KPMG

Quay conclusions

Finding the best choices for additional port capacity in NSW

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Executive Summary

Purpose of the study

The purpose of this study is to determine the relative competitiveness and the likely catchment areas of Port Botany, Port Kembla and Port of Newcastle as container ports. Our work considers the entire logistics chain costs from source to consumption, including costs incurred through additional terminal investment, through the development of an evidence-based origin-destination model for containers in NSW.

Noting that NSW's various ports compete within a national freight market, we also consider the interstate competition from the Port of Melbourne and the Port of Brisbane.

Freight matters

Freight is the life blood of the national economy, underpinning all aspects of daily life. The cost of freight is added to each imported item we purchase; and is added to the final price of the goods Australia exports to foreign markets.

In this way, the cost of freight is ultimately absorbed by consumers in the price we pay for household or other goods; and is added to the price of each good Australian businesses export to global markets.

Freight is rarely 'front page news', but the cost of poor freight policies or projects ultimately accrue to each Australian business and each Australian household – meaning good and well-timed choices underpin individual household wellbeing and overall economic growth.

Australia's container freight market sees:

Over 80 per cent of Australia's containerised freight flows through just three key container ports; Port Botany, Port of Melbourne and the Port of Brisbane.

90 per cent of containerised freight in New South Wales (NSW) moves through Port Botany, but competes with Melbourne and Brisbane in the State's southern and northern regions.

Source: ACCC (2018)[1] and NSW Ports (2015)[2]

What is a TEU?

A twenty-foot equivalent unit, or a TEU, is a standardised metal container that is 20 feet long.

These containers were designed to allow freight to be readily transferred between ships, trains and trucks. The standardisation of these containers has contributed to the easier movement of freight.

[1] ACCC (2018), Container stevedoring monitoring report 2017-18.
[2] NSW Ports, Navigating the Future NSW Ports' 30 Year Master Plan, October 2015

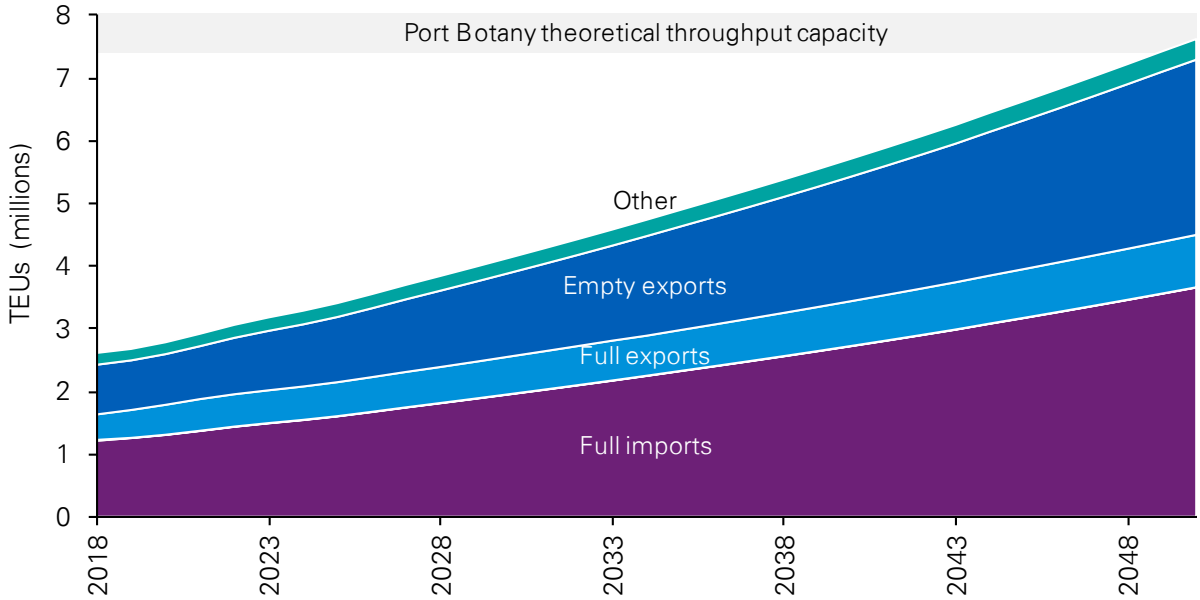
Planning the right future container capacity is important

Each of the existing major Australian container ports has capacity to accommodate growth for many decades; but the very long-term nature of freight has seen a corresponding focus on long-term freight planning, across the Australian and state governments.

In 2017/18, Australia's total container volumes across all ports was 8 million twenty-foot equivalent units (TEUs), the highest-ever volume[3]. Port Botany accounted for over 2.7 million TEUs during this period[4].

Figure 1 below shows that over the coming 30 years, Port Botany's container throughput will be almost as large as Australia's current total container trade volume; growing at 3.4 per cent per annum and reaching the mid-7 million TEUs by 2050.

Figure 1: Projected container throughput at Port Botany



Source: BIS Oxford Economics for NSW Ports

NSW Ports estimates a theoretical throughput capacity of mid-7 million TEUs per annum at Port Botany, based on current technologies, known infrastructure requirements and contemporary operating models. When Port Botany nears "capacity", Port Kembla is planned to provide new container capacity.

NSW transport policy and government planning designates Port Kembla as the location for future container capacity, because it is closer and better connected to Sydney's south west and west where much of the state's logistics and warehousing activity resides, as well as where the majority of the projected population growth will take place.

The Port of Newcastle has recently sought to contest the established port and freight planning in NSW. For example, a recent Deloitte Access Economics Report explored whether the Port of Newcastle could play a useful role in Australia's growing container task.

[3] ACCC (2018), Container stevedoring monitoring report 2017-18

[4] ACCC (2018), Container stevedoring monitoring report 2017-18.

The NSW container market

In considering long-term port and freight capacity, it is important to understand how, where and why containers travel across Sydney and NSW. For example, more than 80 per cent of full import containers arriving at Port Botany will be consumed within 40 kilometres of the Port's gate5.

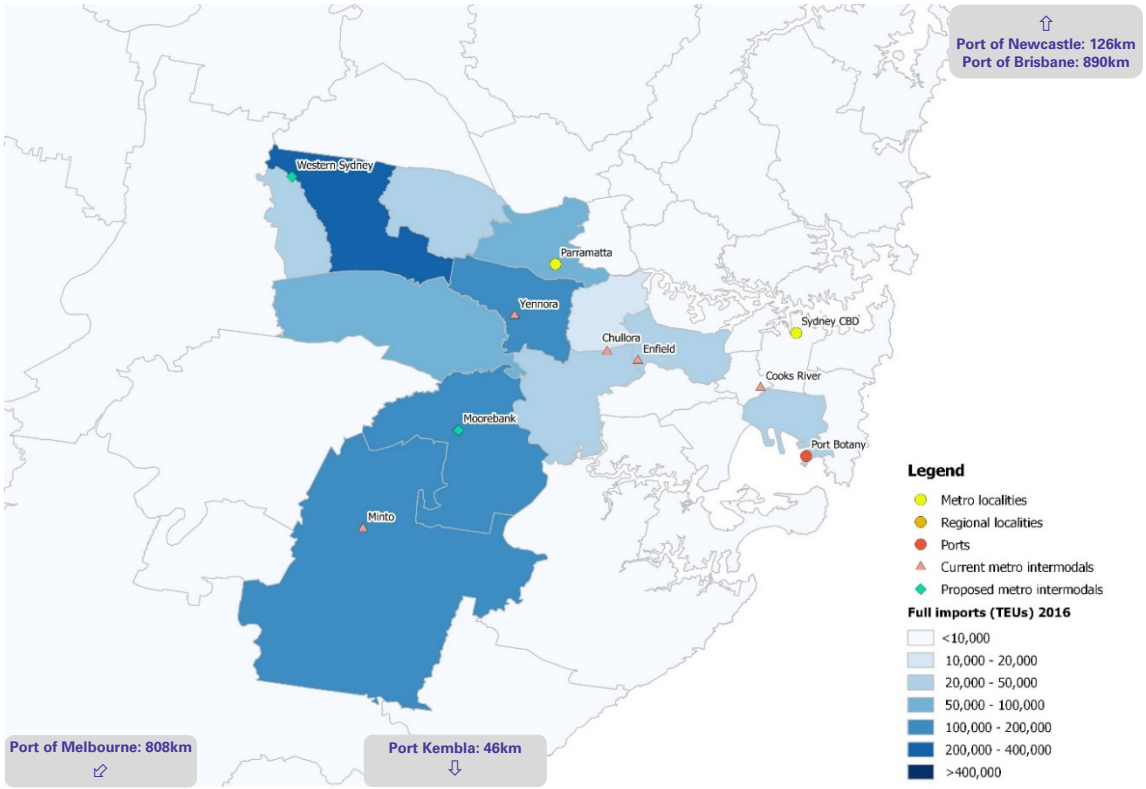
Origin destination data drawn from Transport for NSW's (TfNSW's) Strategic Freight Model (SFM)6 suggests that few full import containers leave the city. Based on 2016 data, less than 1 per cent of full import containers were destined for regional areas; and 2 per cent destined for the Central Coast, Newcastle and Hunter regions.

As Sydney's population has grown and land values have increased, this has caused freight warehouses and distribution centres to move westwards – away from traditional industrial locations around Port Botany, in favour of new facilities in Western Sydney. This westward drift is being met by investment from companies in new, state of the art intermodal, logistics, delivery and distribution centres across Sydney's greater west and south west.

Greater Western Sydney is a logistics powerhouse, with centralised warehousing being commonplace within the M4 and M7 Motorway corridors. Warehouses and distribution centres are already strategically located across the transport network to maximise efficiency. The development of modern intermodal facilities will provide further impetus for the development of additional warehousing and delivery centres, in line with demand growth.

It is expected that this trend will continue. Retailers are constantly seeking to increase their purchasing power and reduce their cost of storing inventory in store. Major retailers, for example Coles and Woolworths, already have well established distribution centres and networks spanning Western Sydney. Figure 2 and Figure 3 overleaf show TfNSW's SFM projection of the distribution of containers in Sydney and its surrounds in 2016 and in 2046.

Figure 2: 2016 full import container distribution

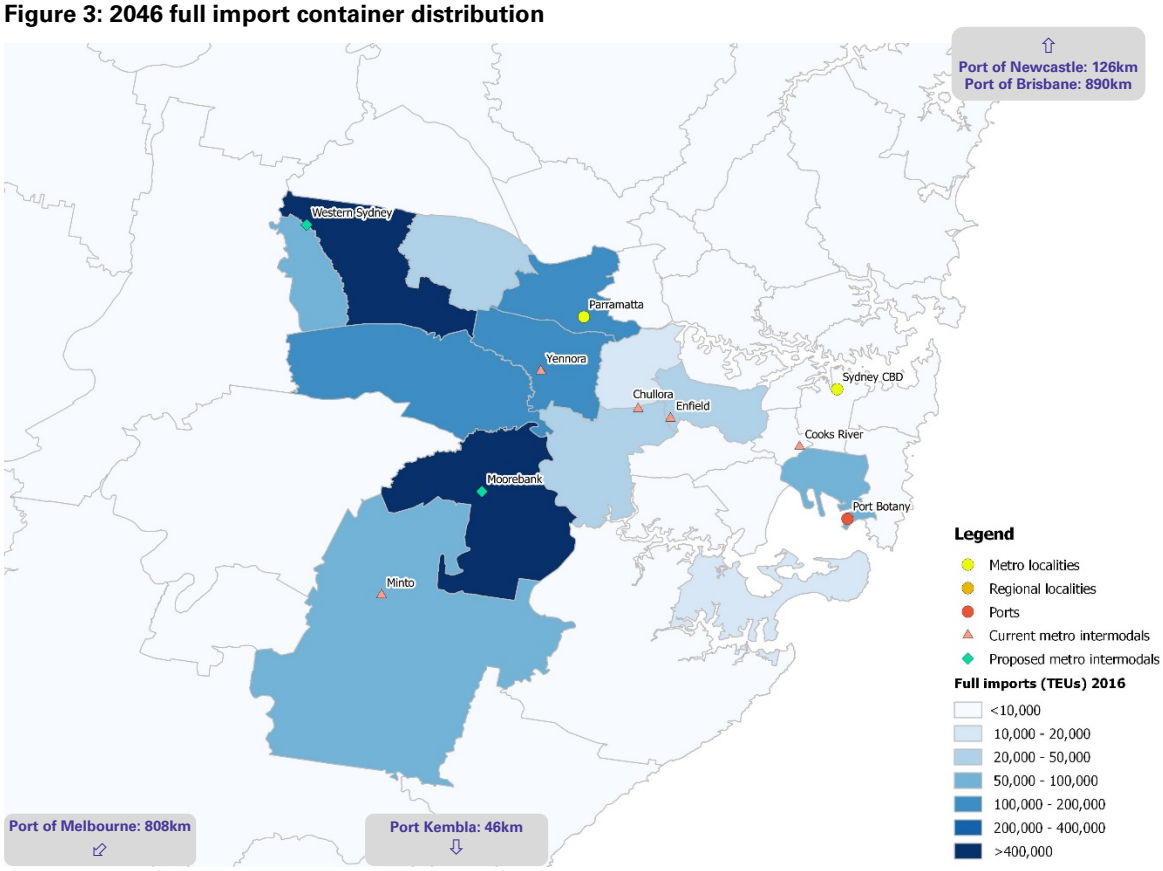


Source: Based on TfNSW SFM data

[5] NSW Ports, Navigating the Future NSW Ports' 30 Year Master Plan, October 2015

[6] The SFM is the NSW Government's strategic modelling tool to represent freight activity and their movements across the State. The SFM forecasts the level of freight generation by commodity, drawing on various macroeconomic and demographic variables.

Figure 3: 2046 full import container distribution



Source: Based on TfNSW SFM data

On the export side, the distribution of containers is more diverse than imports. It is in this market that the role of containers outside of Sydney, Newcastle and the Illawarra are more evident, accounting for a little over a quarter of all full export containers in both 2016 and 2046, based on our review of the SFM data. Even so, much of the export trade in full containers originates within Sydney.

However, containerised trade in NSW is import-oriented. This is demonstrated by Port Botany's recent trade figures for 2017/18, with imports accounting for 75 per cent of total containerised trade in the port – importing 1.21 million TEUs in comparison to full exports of 0.41 million TEUs.

Freight container cost and origin/destination model

Many Australian freight studies are limited by only considering isolated factors, across a fundamentally sophisticated and connected supply chain.

We have developed a model to assess the container shares of the three existing major container ports in NSW, Victoria and Queensland – and to assess the impact of potential new container ports at Port Kembla and/or Port of Newcastle.

