both help balance the two-way traffic and at the same time use bigger vessels. Others are yet to change but an increase in this practice of combining the trades using bigger vessels we consider likely to occur.

This has other benefits. New Zealand's trade overall is imbalanced such that there are more containerised exports than there are imports and thus empty containers must be positioned into New Zealand to make up the deficit. Australia on the other hand imports much more containerised product than it exports, its export trade being predominantly in dry and wet bulk commodities. This means that the two countries benefit greatly by the shipping lines positioning their empty containers from Australia to New Zealand, an imbalance that cannot just be handled by the captive trans-Tasman trade vessels.

3.1.4 A Hub Port

As bigger vessels are deployed, it is likely that some services would seek to reduce their New Zealand calls to a single port. This reduces the probability of delays to schedules, a key factor in the effective deployment of larger vessels. If the bigger vessels can relay their cargo into other services to which they have access they can reduce their steaming distances almost certainly to the extent of reducing by the number of the larger vessels required in their weekly services, the saving more than adequate to pay for the trans-shipping costs associated with relaying the cargo through the hub port.

Additionally, much of New Zealand's import containerised freight is landed in Auckland then re-distributed throughout the country. This means that much of the southern region of New Zealand's demand is necessarily routed through Auckland. This cargo, together with daily domestic distribution, gives rise to a considerable domestic cargo trade which at present mainly moves by truck and rail via Wellington.

Transporting large volumes of cargo by sea is far more cost effective than by land modes. If carriers increase the use of a hub port, combined with the onwards distribution of cargo from Auckland, distribution centres sets up for viable feeder services between an upper North Island hub port and southern ports (i.e., southern North Island ports and South Island ports).

Note that the use of Manukau as a hub port rather than Auckland or Tauranga has the advantage of reducing the steaming time to Lyttelton by 24 hours making it a highly desirable option for future freight movement on this trade lane.

3.1.5 Possible future scenarios

We have considered three possible future scenarios:

- **Scenario 1: Carriers maintain New Zealand trades as stand-alone**. Ships may need to be purpose built, in the 6,000 to 9,000 teu size range. Possible but not probable, as the economics of a combined Australia / New Zealand service with larger ships are superior to a single trade service.
- **Scenario 2: As in the past, New Zealand combines with East Coast Australia trade**. This would result in use of standard ships in the 10,000 teu to 14,000 size range, probably seeking a discharge on the eastern seaboard of Australia, a full New Zealand load and discharge at a hub port, then loading northbound in Australia.

- **Scenario 3: New Zealand trade served by feeder ships from Australia.** This too might occur, through any of the eastern seaboard ports acting as a hub. The size range of ships may be similar to the present sizes that call at New Zealand, 4,000 teu to 6,000 teu. But New Zealand would have very little control over Australian port developments or industrial relations. This is a very risky option for New Zealand, as is likely to occur only at the fringe.

The most probable outcome is a hybrid of Scenario 1 and Scenario 2; some operators crossing the Tasman to a hub port with say 10,000 teu to 14,000 teu ships, others with NZ only services in 6,000 teu to 9, 000 teu ships some of which will continue to call also at the Southern ports adding to the growing network of feeder services. Ports, or at least a hub port, would need channels and wharf/ handling equipment for the larger ship size of course.

3.2 Breakbulk and Bulkers

It is generally expected that the number of break-bulk and bulk vessels will continue to grow rather than increase in size:

- **Dry bulk imports and exports**: Bulkers will likely continue to be sized to suit the overseas discharge port capabilities, i.e., a full load of export logs (from other ports) in ships of 32k dwt to 60k dwt. These ships will mostly still use their own ship's gear to load and unload cargo and as such this tends to define the maximum beam that suits shipboard crane operations. These vessels are likely to remain smaller than the larger containerships for which ports must plan to accommodate.
- **Car carriers:** These vessels are generally no bigger than low draft Panamax size so unlikely to determine channel dimensions except in so much as the potential windage on their high sides might increase the allowance for channel width. It might be expected that with car import volume growth, the annual number of car carriers would increase in line with cargo growth.
- **Multi-purpose vessels**: Are not expected to define channel requirements.

3.3 Liquid bulk

The recent closure of the oil refinery in New Zealand has changed the pattern of distribution for fuel oils with more focus on direct delivery to all major centres in New Zealand, but perhaps has opened the opportunity for more rationalisation.