The aggregate demand and distribution of containers used in the model was informed by data inputs from NSW Ports and TfNSW. Aggregate container volume projections to 2046 were provided by NSW Ports. The distribution of import and export containers was based on the split in container volumes by Statistical Area 3 (SA3) area[7], generated by TfNSW's SFM. All modelling has been undertaken to align with model years used by government agencies (2016, 2031 and 2046), which fall on census years. Container volumes originating or destined for a particular area were derived as a product of NSW Ports' aggregate volumes and the shares derived from the SFM. We note that container movements

[7] SA3s form part of the Australian Statistical Geography Standard (ASGS) used by the Australian Bureau of Statistics and other organisations including Transport for NSW to enable the publication of statistics that are comparable from a spatial perspective, and can be readily aggregated or disaggregated to larger or smaller regions. These geographical definitions were introduced in 2011. Within urban areas, SA3s provide a finer disaggregation of regions, which provides for a finer assessment of travel distances and costs to guide this study.

to / from the ACT have been excluded from the analysis due to unavailability of forecasts from TfNSW.

A key focus of the model was the build-up of three different cost modules, which in turn influence the preference for a particular transport mode and a particular container terminal. These are:

Landside costs: The landside cost module incorporates movement costs between the port gate and each container's origin or destination. It sees road or rail travel times, wait times and lift times at intermediate points, incorporated in the model;

Container terminal costs: The container terminal cost module includes costs incurred between the quayside and the port gate. It incorporates wharfage, navigation and pilotage charges and stevedore charges. The unitised costs of new container terminal infrastructure is also included in the model; and

Bluewater shipping costs: Bluewater shipping costs refer to the costs incurred by container shipping lines travelling between ports. This module was able to vary by ship size, which in turn impacted the blue water costs.

The prospect of additional competition between different container terminals within NSW was tested by developing four scenarios along with a common set of infrastructure assumptions (see Table 1). These scenarios consider a 'no new ports' scenario, which is the basis for establishing what the effect of building a container terminal at either Port Kembla or Port of Newcastle would have on container movements. This was undertaken to determine the impact from the introduction of either port in isolation. For completeness, the final scenario assumes container terminals are developed at both Port Kembla and the Port of Newcastle.

Table 1: Model scenarios

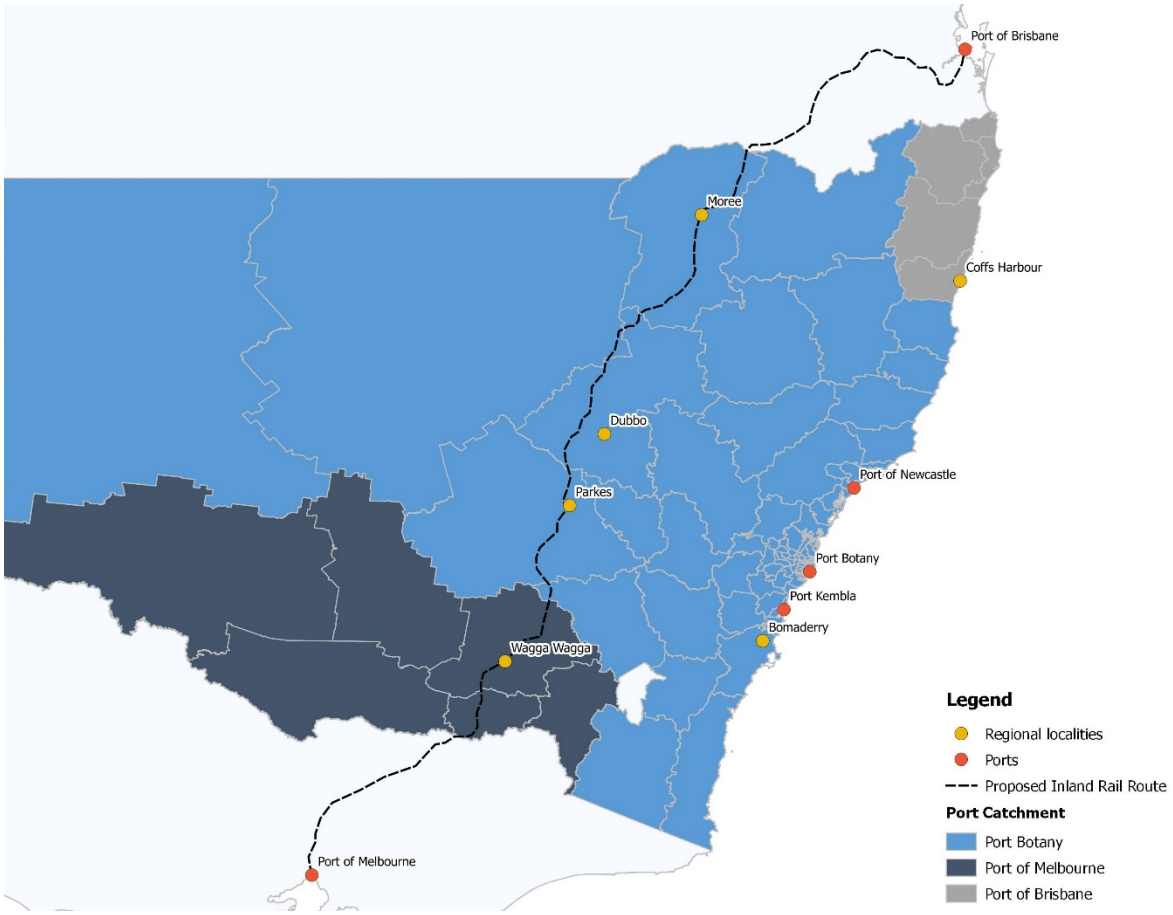
Ports	Current	2031	2046
'No new ports' scenario Port Botany, Port of Brisbane, Port of Melbourne	✓	✓	✓
'With Port Kembla' scenario Port Botany, Port of Brisbane, Port of Melbourne and Port Kembla		✓	✓
'With Port of Newcastle' scenario Port Botany, Port of Brisbane, Port of Melbourne and Port of Newcastle		✓	✓
'All ports' scenario Port Botany, Port of Brisbane, Port of Melbourne, Port Kembla and Port of Newcastle		✓	✓
Infrastructure projects			
Northern Sydney Freight Corridor	✓	✓	✓
WestConnex – M4 Widening	✓	✓	✓
WestConnex – M4 East & New M5		✓	✓
WestConnex – M4-M5 & Rozelle Interchange		✓	✓
NorthConnex		✓	✓
Sydney Gateway – connection with WestConnex		✓	✓
Port Botany Rail Line duplication		✓	✓
Western Harbour Tunnel		✓	✓

Ports	Current	2031	2046
Southern Sydney Freight Line Upgrade		✓	✓
F6 Extension		✓	✓
Inland Rail		✓	✓
Maldon - Dombarton Railway Line			✓
Western Sydney Freight Line			✓

Modelling results – 'no new ports' scenario

The modelling results under the 'no new ports' scenario are shown in Figure 4 below. This shows the expected catchment by port in 2016, based on bluewater, terminal and land transport costs. It should be noted that the illustration merely shows which port offers the lowest cost from each area. In practice, cost differentials may not be significant in particular in areas around the boundary of each catchment. It can be expected that in these areas, container volumes would be contestable.

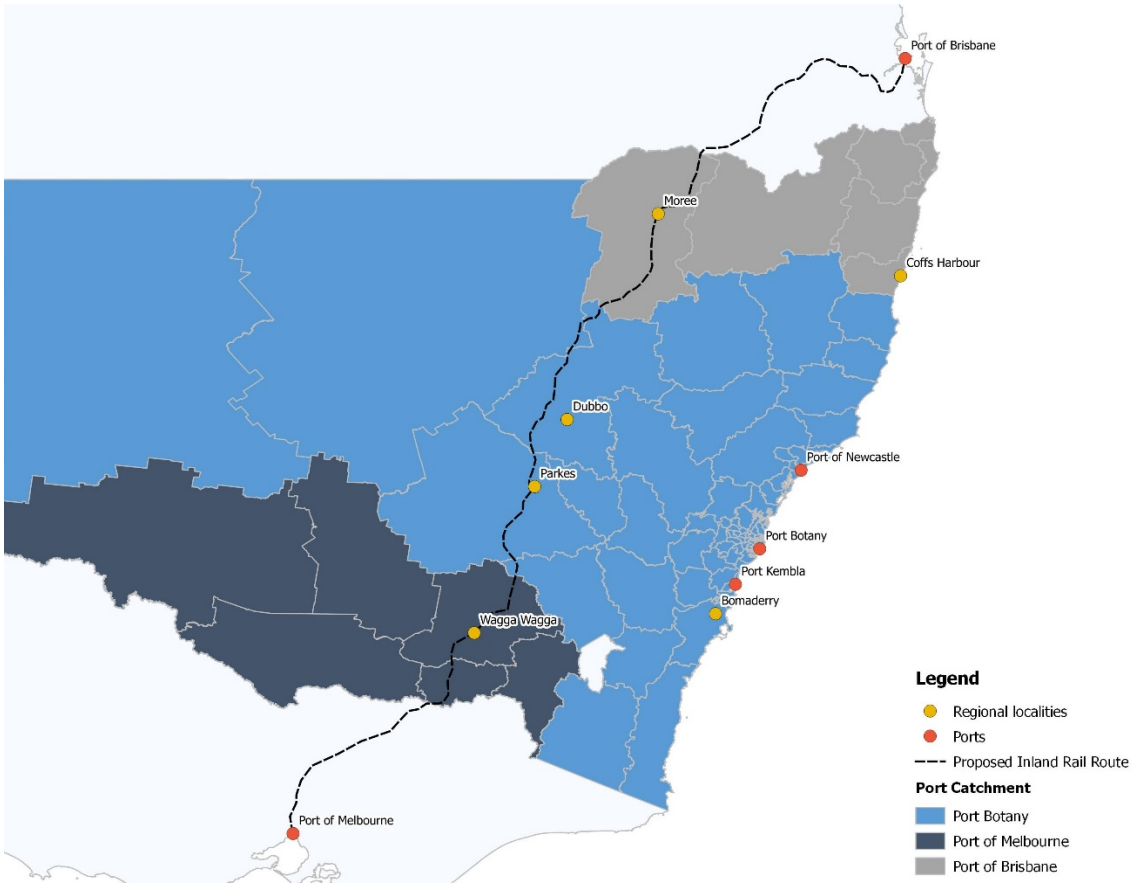
Figure 4: 2016 catchment map based on lowest costs under 'no new ports' scenario



Source: KPMG analysis. Costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

Figure 5 overleaf shows the potential catchment area for the Port of Brisbane and the Port of Melbourne in 2046, reflecting the impact of Inland Rail.

Figure 5: 2046 catchment map based on lowest costs under the 'no new ports' scenario



Source: KPMG analysis. Costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

Table 2 provides a breakdown of the volume of containers by port under the 'no new ports' scenario. Between 2016 and 2046 the forecasts container shares between the three ports broadly remains constant. Inland Rail plays a role in solidifying the volume of containers to the Port of Brisbane and Port of Melbourne.

Table 2: Volume of NSW's containerised IMEX freight by TEU under the 'no new ports' scenario

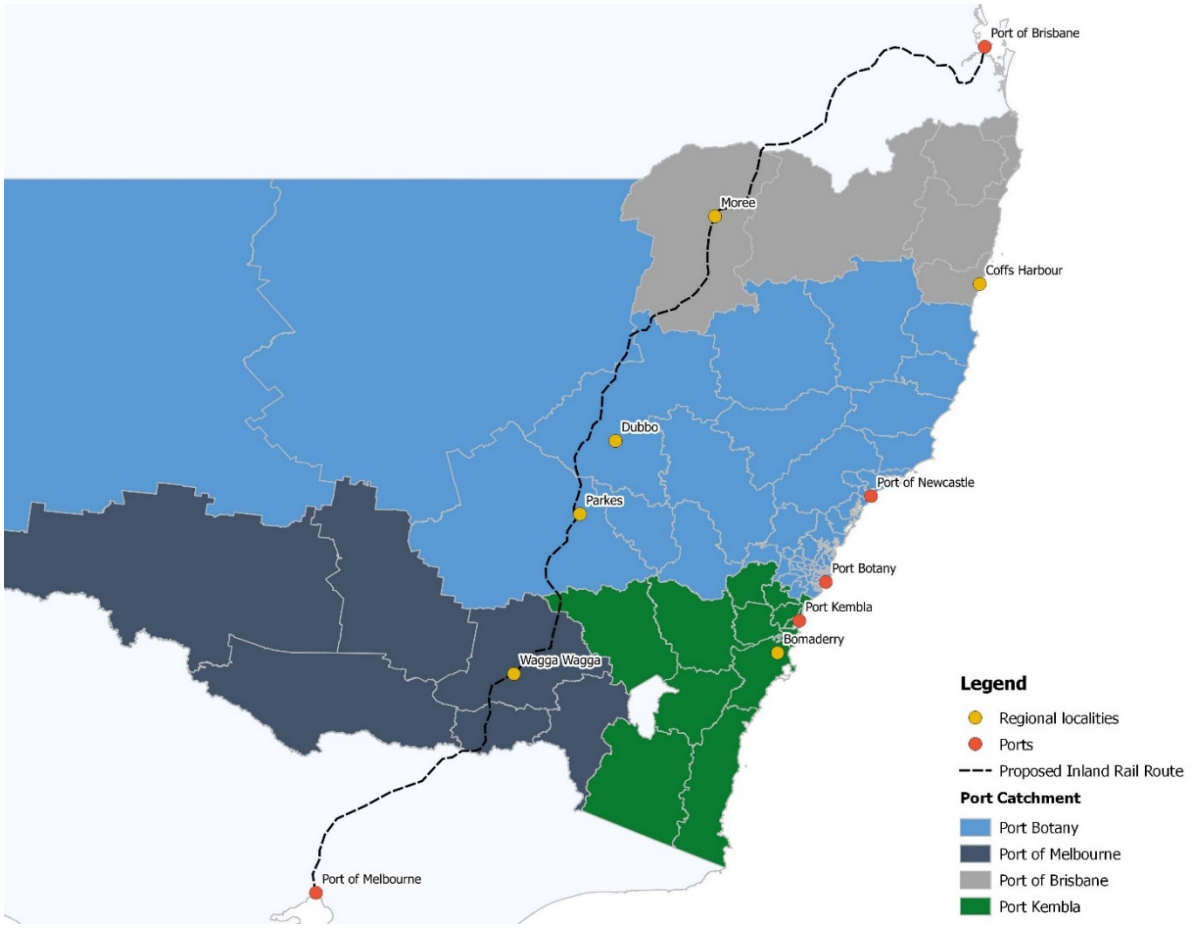
Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,868,000	0	0	43,000	107,000
2046	2,999,000	0	0	73,000	184,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	503,000	0	0	38,000	67,000
2046	640,000	0	0	57,000	86,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	3,739,000	0	0	87,000	195,000
2046	6,047,000	0	0	142,000	311,000

Source: KPMG analysis

'With Port Kembla' scenario

The second scenario tested the introduction of Port Kembla as an additional container port. This scenario tests Port Kembla's attractiveness to shippers when Port Botany is not constrained. Figure 6 shows Port Kembla would be an attractive option for localities in southern NSW, including the South Coast and Illawarra. These results assume that the quayside capital expenditure at Port Kembla could be annuitised over the combined container volume of both Port Kembla and Port Botany's catchment.

Figure 6: 2046 catchment map based on lowest costs under the 'with Port Kembla' scenario



Source: KPMG analysis. Costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

The modelling found that Port Kembla would be expected to share some container volume with Port Botany within metropolitan Sydney. The development of the F6 extension and Maldon Dombarton Rail Line reduce the land transport cost margin between Port Botany and Port Kembla.

Introducing Port Kembla will attract container volumes from Port Botany, from the South Coast of NSW and as far west as Young-Yass, rather than Port of Melbourne. There are metropolitan areas on the south western fringes of Sydney that would fall into Port Kembla's catchment.

It is expected that Port Botany would continue to attract a large part of the Sydney market, owing to the higher ship call frequency and proximity to most of the high volume destinations within Sydney.

Table 3 overleaf provides a breakdown of the volume of containers by port under the 'with Port Kembla' scenario. Under this scenario, Port Kembla is projected to attract approximately 11 per cent of NSW container throughput in 2046.

Table 3: Volume of NSW's containerised IMEX freight by TEU under the 'with Port Kembla' scenario

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,576,000	290,000	0	43,000	109,000
2046	2,602,000	386,000	0	76,000	192,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	441,000	61,000	0	39,000	66,000
2046	576,000	61,000	0	59,000	87,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	3,213,000	522,000	0	89,000	198,000
2046	5,334,000	694,000	0	148,000	324,000

Source: KPMG analysis

'With Port of Newcastle' scenario

The third scenario tests the potential introduction of Port of Newcastle as an additional container port, instead of Port Kembla. This scenario tests Port of Newcastle's attractiveness to shippers when Port Botany is not constrained.

Figure 7 overleaf shows the potential catchment area based on composite costs in 2046. This shows that the Port of Newcastle would be preferred by consignors and consignees north of Sydney. Although the Port of Newcastle will draw volumes from the Central Coast, Newcastle and the Hunter region, it will still be an area that would be subject to competition with Port Botany. While the region's proximity to the Port of Newcastle is an advantage, as with Port Kembla, Port Botany will still be attractive given its ability to offer shippers more services, as the port will handle more freight, and potentially lower wharfage, as the cost of Port Botany's infrastructure, much of which is sunk, can be recovered over higher volumes.

In addition, the Port of Newcastle will need to contend with competition from the Port of Brisbane. The proximity of the Port of Brisbane to the Northern Rivers region as well as Inverell and Moree, will see these areas continue to be served from Brisbane.

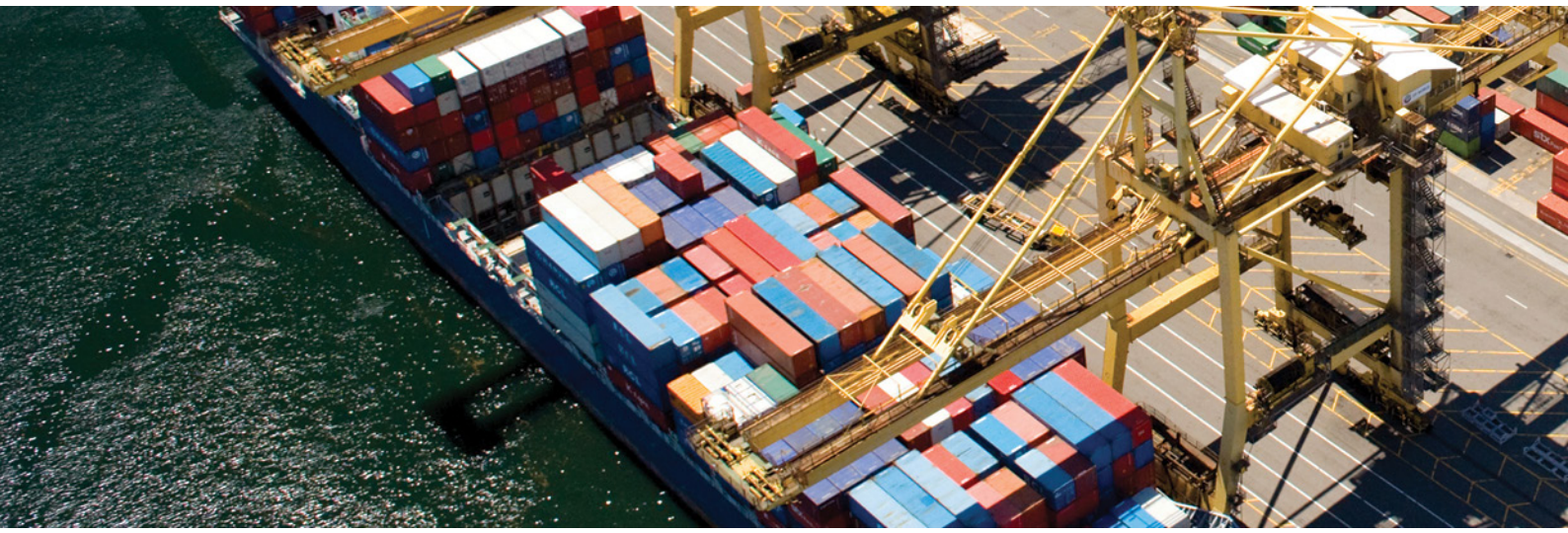
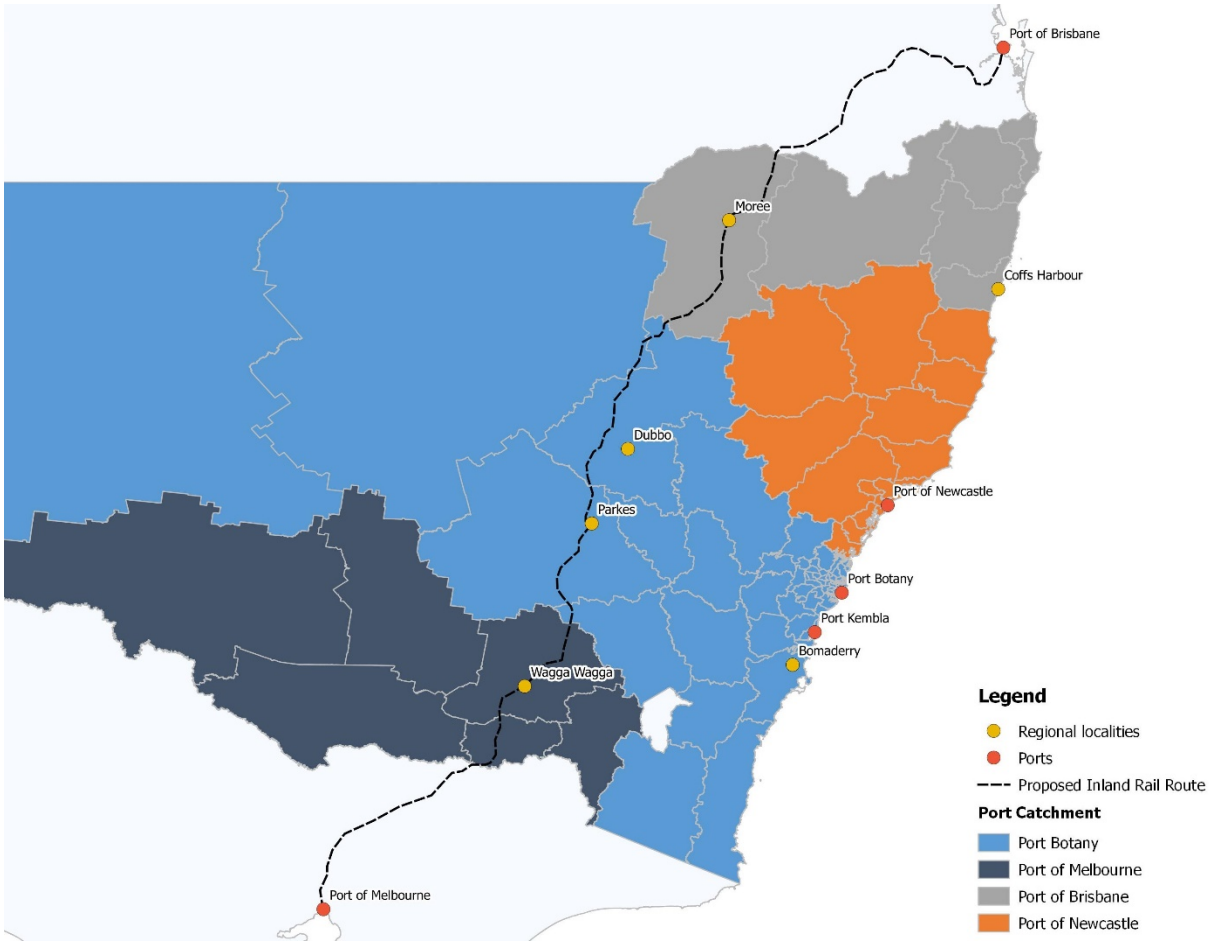


Figure 7: 2046 catchment map based on lowest costs under the 'with Port of Newcastle' scenario



Source: KPMG analysis. Costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

Table 4 overleaf provides a breakdown of the volume of containers by port under the 'with Port of Newcastle' scenario. Under this scenario, Port of Newcastle is projected to attract approximately 6 per cent of NSW container throughput in 2046 when Port Botany is unconstrained. However, absolute volumes in 2046 are projected to be below 400,000 TEUs. These volumes also serve to raise the wharfage required to cover the costs of construction considerably.

Table 4: Volume of NSW's containerised IMEX freight by TEU under the 'with Port of Newcastle' scenario

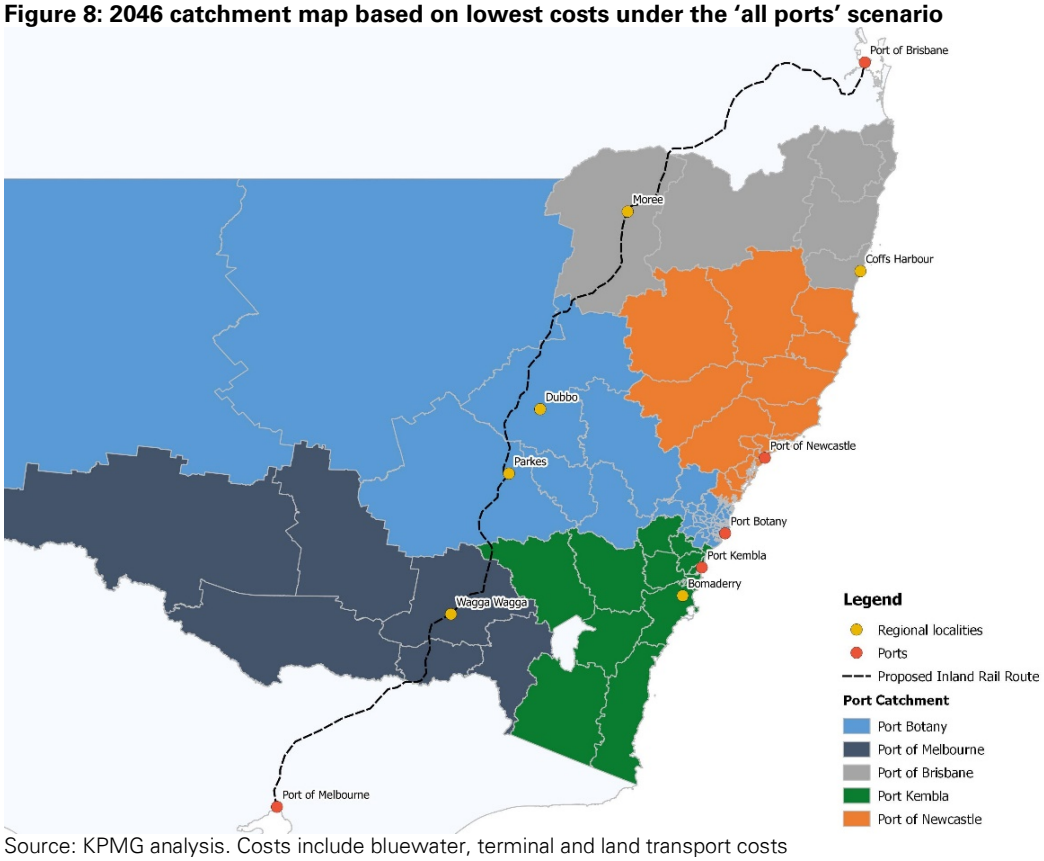
Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,750,000	0	127,000	40,000	101,000
2046	2,841,000	0	172,000	69,000	175,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	427,000	0	84,000	32,000	63,000
2046	556,000	0	95,000	50,000	82,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	3,470,000	0	289,000	78,000	184,000
2046	5,694,000	0	379,000	131,000	296,000

Source: KPMG analysis

'All ports' scenario

The final scenario assumes that both Port Kembla and Port of Newcastle container terminals are developed by 2031. Figure 8, Table 5 and Table 6 provides the potential catchments and a breakdown of the share of containers by port under the 'All Ports' scenario. This scenario seeks to test whether the shares of Port Kembla and Port of Newcastle may be affected by each other's presence in the market. When all ports are considered, the shares for Port Botany and Port Kembla are not materially different from the other scenarios.