Presently the MR2 size of about 50k dwt are generally deployed to all regions of New Zealand. Over the first 11 months since the refinery closed, the discharge port for Auckland's fuel, Marsden Point, had 71 deliveries of refined fuel. Two of these (3%) were LR1 size at about 75k dwt, and two others were LR2 size, 110k dwt. The other 67 were all 45k dwt to 50kdwt. Although oil imports are expected to peak about 2030 (see section 2.2), it is likely that intermittent use of LR1 and LR2 tankers will continue to occur, at least for deliveries to the largest market, Auckland, as Marsden Point has the depth to accommodate them.

4 Implications for Feasibility Study

The Manukau Harbour port feasibility study is a technical study that is seeking to determine if the Manukau Harbour *could* be a port for large ships (as opposed to *should* it be). The implications for the Manukau Harbour are derived from the information set out throughout this overview. In technical terms, the following assumptions need to be set:

- Cargo forecast
- Traffic density
- Design ships

This section sets out an analysis of projected cargo volumes, shipping traffic density and design ships for channel assessments, as they relate to navigability and required channel dimensions.

4.1 Cargo forecast for a Manukau Harbour port

In the analysis of upper North Island port options, Sapere (2020)[15] analysed cargo growth to assess the capacity of the Port of Auckland and explored alternative options for meeting this future demand. The year 2019 was used as the baseline and forecasts were for 60 years to 2079. Sapere presented three levels of growth for containerised cargo, see section 2.2 above. These result in a very wide spread, illustrating the difficulty in forecasting so far into the future, and other sources have suggested inputs or cross-checks which should be considered at any future reviews, for example OECD long term projections, or NZ GDP and population projections. For consistency with previous studies, we have landed on Sapere's medium growth forecast at 2.26% cagr. Our resulting forecast cargo throughputs for a Manukau Harbour hub port that covers all the upper North Island containerised imports and exports plus the vehicle and dry bulk that presently trade through POAL, 50% of southern port container imports and exports as transhipments, and the liquid bulk cargo for the Auckland region that are presently imported through Marsden Point, are presented in Table 4-1 for 30 and 60 years from the baseline.

Table 4-1: Forecast trade volumes for a Manukau Harbour Hub Port

Cargo type	Forecast annual throughput by year 2049	Forecast annual throughput by year 2079
Containers	4 M TEU imports/ exports, 1 M TEU feeder ships to/from southern ports	8 M TEU imports/ exports, 2 M TEU feeder ships to/from southern ports
Vehicles	172,500 CEU	345,000 CEU
Dry bulk	2.3 Mt	4.6 Mt
Liquid bulk	Peaks in 2030, then declines to below present levels	7.5 Mt. Assumes Auckland region cargo is imported through Manukau Harbour rather than Marsden Point

[15] Sapere (2020), Analysis of UNISCS working Group Options – Integrative Report, Section 3, 24 August 2020

These forecasts were tested with NZ Ports and Shipping lines. We received agreement from Shipping Line participants on the forecast growth rate but caution from one participant at the NZ Port CEO Group meeting who considered the forecasts may be high[16]. Details of this engagement are provided in TWP07a – Institutional Knowledge.

4.2 Traffic density

MoT FIGS data[17] show the number of overseas ship calls at ports by ship type each year. A breakdown of overseas ship visits in 2019 is provided in Table 4-2.

Table 4-2: Overseas ship visits in 2019, split by major port and type

NZ port	Vessel type, calls per year					
	Container	Bulk	Vehicle	Tanker	Cruise	Other
Port of Auckland	589	106	179	20	127	102
Port of Tauranga	759	412	12	95	113	95
Napier Port	295	196		26	71	49
CentrePort	146	118	72	53	111	17
Port Nelson	121	77	49	16	6	18
Lyttelton	315	113	72	99	20	42
PrimePort Timaru	51	114		31	13	23
Port Otago	186	36			100	1
South Port	80	95		49		26
Other ports	94	499	0	265	334	138
Total	**2636**	**1766**	**384**	**654**	**895**	**506**

Using the 2019 data as a base, we have extrapolated through 60 years to 2079 using the information gathered on forecast cargo growth rates (section 2.2) and the relationship between ship type, cargo growth and ship numbers (section 3).

4.2.1 Assumption for traffic estimates

In order to arrive at an upper estimate, the basic assumption is that Manukau would become the primary import/ export port for the upper North Island:

- All of the region's containerised cargo would be loaded and discharged at Manukau.
- A portion of the southern New Zealand container imports and exports would be transhipped at Manukau. We have assumed 50%.