Figure 8: 2046 catchment map based on lowest costs under the 'all ports' scenario



Source: KPMG analysis. Costs include bluewater, terminal and land transport costs

Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

Table 5: Share of NSW's containerised IMEX freight by % under the 'All Ports' scenario

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	95.4%	0.0%	0.0%	1.4%	3.2%
2031	72.6%	13.9%	6.5%	2.0%	5.0%
2046	75.0%	11.6%	5.6%	2.2%	5.5%
Full exports					
2016	91.6%	0.0%	0.0%	0.7%	7.7%
2031	61.6%	8.4%	14.2%	5.4%	10.4%
2046	63.6%	6.6%	12.6%	6.5%	10.6%
All containers					
2016	95.9%	0.0%	0.0%	0.9%	3.2%
2031	73.6%	12.4%	7.5%	2.0%	4.6%
2046	76.6%	10.4%	6.2%	2.1%	4.7%

Source: KPMG analysis

Table 6: Share of NSW's containerised IMEX freight by volume under the 'All Ports' scenario

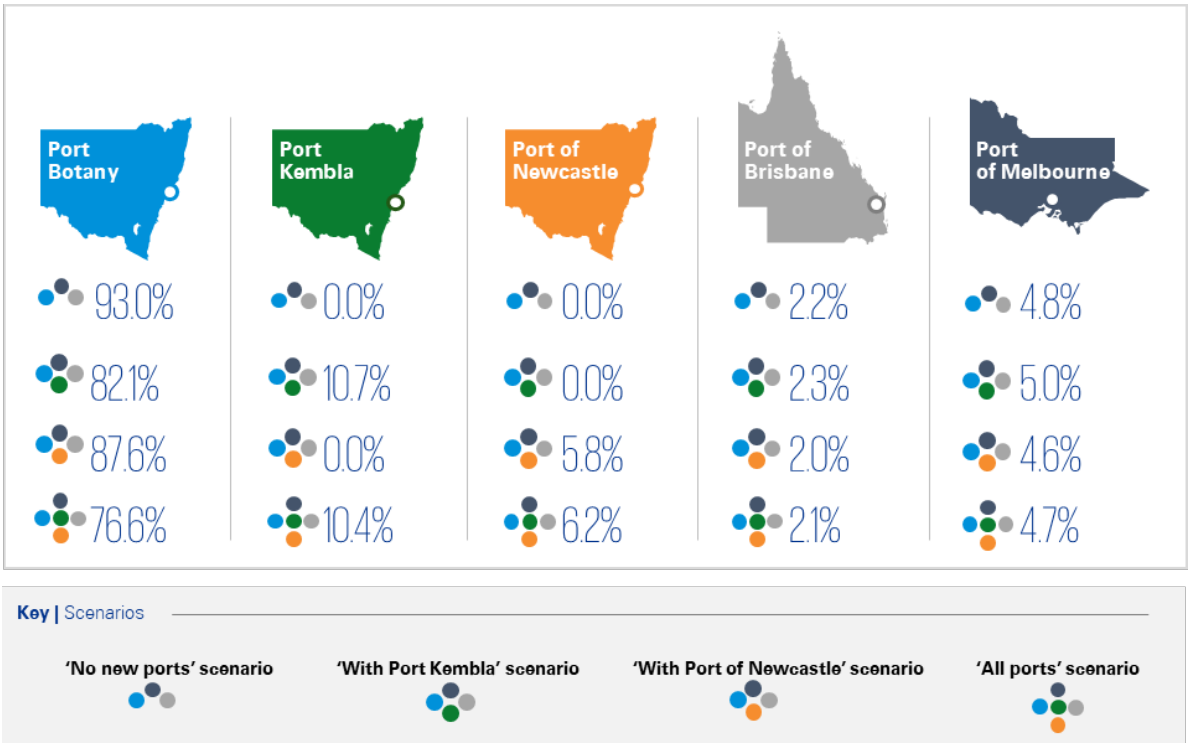
Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,465,000	281,000	131,000	40,000	101,000
2046	2,444,000	379,000	183,000	71,000	180,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	374,000	51,000	86,000	33,000	63,000
2046	498,000	52,000	99,000	51,000	83,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	2,960,000	498,000	300,000	79,000	185,000
2046	4,979,000	676,000	406,000	135,000	305,000

Source: KPMG analysis

Summary of scenarios

Based on the port scenarios tested, Port Botany is projected to continue to attract a majority of the state's containers. Should Port Kembla also be established, its proximity to Sydney – particularly Western and South Western Sydney where much of the state's logistics and warehousing activity occurs, would see it attract a little over ten per cent of future container volumes by 2046.

Figure 9: 2046 port shares by scenario



Source: KPMG analysis

An additional port may well lead to an increase in costs across the container supply chain. Compared to the 'no new ports' scenario, costs across the container supply chain would be at least $21 million per year higher by 2046 if one additional container port was developed. This cost increases to $75 million per year by 2046 with two additional container ports.

This demonstrates the efficiency that may be gained from using existing port infrastructure as opposed to developing new port infrastructure, the costs of which need to be recovered from users (or potentially taxpayers).

We note that these costs do not include the broader impacts of higher costs on the economy, including the public cost of infrastructure that would be required to support any new container port.

Landside connections and constraints

The NSW Port Choice Model developed by KPMG does not account for the residual cost to the public for new infrastructure required for either port, focusing on costs expected to be incurred by users.

However, this is an important consideration in the overall contemplation of the best location for additional container capacity to service NSW.

The requirement for public infrastructure investment is driven by the road and rail constraints to/from each port, which are summarised below.

Connections to the Illawarra

Rail

- Port Kembla enjoys good rail connectivity through the port, servicing the steel industry and wider cargo movements.
- Port Kembla is connected to Sydney's Metropolitan Freight Network and the interstate freight network via either the Illawarra line to Sydney; or the Moss Vale to Unanderra line which connects to the Main South (Sydney-Melbourne) line, at Moss Vale.
- While freight could face greater pressure for paths from passenger demands on the Illawarra Line, publicly available information suggests the line has 20 spare paths, which could accommodate up to 1 million TEUs.
- The Moss Vale to Unanderra Line, while providing a longer route, provides network resilience and largely avoids much of the passenger traffic in Sydney.
- While Port Kembla is serviced by two existing rail connections to Sydney, the Illawarra Line is affected by growing passenger train priority and can be affected by weather events; whilst it is longer, increasing transport time. This may offer some opportunity to delay the development of the planned Maldon-Dombarton Rail Line (MDRL), at least in the initial years of operation.
- Based on a single track alignment with diesel based operations, the cost of developing the MDRL was estimated to be $806 million in 2013-14, approximately $850 million today[8].

Road

- The road network connecting Sydney and Port Kembla provides broad connections to Sydney; with Picton and Appin Roads providing connections to the south west of Sydney and the M1 Princes Motorway connecting to southern Sydney.
- The M1 Princes Motorway sees heavy vehicles account for 17 per cent of all traffic. Good road connections would complement a future container terminal investment at Port Kembla.
- Drawing on guidance from the Highway Capacity Manual and current peak period heavy vehicle volumes, the motorway's capacity has been estimated to be in the order of 1,400 vehicles per lane per hour.
- At historical growth rates, capacity appears to be available for approximately two decades – although improvements may be necessary to improve safety, and on Picton and Appin Road, increase capacity.

[8] Ibid. Costs escalated in line with movements in the 'Other Heavy and Civil Engineering Construction' price index, which forms part of the ABS Producer Price Index

Connections to the Hunter

Rail

- A container port at Newcastle currently does not enjoy the same advantages as Port Kembla in terms of rail connections, with only one link, shared with a mix of passenger and freight traffic.
- Connecting Newcastle to Sydney's logistics hubs across Western Sydney would require freight rail services to traverse the constrained Main North Line (between Strathfield and Newcastle) which is subject to substantial and growing passenger demand.
- ARTC[9] estimates just nine train paths are spare northbound and seven train paths are spare in the southbound direction on the Main North Line.
- A high-level assessment suggests that spare paths may realise capacity for around 400,000 TEUs[10], assuming a high level of back loading – whether this capacity would be available to service containers from the Port of Newcastle would depend on the level of demand from other potential path users.
- It is likely that a container port at Newcastle would instead require a new rail link between Sydney and the Port of Newcastle. However, this would likely be as challenging as it would be expensive, due to:
  - Undulating terrain, requiring extensive tunnelling and the construction of many bridges;
  - Protected lands and national parks, including culturally and environmentally sensitive areas; and
  - The comparatively longer distance between Newcastle and Sydney's key consumption areas.

Road

- As with the Sydney to Newcastle rail corridor, the M1 Motorway traverses rugged terrain and serves the growing population centres on the Central Coast.
- The M1 Pacific Motorway is an important conduit for freight movements, with heavy vehicles accounting for 18 per cent of all traffic – even during the morning peak period.
- Drawing on guidance from the Highway Capacity Manual[11] and current peak period heavy vehicle volumes, the motorway's capacity has been estimated to be in the order of 2,000 vehicles per lane per hour.
- At historical growth rates, capacity appears to be available for approximately 30 years notwithstanding that onward connections onto Pennant Hills Road (this will be better managed by NorthConnex) and Pacific Highway are congested currently.
- However, the road network does not provide a contiguous link to the Port of Newcastle.
- This would require container trucks to navigate the arterial road network through Wallsend or take the more circuitous route using the New England Highway.
- Both routes are busy during the commuter peak periods and investments on both routes are not inexpensive.

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[9] ARTC (2015), *2015-2024 Sydney Metropolitan Freight Strategy*
[10] We have assumed 10 paths in each direction, 600m trains to allow these trains to use existing loops and intermodal facilities in Sydney and 70 percent slot utilisation in both directions
[11] TRB (2016), Highway Capacity Manual, *Sixth Edition: A Guide for Multimodal Mobility Analysis*

Required Infrastructure

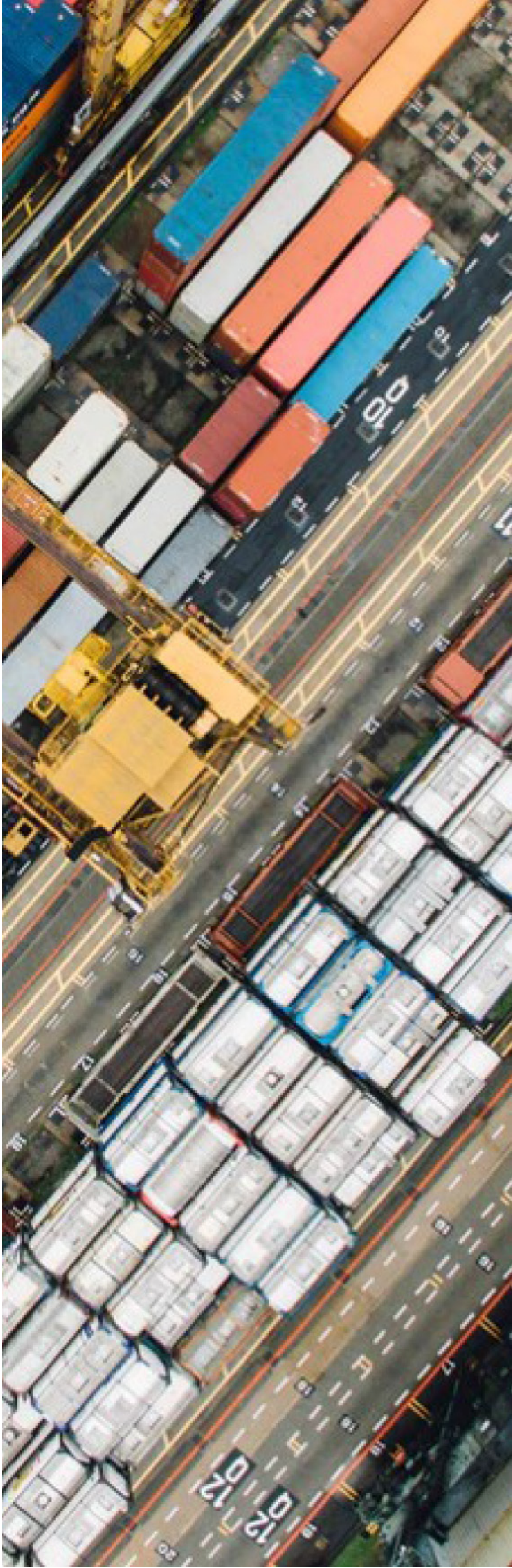
Of the two potential additional container ports, the Port of Newcastle would likely to be the first to trigger a requirement for more infrastructure. These works would include:

- A potential need for a dedicated rail alignment between Hexham and Fassifern to avoid container volumes impacting on local communities and passenger rail services.
- Augmentation of existing rail capacity on the Main North Line between Strathfield and Newcastle.
- Potential new rail initiatives/infrastructure to provide onward connections to Western Sydney - in its most ambitious form, a new rail alignment between Western Sydney and the Central Coast.
- Changes to the configuration of existing intermodal terminals in the Sydney region to accommodate longer trains that may serve Port of Newcastle.
- Various road improvements on the Newcastle road network to ease the flow of container trucks through the area.

With time, additional infrastructure would be required to improve the reliability of freight flows to and from Port Kembla.

Potential works would revolve around developing the Maldon-Dombarton Rail Link, along with potential improvements to the M1 Princes Motorway, Picton Road and Appin Road.

Road improvements are likely to be triggered by other demands, including safety as well as the emergence of new residential developments between South Western Sydney and the Illawarra.



Quay conclusions

Premature port investments = higher costs for NSW

Our key finding is that new container terminal capacity is not needed in NSW for several decades at least – and that premature development of a new terminal would increase costs across the entire NSW supply chain because it would:

- **Duplicate existing, lowest cost container capacity that is less than half full:** Port Botany has three competing stevedores who moved 2.7 million TEUs in 2017/18, within a theoretical capacity of over 7 million TEUs per annum – meaning it is less than half full.
- **Attract low volumes, because of higher costs:** User choice modelling shows that until Port Botany's stevedores near capacity, both Port Kembla and Port of Newcastle would struggle to attract enough users – because of their higher costs in recouping capital invested and higher landside transport costs to reach fewer users. Our modelling shows that under different scenarios where Port Kembla and/or Port of Newcastle are developed, by 2046, these ports will only account for circa 10 per cent and circa 6 per cent of total containerised trade respectively.
- **Require massive public investment to fund landside freight infrastructure:** 80 per cent of import containers are consumed within 40 km of Port Botany. Less than 1 per cent of full import containers were destined for regional areas; and 2 per cent destined for the Central Coast, Newcastle and Hunter regions. This means that most containers will need to travel to or from Sydney; in turn requiring many tens of billions in public funding to upgrade road and rail capacity.

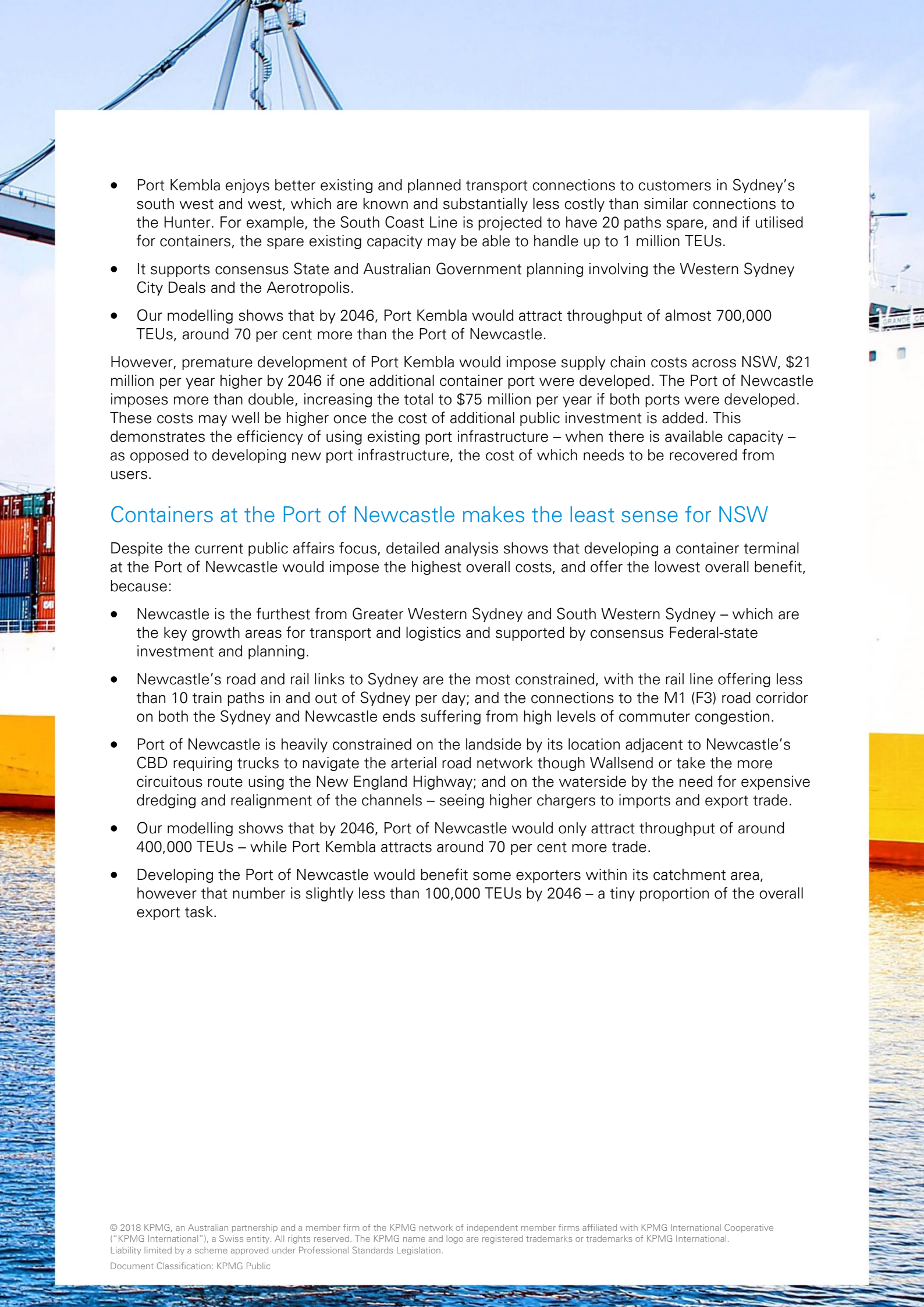
Maximising the use of Port Botany will ensure that the benefits are harnessed from existing and committed investments made by the Australian Government, the NSW Government and businesses including WestConnex, the Southern Sydney Freight Line, Moorebank Intermodal Terminal and Sydney Gateway.

Port Botany's role as the container 'growth port' also ensures continuing alignment to the supporting supply chain investments made by businesses including NSW Ports, stevedores and warehousing and logistics assets developed by major customers.

Port Kembla makes the most sense for containers, but only once Port Botany nears capacity

Our next finding confirms that Port Kembla offers the lowest overall costs and highest overall benefits for an additional container port – but only when it is needed in several decades – because:

- Port Kembla's proximity to the population and employment growth areas in Greater Western Sydney and South Western Sydney enhance its attractiveness as a second container port, when required.
  - Analysis of census data shows that Sydney is home to 70 per cent of all transport, postal and warehousing jobs across the state, compared to 9 per cent collectively for the Central Coast, Newcastle and Hunter region. By 2046, this density is expected to increase in the Western Sydney Employment Area, west of Eastern Creek.
  - Port Kembla is circa half the distance relative to Newcastle from the five largest container consumption areas in 2046, as projected by TfNSW – which all reside in Western and South Western Sydney.



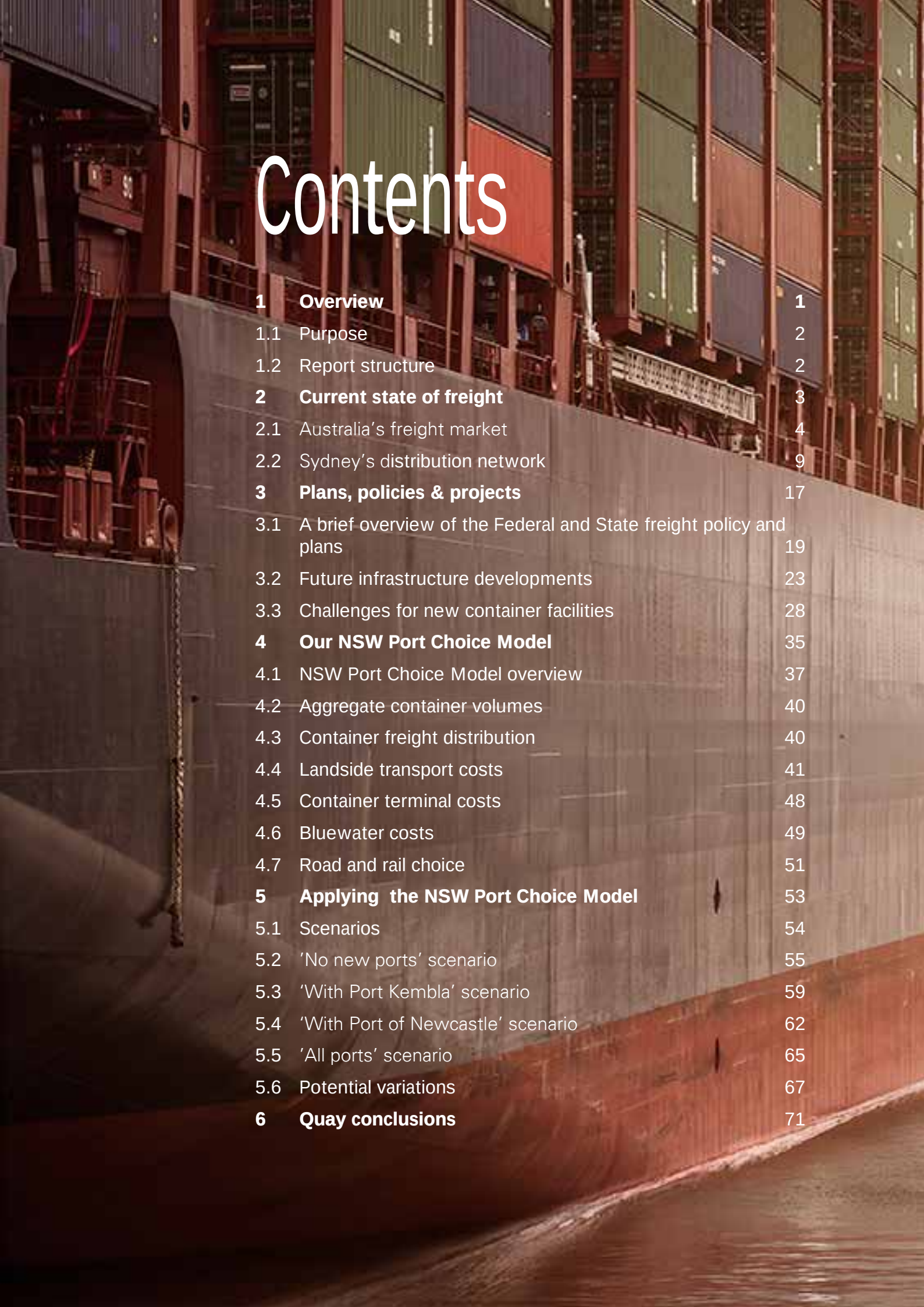
- Port Kembla enjoys better existing and planned transport connections to customers in Sydney's south west and west, which are known and substantially less costly than similar connections to the Hunter. For example, the South Coast Line is projected to have 20 paths spare, and if utilised for containers, the spare existing capacity may be able to handle up to 1 million TEUs.
- It supports consensus State and Australian Government planning involving the Western Sydney City Deals and the Aerotropolis.
- Our modelling shows that by 2046, Port Kembla would attract throughput of almost 700,000 TEUs, around 70 per cent more than the Port of Newcastle.

However, premature development of Port Kembla would impose supply chain costs across NSW, $21 million per year higher by 2046 if one additional container port were developed. The Port of Newcastle imposes more than double, increasing the total to $75 million per year if both ports were developed. These costs may well be higher once the cost of additional public investment is added. This demonstrates the efficiency of using existing port infrastructure – when there is available capacity – as opposed to developing new port infrastructure, the cost of which needs to be recovered from users.

Containers at the Port of Newcastle makes the least sense for NSW

Despite the current public affairs focus, detailed analysis shows that developing a container terminal at the Port of Newcastle would impose the highest overall costs, and offer the lowest overall benefit, because:

- Newcastle is the furthest from Greater Western Sydney and South Western Sydney – which are the key growth areas for transport and logistics and supported by consensus Federal-state investment and planning.
- Newcastle's road and rail links to Sydney are the most constrained, with the rail line offering less than 10 train paths in and out of Sydney per day; and the connections to the M1 (F3) road corridor on both the Sydney and Newcastle ends suffering from high levels of commuter congestion.
- Port of Newcastle is heavily constrained on the landside by its location adjacent to Newcastle's CBD requiring trucks to navigate the arterial road network though Wallsend or take the more circuitous route using the New England Highway; and on the waterside by the need for expensive dredging and realignment of the channels – seeing higher chargers to imports and export trade.
- Our modelling shows that by 2046, Port of Newcastle would only attract throughput of around 400,000 TEUs – while Port Kembla attracts around 70 per cent more trade.
- Developing the Port of Newcastle would benefit some exporters within its catchment area, however that number is slightly less than 100,000 TEUs by 2046 – a tiny proportion of the overall export task.



Contents

01

Overview

1.1 Purpose

The purpose of this study is to determine the relative competitiveness and the likely catchment areas of Port Botany, Port Kembla and Port of Newcastle as container ports, considering the entire logistics chain costs from source to consumption, including costs incurred from additional terminal investment, through the development of an evidence based origin destination model for containers in NSW.

1.2 Report structure

The report is structured as follows:

- **Chapter 2** provides an overview of current and near term trends associated with Port Botany.
- **Chapter 3** considers the position of government policies and associated infrastructure plans and their potential to shape the competitive landscape.
- **Chapter 4** outlines a strategic whole-of-chain model to assess the impact of cost changes in the chain and their potential impact on the catchments of legacy and potentially new container terminals.
- **Chapter 5** summarises the model outcomes, after applying this model to potential port competition scenarios.
- **Chapter 6** summarises the key findings as well as other considerations that may impact on port competitiveness in the future.

Appendix A provides a summary of the relevant state government plans and strategies and **Appendix B** provides the detailed inputs and assumptions used in the freight container model.

02

Current state of freight

2.1 Australia's freight market

Freight is the life blood of the national economy, underpinning all aspects of daily life. The cost of freight is added to each imported item we purchase; and is added to the final price of the goods Australia exports to foreign markets.

In this way the cost of freight is ultimately absorbed by consumers in the price we pay for household or other goods; and is added to the price of each good Australian businesses export to global markets.

Freight is rarely 'front page news', but the cost of poor freight policies or projects ultimately accrue to each Australian business and each Australian household – meaning good choices underpin individual household wellbeing and overall economic growth.

The structure of Australia's economy and ongoing shift away from domestic manufacturing, means that most imports arrive through the main capital city container ports; while most exports leave via largely remote bulk commodity ports.

This report considers the current structure and forward requirements of the NSW container freight market.

Australia's container freight market sees:

- Over 80 per cent of Australia's containerised freight flows through just three key container ports; Port Botany, Port of Melbourne and the Port of Brisbane[12].
- 90 per cent of containerised freight in New South Wales (NSW) moves through Port Botany, with some competition with Melbourne and Brisbane in the State's southern and northern regions[13].

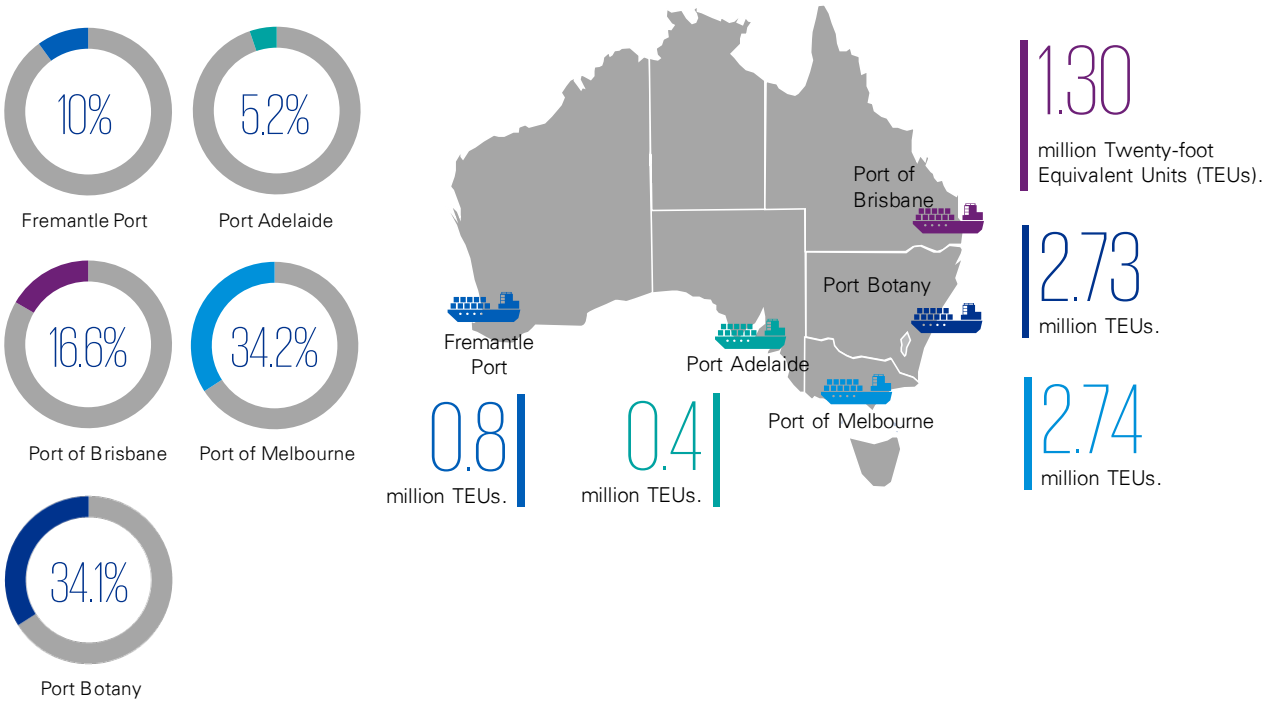
Each of the existing major ports has capacity to accommodate growth for many decades; but the very long-term nature of freight planning has seen a range of potential new container ports explored in recent years, in the context of long-term freight requirements.

Examples include Victoria's consideration of new container capacity at either Bay West or Port of Hastings; and the recent Deloitte Access Economics report, commissioned by Port of Newcastle, which considered whether Newcastle – the world's largest coal export port – could play a useful role in Australia's growing container freight task.