[16] Note that in the view of the study team, the approach put forward at the NZ Port CEO Group meeting is overly simplistic in that their approach to making projections are based only on population growth, and not on a combination of population growth and GDP growth. In the project team's view, their views of growth are too low. Given that the forecasts do not change the design vessel assumptions their comments were noted but not adopted. See TWP07a (PMM) - Engagement - Institutional Knowledge, footnote 13 for further details.

[17] https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/figs-overseas-ship-visits/

- Only the present Auckland bulkers would operate through Manukau; Tauranga would still attract the majority of bulkers.
- Cruise ships would not transfer to Manukau.
- General cargo / multi-purpose and reefer ships would continue to call at both Manukau (replacing Auckland) and Tauranga.
- Tanker calls at Manukau Harbour would in due course replace the Marsden to Auckland pipeline.
- Domestic shipping estimates have been added for future coastal shipping feeder ships (7 per week), fishing vessels (2 a day in and out) and service craft (1 a day in and out). Note that normally, all of these ships would have pilot-exempt Masters.

Based on Sapere's medium growth calibrated forecast (except for vehicle carriers, see section 2.2), the traffic growth assumptions are:

i. *Bulkers, heavy load carriers, chemical tankers*: Size of ships does not increase, thus growth rate in ship numbers is dictated by the growth in cargo volumes. We have used Sapere's calibrated forecast growth rate for bulk freight of 2.26% cagr.
ii. *Overseas container ships, RoRo cargo ships, refrigerated cargo carriers*: Number of ships does not increase, thus growth in cargo volumes is accommodated by a growth in ship size. We have used a traffic growth factor of 1.0 (0% cagr).
iii. *General cargo/ multi-purpose ships*: both size of ships and number of ships grows. We have used a traffic growth rate of 0.68% cagr.
iv. *Vehicle carriers*: The annual number of car carriers increases, although the size of the largest ships does not increase as vehicle carriers calling at New Zealand are already at the largest size and this is not expected to change. We have used Sapere's officials' forecast to estimate growth. This results in a traffic growth rate of 0.79% cagr.
v. *Products tankers*: size of ships does not change. Cargo volumes peak in 2030 and then decline. Using data from BusinessNZ Energy Council's future demand report, we have used a negative traffic growth rate of (0.67)% cagr.

4.2.2 Traffic estimate

Adopting the Sapere timeline, we have looked ahead 60 years. Based on the Sapere **medium growth cargo** volume forecast (the calibrated forecast)[18], the 2079 estimate of ships that would call at a Manukau port is about 4,000 pa, see Figure 4-1.

[18] Except for vehicle carriers, where we have used the low growth (officials') forecast

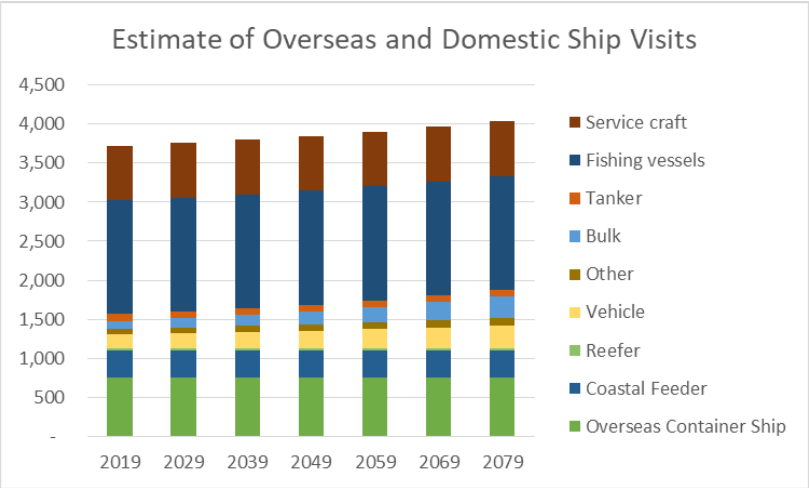

Figure 4-1: Traffic Density for a Port at Manukau

4.2.3 Influence of cargo growth

Sapere looked at three cargo volume forecasts: a medium growth (calibrated) forecast; a higher growth forecast and; a low growth (officials' agreed) forecast. The traffic estimate is not very sensitive to the cargo throughput, as many of the ship types will accommodate higher cargo volumes by an increase in size rather than in numbers. There is insufficient data in Sapere's reports to look at the traffic split by ship types for the higher growth[19], but the difference between the low growth traffic estimate (3,914 ships) and medium growth (4,036 ships) is 122 ships (3% of the medium growth traffic estimate), see Figure 4-2.

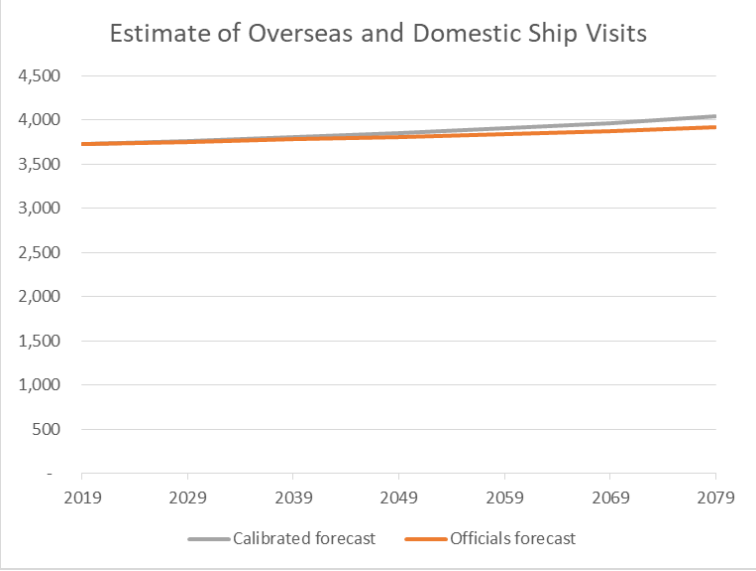

Figure 4-2: Traffic growth: Calibrated cargo growth forecast compared with officials' cargo growth forecast

[19] Note that Sapere's higher growth forecast has an overall cagr of 2.51%, only marginally higher than their medium growth rate of 2.26%

4.2.4 Traffic forecast

The traffic forecast for six decades hence is shown in Table 4-3. The medium growth estimate is recommended for the concept channel design. The engagement with the New Zealand Port CEO Group agreed with these projections.

Table 4-3: Estimate of Overseas and Domestic Ship Visits by 2079

	Low growth	Medium growth
Bulk	160	270
Container		
Overseas Container Ship	750	750
Coastal Feeder	350	350
Other	107	104
Reefer	25	25
Tanker	74	89
Vehicle	288	288
Domestic shipping		
Fishing vessels	1,460	1,460
Service craft	700	700
Grand Total	**3,914**	**4,036**

For analysis of ship operability, which has a ship-size element to its evaluation, we have split out the overseas containerships into size groups (Table 4-4):

Table 4-4: Estimate of overseas containership visits by size, 2079

Overseas Containership size	Ship length	Number of ship visits
<1,100 teu	<150m	60
1,100 to 3,500 teu	150m to 250m	128
3,500 to 6,500 teu	250m to 300m	250
6,500 to 9,000 teu	300m to 335m	45
About 10,000 teu	351m	134
About 15,000 teu	365m	134

4.3 Design ships

There are several ship types that need to be considered as design ships. The largest dimensionally are likely to be regular call containerships, although tankers of LR2 size, while presently only intermittent callers at New Zealand ports, may need to be considered.

The median size of containerships calling in New Zealand at present (2022) is about 3,250 teu[20], although ships of 9,000 teu do already call. Many of the larger ships are combining trades with Australian ports, and thus are not fully laden when transiting New Zealand.

The Sapere medium growth forecast[21] is for a 3.8 times growth in container volumes by 2079. Applying this factor to the present 3,250 teu median size results in a median size of 12,350 teu. Using the reasoning in section 3.1.5, this results in two groups of containership size; some operators crossing the Tasman to a hub port with say 10,000 teu to 14,000 teu ships, others with New Zealand only services in 6,000 teu to 9,000 teu ships. To be conservative, we have chosen containership sizes slightly above these ranges: 7,000 teu, 10,000 teu and 15,000 teu. From a design channel viewpoint, the beam of the largest size dictates the horizontal channel dimensions, whereas the deeper operational draft of the smaller ships dictates the vertical dimensions.

Translating this into the probable ship types and sizes 5 to 6 decades into the future through to 2079, it is recommended that the data in Table 4-5 be used as inputs to channel dimension work to ascertain the required channel size.