[12] ACCC (2018), Container stevedoring monitoring report 2017-18.
[13] NSW Ports, Navigating the Future NSW Ports' 30 Year Master Plan, October 2015

Figure 10 shows the 2017/18 market share and throughput of Australia's container ports – with the three major ports handling five out of six containers entering or exiting the country.

Figure 10: Market share and throughput of Australia's five major container ports (2017/18)



Source: ACCC (2018)[14]

What is a TEU?

A twenty-foot equivalent unit, or a TEU, is a standardised metal container that is 20 feet long. These containers were designed to allow freight to be readily transferred between ships, trains and trucks. The standardisation of these containers has contributed the easier movement of freight.

Australia's three major sea ports have undertaken major investment in new waterside capacity – with new terminals in Sydney and Melbourne. Brisbane has significant unused capacity to expand its waterside berthing as needed.

These waterside investments have been matched by significant land-side capacity upgrades at each major port, including motorway grade connections and dedicated freight rail projects under delivery or in advanced stages of planning.

Interstate freight infrastructure is also being substantially upgraded, with examples including:

- **Inland Rail:** A circa $11 billion dedicated north-south interstate freight rail line, connecting Brisbane and Melbourne via western NSW to provide relief through Sydney. This is due to be completed by 2024; and
- **Pacific Highway:** A dual carriageway road freight connection between Sydney and Brisbane, to be completed in 2020.

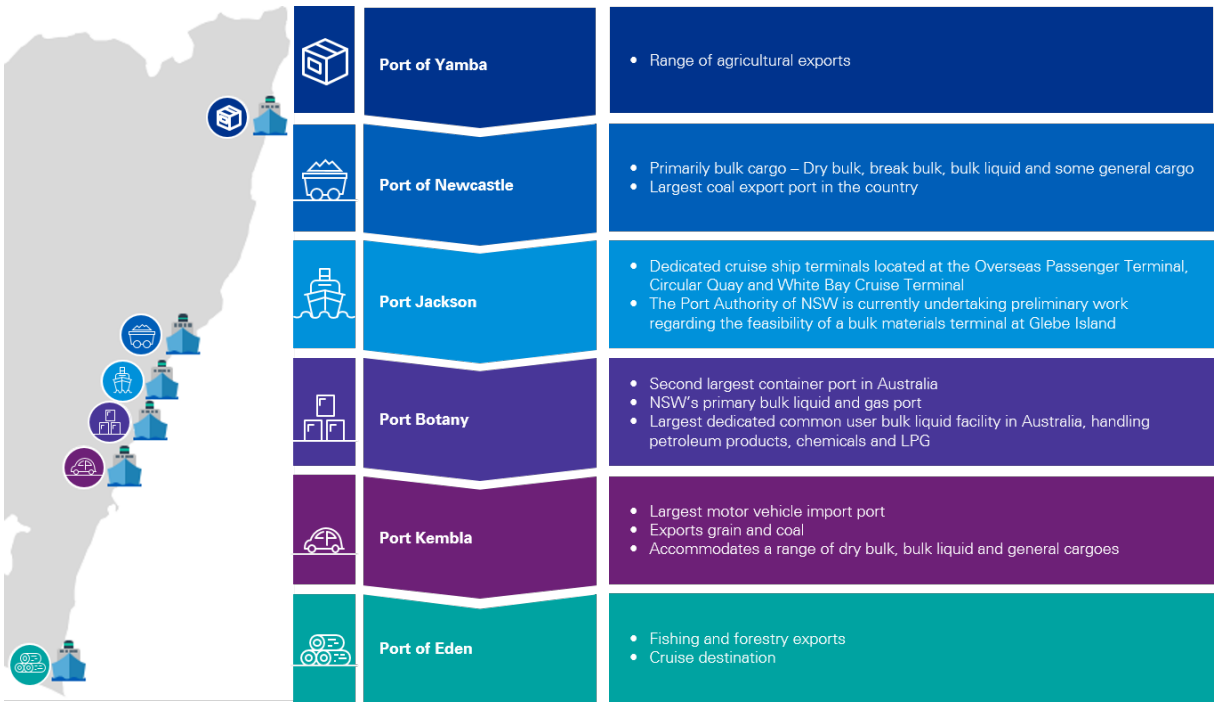
[14] ACCC (2018), Container stevedoring monitoring report 2017-18

2.1.1 Different ports do different jobs

Within NSW there are four major ports, as well as minor ports at Yamba and Eden. Each of these ports has dedicated facilities to serve specialised industries and customer groups. For example, Port Botany is one of Australia's largest container ports and moves practically every container entering or leaving NSW – and more than one third of all containers nationally. In addition, Port Botany is NSW's primary bulk liquid and gas port.

Newcastle is focused on coal and bulk exports – and is the world's largest coal export port; while Port Kembla is focused on 'roll on, roll off' vehicle imports. The dominant roles of each NSW port are outlined in Figure 11.

Figure 11: Overview of ports in NSW



Source: NSW Ports[15], NSW Government[16] and the Port Authority of NSW[17]

2.1.2 Container dynamics: the role of Port Botany

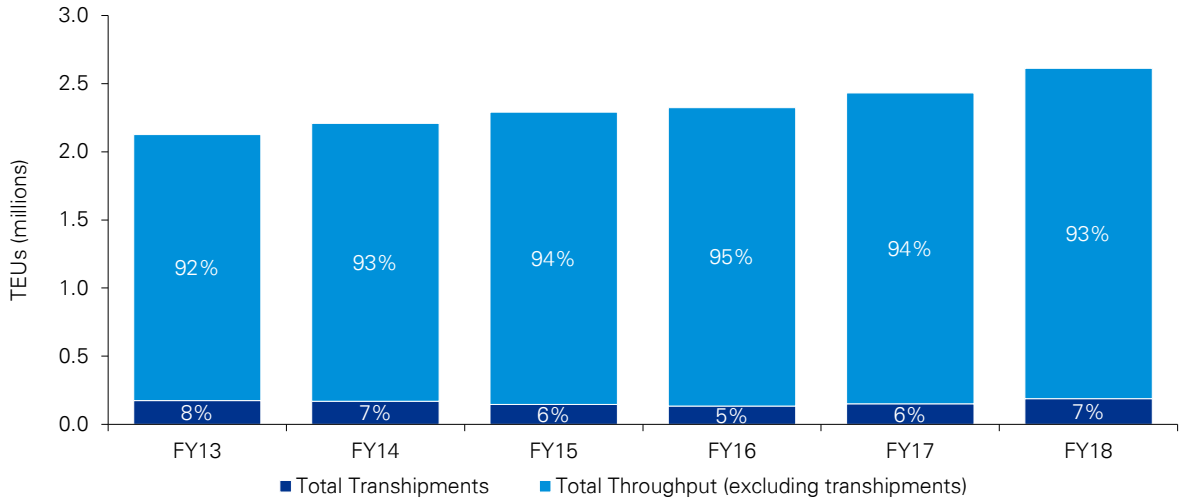
Containerisation has intensified competition between global ports – and fundamentally changed the way container ports operate - and how they compete. Globally, this has seen port container volumes converge through a smaller number of more efficient ports, vigorously competing with one another.

These trends have been reflected in Australia, but at a smaller scale and with less inter-port competition, mainly because of Australia's relatively small volumes of containerised trade but also due to concentrated settlement patterns and long-distances which make 'Le Havre Hamburg Range[18]' style competition less likely to emerge.

In practice, Australia's ports are located at the 'end of the line' for shipping companies, meaning that transhipments – the shipment of goods or containers to an intermediate destination, then yet to another destination, are (extremely) limited. For example, at Port Botany transhipments account for approximately 7 per cent of total containerised volume on average per year (as detailed in Figure 12).

[15] NSW Ports, Navigating the Future NSW Ports' 30 Year Master Plan, October 2015
[16] NSW Government, NSW Freight and Ports Plan 2018 – 2038, September 2018
[17] Port Authority of NSW, Annual Report 2016-17, October 2017
[18] This range is defined as consisting of the ports of Hamburg, Amsterdam, Rotterdam, Antwerp, Zeebrugge, Dunkirk, Le Havre and Bremerhaven. These ports operate in a highly competitive environment.

Figure 12: Port Botany – Transhipments as a proportion of total TEUs

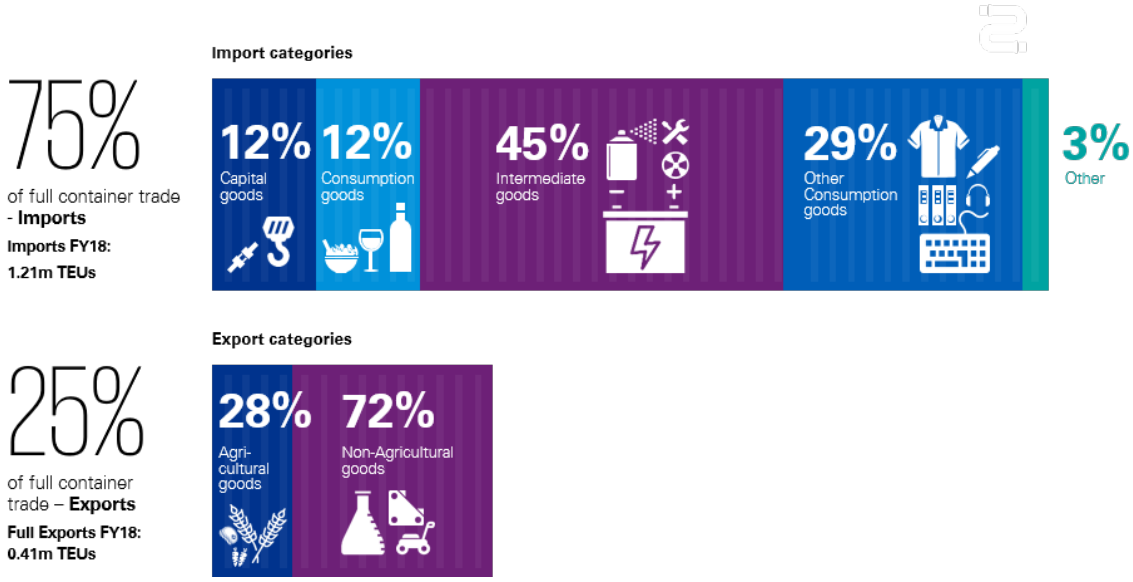


Source: NSW Ports (2018)

2.1.3 What items does Port Botany import and export in containers?

The primary form of trade through Port Botany is through containers. Port Botany imports and exports a range of items through these containers, as detailed in Figure 13 below.

Figure 13: Breakdown of containerised trade at Port Botany



Source: NSW Ports (2018)

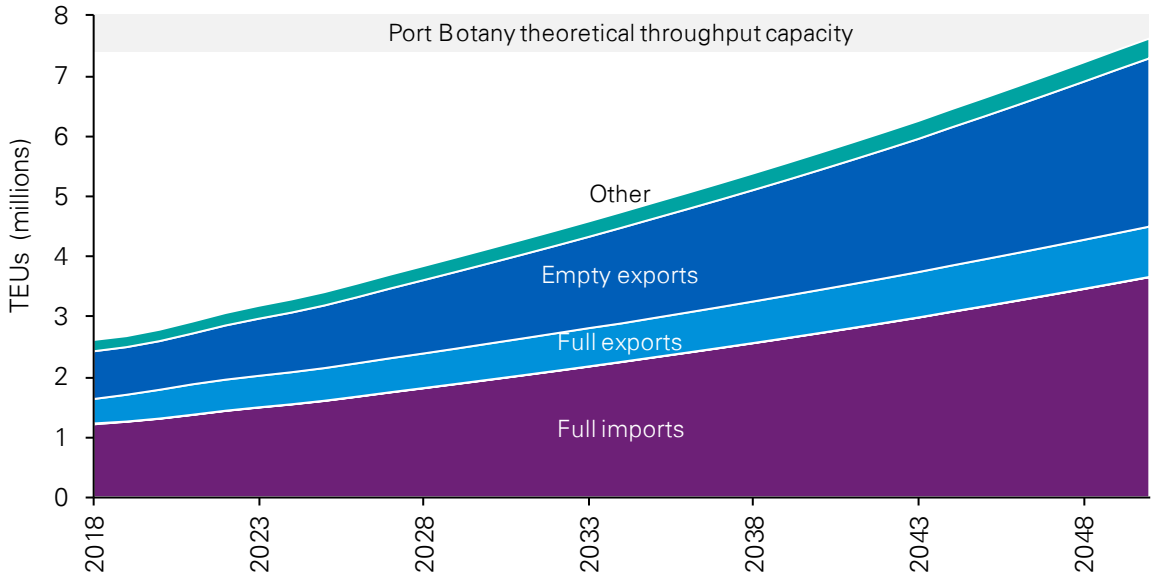
In relation to imports, the composition reflects a combination of goods that are used as inputs into business processes here (e.g. machinery) and parts or consumption goods for sale to the local market (e.g. electronics). On the export side, containerised trade is overwhelmingly driven by agricultural commodities (e.g. meat).

2.1.4 Port Botany's projected growth and estimated capacity

In 2017/18, Australia's total container volumes across all ports was 8 million twenty-foot equivalent units (TEUs), the highest-ever volume.

Figure 14 below shows that over the coming 30 years, Port Botany's container throughput will be almost as large as Australia's current total container trade volume; growing at 3.4 per cent per annum and reaching 7.6 million TEUs by the middle of the century, assuming no capacity constraints. NSW Ports' current planning is based around a theoretical throughput capacity between seven and eight million TEU per annum, based on current technologies, known infrastructure and current business models.

Figure 14: Projected container throughput at Port Botany



Source: BIS Oxford Economics for NSW Ports

While current volumes remain below theoretical capacity, achieving this capacity does depend on everyone in the container supply chain making the appropriate investments at the right place and at the right time. This involves co-ordinated decision making not only by NSW Ports, but stevedores, their customers as well as all three levels of government, their agencies and transport network managers. Therefore, ongoing planning relating to how NSW handles its containers to and from Port Botany; and potentially from an additional container port, requires ongoing monitoring and policy development to ensure that the community and businesses get value for money from major investments that support the container supply chain.

2.2 Sydney's distribution network

2.2.1 Where do the containers go?

In considering long-term port and freight capacity, it is important to understand how, where and why containers travel across Sydney and NSW. For example, more than 80 per cent of full import containers arriving at Port Botany will reach their destination within 40 kilometres of the Port's gate[19].

Our review of the origin destination data drawn from Transport for NSW's (TfNSW's) Strategic Freight Model[20] (SFM) suggests that few full import containers leave the city. Based on 2016 data, less than 1 per cent of full import containers was destined for regional areas. Even within urban areas, only 2 per cent of full import containers are attributable to the Central Coast, Newcastle and Hunter regions.