Table 4-5: Manukau Harbour Design Ships

			Container ships			Bulker	Car carrier	Tankers	
Design Vessels	**Abbreviation**	**Unit**	**15,000 teu Container Ship**	**10,000 teu Container Ship**	**7,000 teu Container Ship**	**40k dwt Bulk carrier**	**PCC 8,500CEU**	**LR2 tanker**	**MR tanker**
		Note:	1	2	3	4	5	6	7
Source of Basis of Parameters			Garrido & PIANC	PIANC Rpt 121	Seaspan	PIANC Rpt 121	Typical large PCC	PIANC Rpt 121	PIANC Rpt 121
Maximum Deadweight	DWT	t	200,000	125,000	81,000	40,000	*41,250*	110,000	50,000
Maximum Displacment (eg loadline)	Δm	t	255,000	174,000	*110,000*	50,000	*55,000*	135,000	66,000
Length overall	Loa	m	365	351	272	195	*230*	260	210
Length between perpendiculars	Lpp	m	343	332	268	185	*215*	245	200
Beam	B	m	53.6	45.8	42.8	29.0	*40.0*	45.0	32.2
Max Draft (eg loadline)	T	m	16.0	15.0	15.0	11.5	*11.5*	15.5	12.6
Block coefficient	CB		*0.68*	*0.70*	*0.62*	*0.79*	*0.54*	0.80	0.79
Min lateral Windage (fully loaded)	Wfl	m2	10,200	8,700		1,700	*6,000*	2,900	1,900
Max lateral Windage (in ballast)	Wb	m2	11,500	9,500		2,800	*7,000*	4,800	3,000
Approx. capacity		teu	15,000	10,000	7,000		*8500 CEU*		
Keel to truck	Hkt	m	*71*	*67*	*64*	*50*	*60*	*55*	*44*
Operating Parameters for Design									
Assumed load factor, arr/dep Bina			67%	90%	90%	100%	85%	100%	100%
Assumed Operating Draft	Top	m	12.4	14.2	14.3	11.5	10.2	15.5	12.6
Displacement at Operating Draft	Δop	t	195,600	162,750	102,710	50,000	48,800	135,000	66,000
Air draft	Hst	m	59.0	53.2	49.3	38.5	49.8	39.5	31.4

Notes to Table 4-5:

1 15,000 teu container ships would only call if combined with Australian trade. On basis of a full discharge in Australia, a full discharge & load in NZ including trans-Tasman cargo, then return to Australia for a full load, it would be 64% full on arrival NZ and 67% full on departure.

2 9,000 to 10,000 teu container ships already call at NZ ports.

3 7,000 teu container ships would be appropriate for NZ only trades (i.e., excluding Australia calls), and would be full operationally, say 95% of teu slots. Allow say another 5% less than maximum deadweight for low cargo density, i.e., 90% of max cargo deadweight when combined with operational maximum load factor.

[20] Derived from average deadweight of containerships in https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/figs-overseas-ship-visits/

[21] Note that Sapere's higher growth forecast has a cagr of 2.51%, only marginally higher than their medium growth rate of 2.26%

4 50k dwt is typically a large size for bulk carriers calling at NZ ports.
5 Large PCC ships call at NZ ports.
6 LR2 tankers are possible, although intermittently.
7 MR2 tankers are the most common size tanker that are likely to call at NZ ports.

Note on required channel dimensions

Table 4-5 indicates that the maximum required depth is for the draft of a LR2 tanker, 15.5 m. However, tankers of this size are likely to be intermittent visitors. In 2022, only 2 called at Marsden Point. Required depth analysis should assume that ships of this draft can wait for sufficient tidal depth before entering port, perhaps the top half of the tide. Mean Sea Level at Manukau Harbour is 1.75 m above chart datum at the Harbour entrance and 2.15 m at the LPG terminal near Hikihiki Bank. If all other ships are to be considered not bound by tide, the two smaller containerships in the above table (Table 4-5), 10,000 teu and 7,000 teu, become the ships that determine the required depth, with operational drafts of 14.2 m and 14.3 m respectively.

If a 15,000 teu containership were to enter at a draft of 14.3 m, its load factor would be about 84%, i.e., considerably above the 64% that we have assessed would be the case. Similarly, a 20,000 teu containership, although unlikely to visit New Zealand, would have a load factor of 83% at an operating draft of 14.3 m.

Table 4-5 also indicates that the horizontal channel dimensions are determined by the beam and length of the 15,000 teu containership, the longest and most wide beam of the set of design ships.

Should even larger ships say 20,000 TEU capacity, wish to use the navigation channel the width, following PIANC empirical calculations, would increase by 30m for Section A, 41m for Section B, and 22m for Section C. Depth is still dictated by the 7,000 and 10,000 TEU vessel. Bearing in mind that channel dimensions are conservative at this concept stage (following PIANC) and future fasttime/real time can be used to refine the channel geometry at later stages of design, and take account of revised vessel forecasts.