As Sydney's population and land values have increased, this has in turn seen new, large-scale intermodal, logistics and delivery centres all moving further westward – away from traditional industrial locations around Port Botany, in favour of new facilities in Western Sydney, reflecting population patterns. Figure 19 illustrates population growth and projections by NSW region in 2016 and 2036 – a key driver of the intensification of industrial activity in Western and South Western Sydney, and the westward shift in the distribution of import containers.

This westward drift is being met by investment from companies in new, state of the art intermodal, logistics and distribution centres across Sydney's greater west and south west. Already, these areas are emerging as logistics powerhouses, with centralised warehousing being commonplace within the M4 and M7 Motorway corridors.

Warehouses and distribution centres are already strategically located across the transport network to maximise transport efficiency. The development of modern intermodal facilities will provide further impetus for the development of additional warehousing and delivery centres, in line with demand growth.

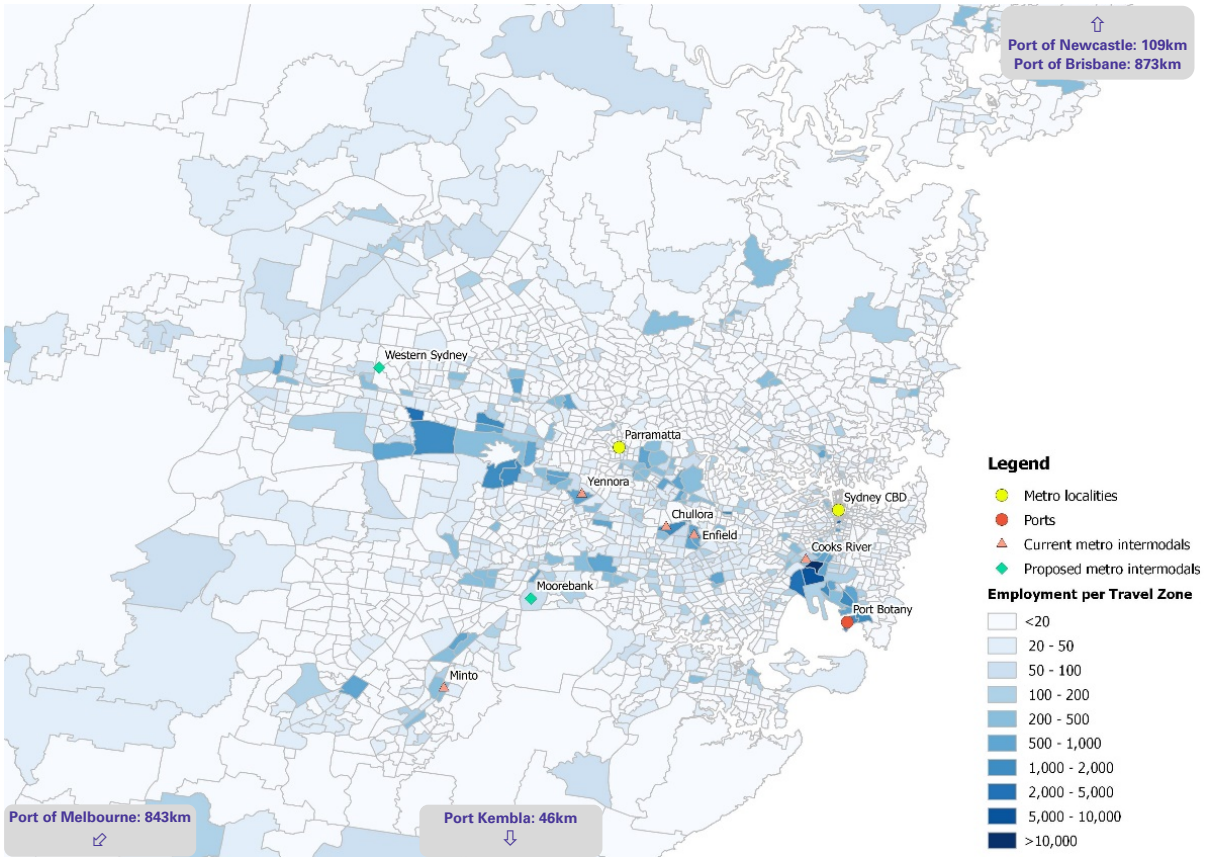
It is expected that this trend will continue. Retailers are constantly seeking to increase their purchasing power and reduce their cost of storing inventory in store. Major retailers, for example Coles and Woolworths, already have well established distribution centres and networks spanning Western Sydney.

These trends are best illustrated using the distribution of transport, postal and warehousing job projections prepared by TfNSW. Figure 15 illustrates the distribution of these jobs in 2016. Already, most of these jobs, aside from around Port Botany, are located in South Western and Central Western Sydney. Most notably, the distribution follows a key freight corridor that has developed over time stretching between the port and Eastern Creek.

[19] NSW Ports, Navigating the Future NSW Ports' 30 Year Master Plan, October 2015

[20] Further detail on the SFM is contained in section 4.1

Figure 15: 2016 transport, storage and warehousing jobs



Source: TfNSW Travel Zone Employment Projections

An analysis of 2016 Census employment data, shown in Table 7, reinforces the absolute scale Sydney has in the transport sector. In absolute terms, Sydney is home to 87 per cent of warehousing and storage service workers and 70 per cent of all transport, postal and warehousing jobs across the state. By comparison, the Central Coast, Newcastle and Hunter region collectively is home to 5 per cent of warehousing and storage service workers and 9 per cent of all transport, postal and warehousing jobs across the state. The corresponding proportions for the Illawarra stood at 1 per cent and 3 per cent respectively.

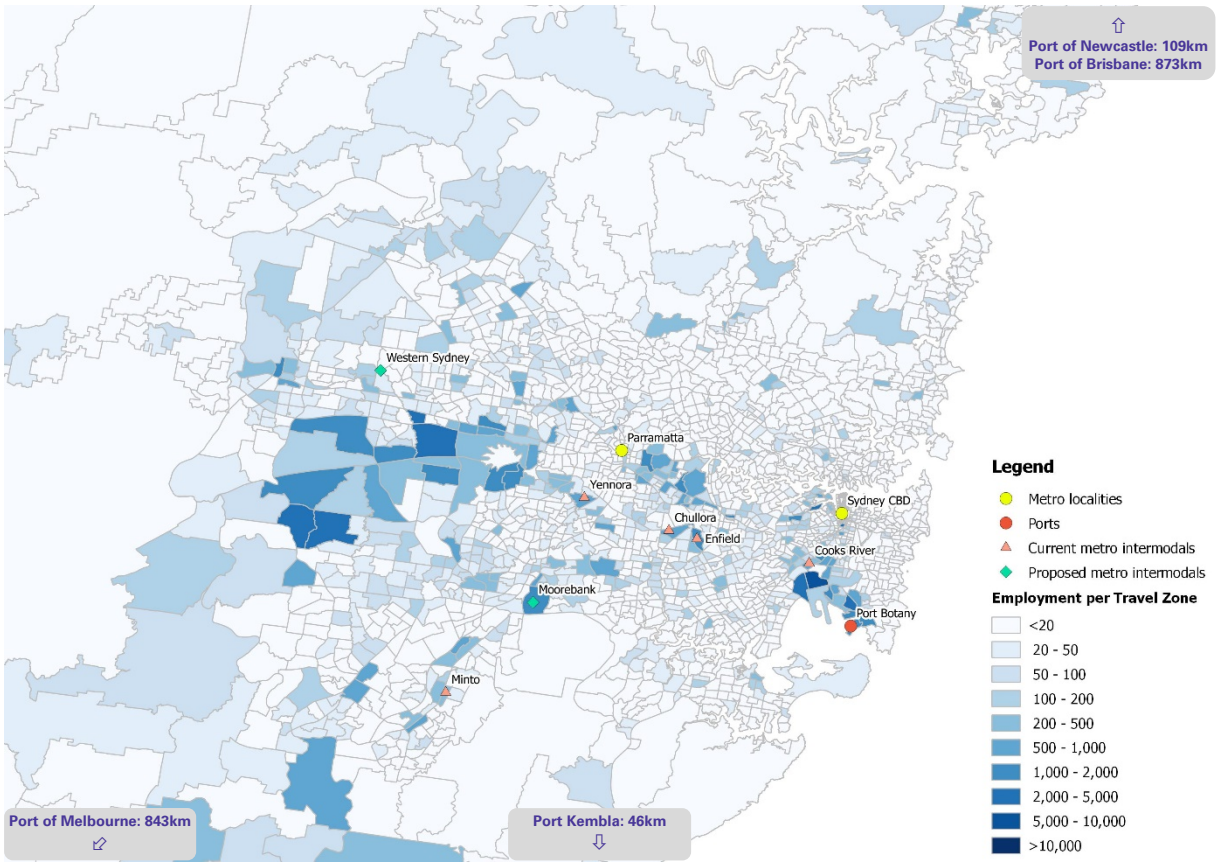
Table 7: Place of work within the transport sector

State/SA4	Warehousing and Storage Services Sub-Sector	Postal and Courier Pick-up and Delivery Services Sub-Sector	Transport, Postal and Warehousing Sector	All Sectors
NSW	14,899	23,797	158,296	3,358,175
Greater Sydney	12,902	16,039	110,271	2,209,294
Central Coast	382	628	3,185	104,732
Newcastle & Lake Macquarie	258	1,127	6,791	155,588
Hunter excluding Newcastle	116	468	3,591	100,101
Illawarra	182	727	4,195	102,028

Source: Based on KPMG analysis of 2016 Census data

By 2046, TfNSW projects that the density of transport, postal and warehousing jobs will increase in the Western Sydney Employment Area, west of Eastern Creek. In the context that employment opportunities in this sector could become increasingly challenged due to the general shift of employment towards the services sector, and the role technology will play in rationalising jobs, these increases represent a further concentration in activity.

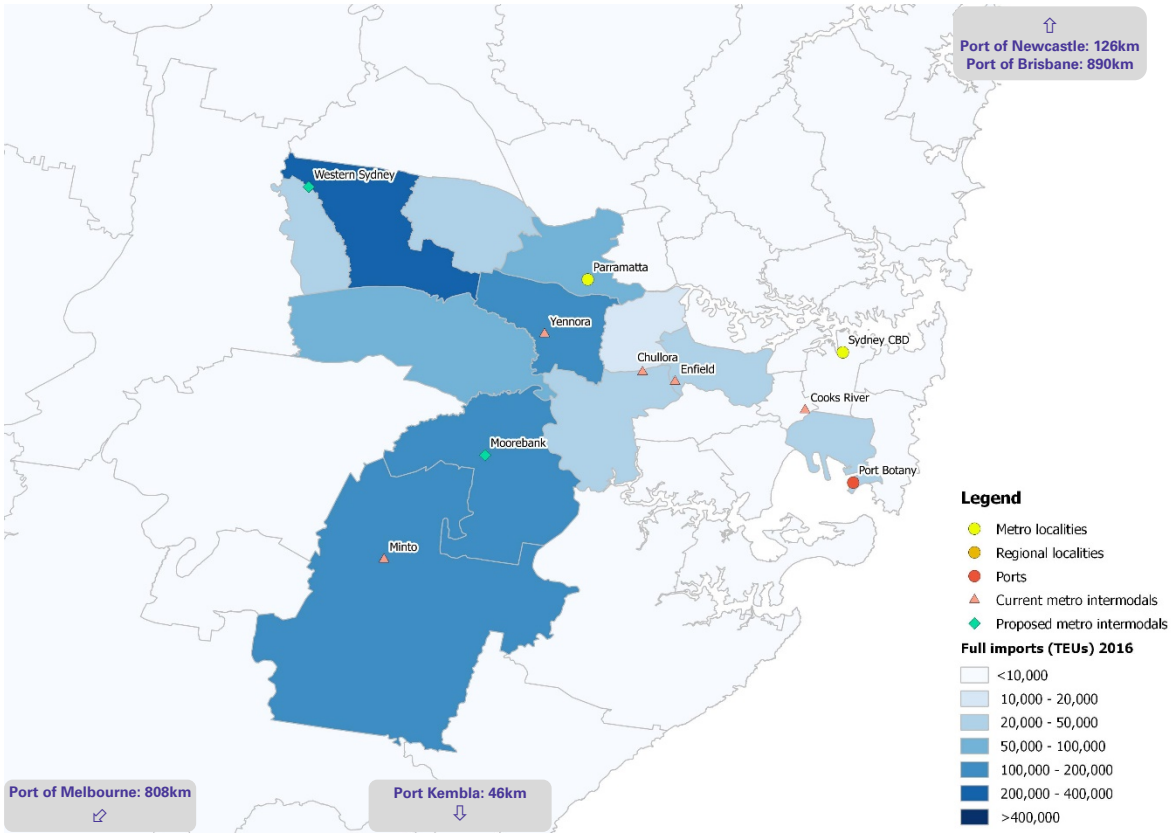
Figure 16: 2046 transport, storage and warehousing jobs



Source: TfNSW Travel Zone Employment Projection

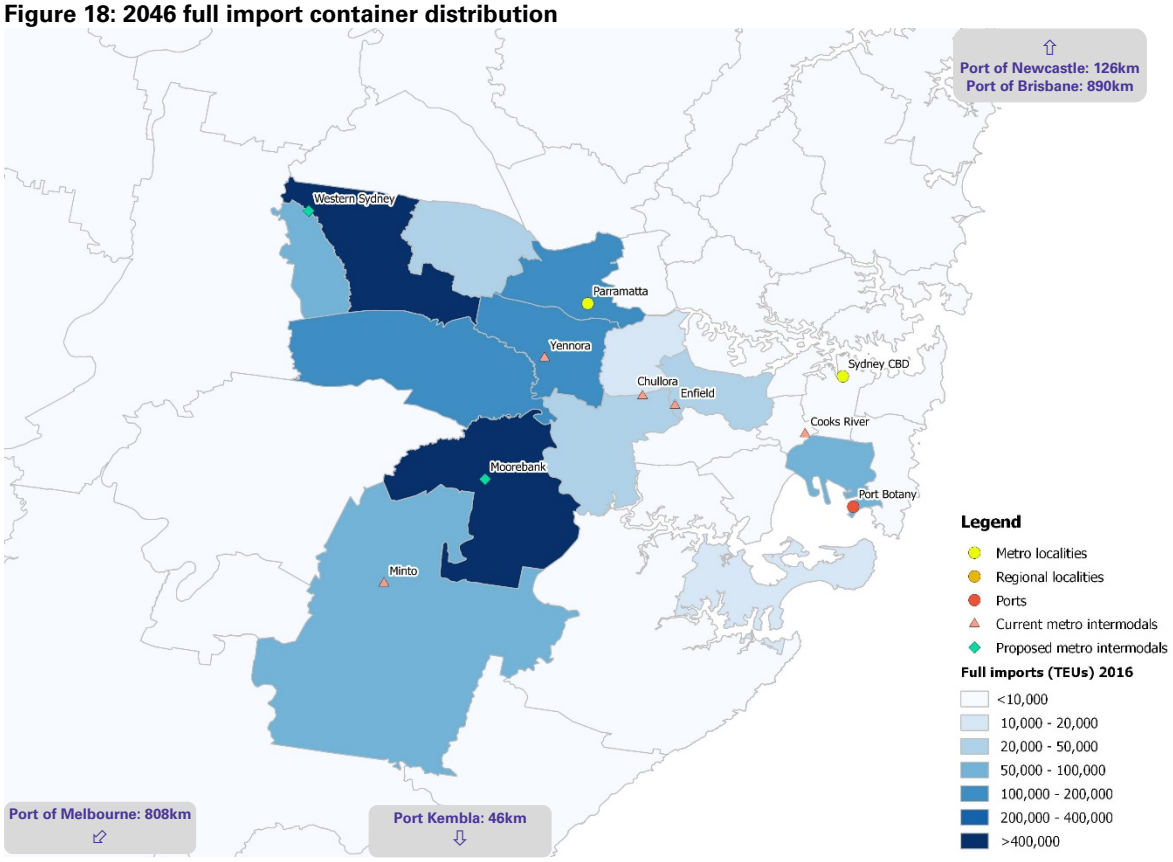
Figure 17 and Figure 18 overleaf illustrate the distribution of full import containers in Sydney and its surrounds in 2016 and 2046, as projected by SFM. The spread of containers is consistent with the distribution of transport, postal and warehousing jobs. Further detail on the methodology used for this analysis is contained in section 4.3.

Figure 17: 2016 full import container distribution



Source: Based on TfNSW SFM data

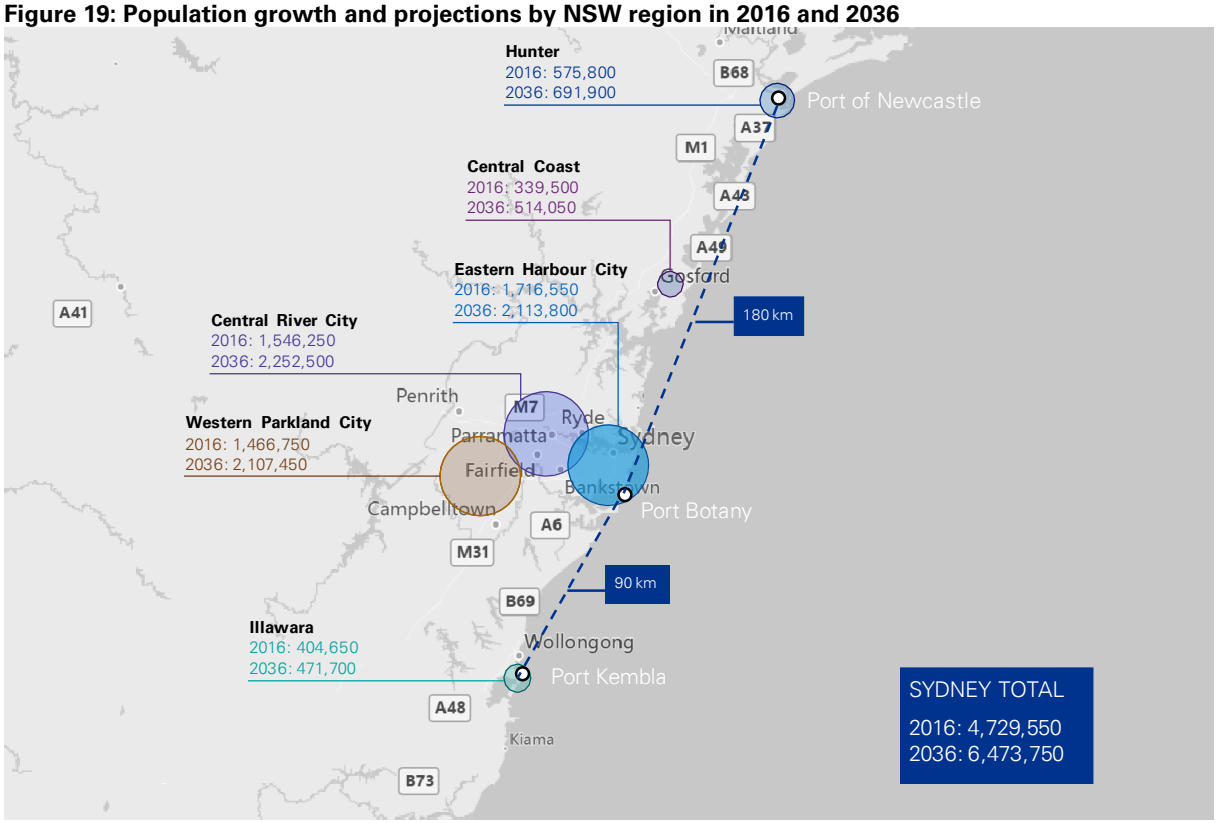
Figure 18: 2046 full import container distribution



Source: Based on TfNSW SFM data

Figure 19 illustrates population growth and projections by NSW region in 2016 and 2036 – a key driver of the intensification of industrial activity in West and South Western Sydney, and the westward shift in the distribution of import containers.

Figure 19: Population growth and projections by NSW region in 2016 and 2036



Source: NSW Ports (2018) based on NSW Government Common Planning Assumptions[21]

2.2.2 How do containers move from Port Botany?

While Port Botany enjoys substantial capacity for additional container throughput on the port and water side, it has also suffered increasing landside transport constraints from urban encroachment. Planning policies that have intensified residential development around the Port mean that the freight task has increasingly been impacted by urban commuter congestion affecting the road and rail network.

A 2017 analysis of the local road network showed that even within the wider Port precinct, port related trucks only accounted for circa 15 per cent of all movements, with passenger vehicles making up the overwhelming majority of trips. In the past decade or so, this has formed an increasing policy focus with a range of infrastructure and operational changes implemented or planned, to ease freight and road congestion around Port Botany.

Historically, the short distances travelled by most container freight has limited the ability of short haul rail freight to compete with the flexibility and efficiency of road transport. However, a range of factors have combined to increase the relative attraction of rail freight, including:

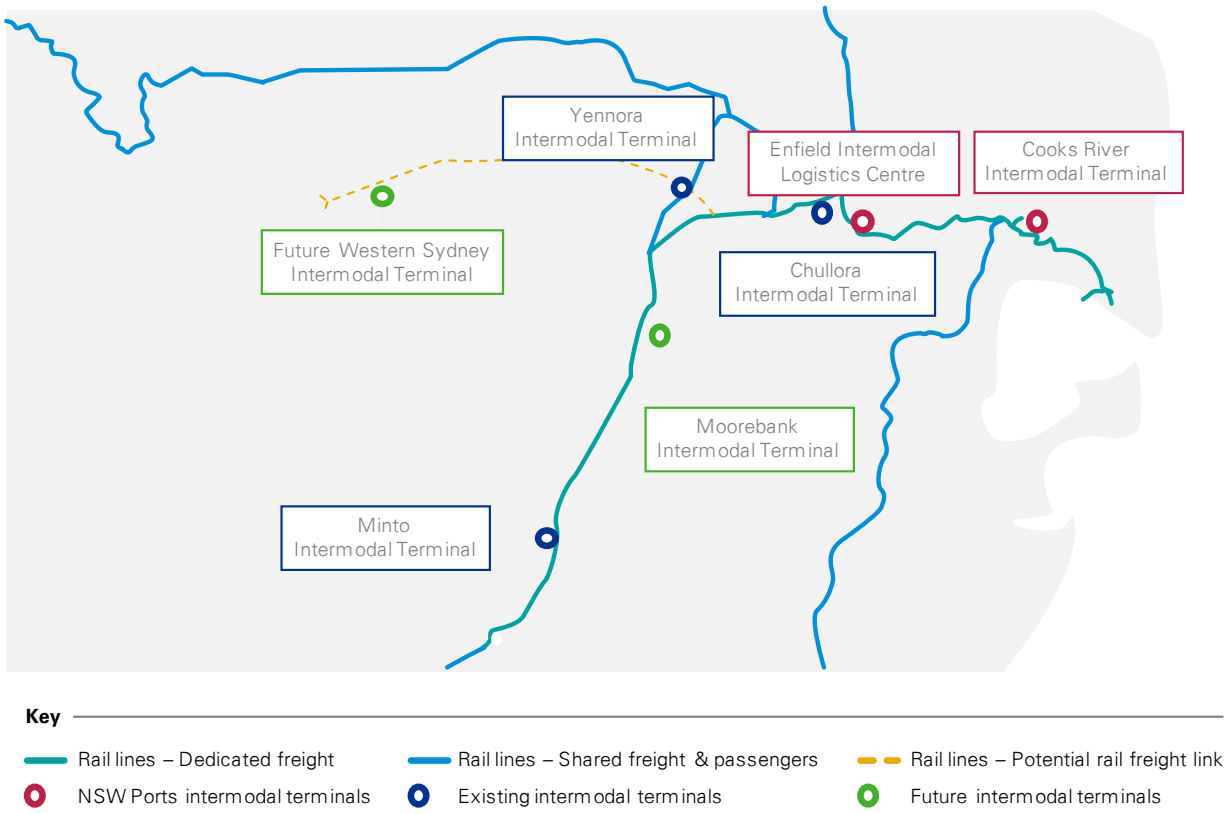
- Increasing congestion across the Sydney road network;
- Completion of Southern Sydney Freight Line, which has provided dedicated rail freight access between Port Botany and South Western Sydney;
- Further investments on the Port Botany Freight Line, and specifically the proposed duplication of the line; and
- Integrated service offerings at intermodal terminals, reducing whole of supply chain costs.

[21] NSW Ports, Port Botany – Planning for Container Growth, AFIF Conference 2018

These operational and infrastructure improvements have seen rail's share of the overall freight task from Port Botany double, to around 20 per cent of total movements[22]. This shift toward rail has been enabled by the development of new intermodal terminals such as Enfield (300,000 TEUs)[23] and Moorebank Intermodal Terminal (1,050,000 TEUs)[24], the latter of which is currently under delivery and due to open in 2019. In conjunction with the Yennora (200,000 TEUs)[25], Minto (200,000 TEUs)[26], and Chullora (200,000 TEUs)[27], these facilities would collectively provide network capacity of up to 1.95 million TEUs. This capacity is in addition to the vital role Cooks River Intermodal Terminal plays in positioning and supplying empty containers.

In addition to these intermodal terminal investments, Pacific National has also sought planning approval for a new intermodal terminal at St Marys. The Western Sydney Freight Line and associated Western Sydney Terminal have the potential to add an additional one million TEUs of capacity to the network. Figure 20 below details the current and proposed import-export (IMEX) intermodal terminals in NSW.

Figure 20: Current and proposed IMEX terminals



Source: NSW Ports (2018)[28]

Together, the pivot of container movements to Sydney's west, growing road network congestion and the development of dedicated rail alignments and supporting intermodals are combing to make rail freight an increasingly attractive alternative to road transport.

[22] NSW Ports (2018)
[23] https://linxcc.com.au/news/linx-to-operate-sydneys-enfield-intermodal-terminal/
[24] http://www.micl.com.au/faq/
[25] ARTC (2015), *2015-2024 Sydney Metropolitan Freight Strategy*
[26] ARTC (2015), *2015-2024 Sydney Metropolitan Freight Strategy*
[27] ARTC (2015), *2015-2024 Sydney Metropolitan Freight Strategy*
[28] Port Botany – Planning for Container Growth – AFIF Conference 2018

2.2.3 Handling Sydney's container exports

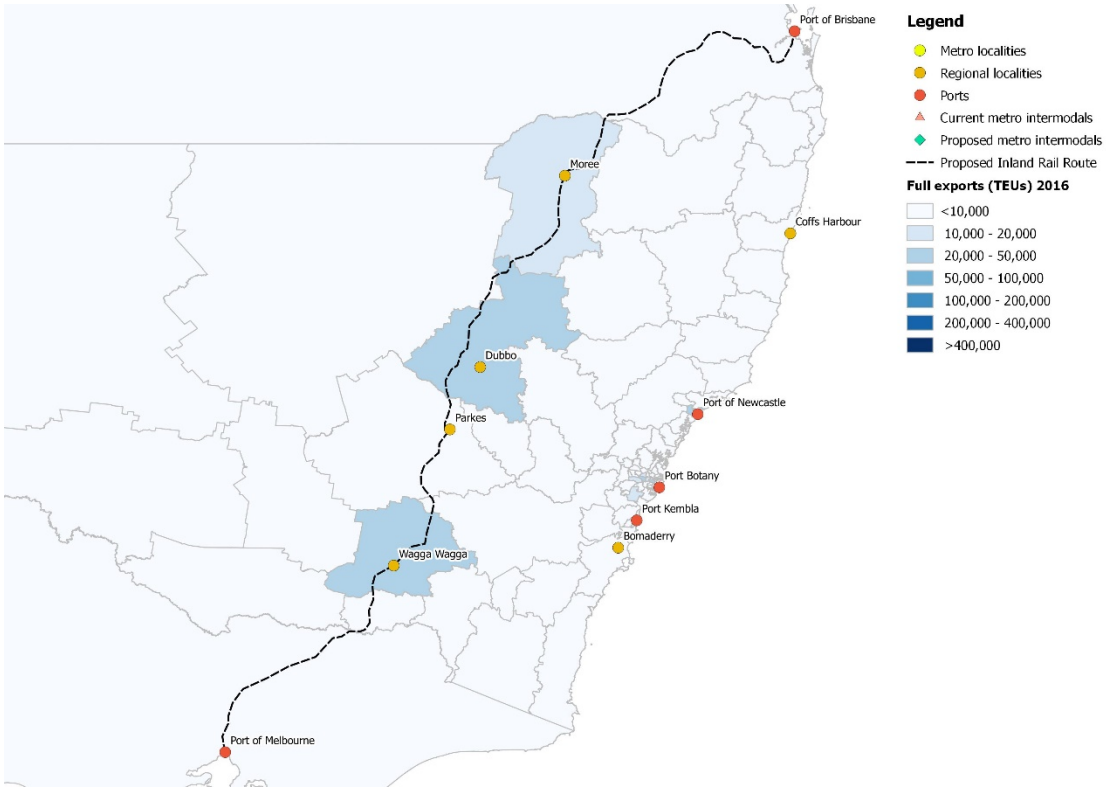
The distribution of export containers

Similar to the distribution of import containers detailed in Section 2.2.1 above, it is important to understand the origin of export containers across Sydney and NSW in considering long-term port and freight capacity. We have analysed the distribution of import and export containers based on the split in container volumes generated by TfNSW's SFM.

On the export side, the distribution of containers is more diverse than imports. It is in this market that the role of containers outside of Sydney, Newcastle and the Illawarra are more evident, accounting for a little over a quarter of all full export containers in both 2016 and 2046, based on our review of the SFM data. Even so, much of the export trade in full containers originates within Sydney.

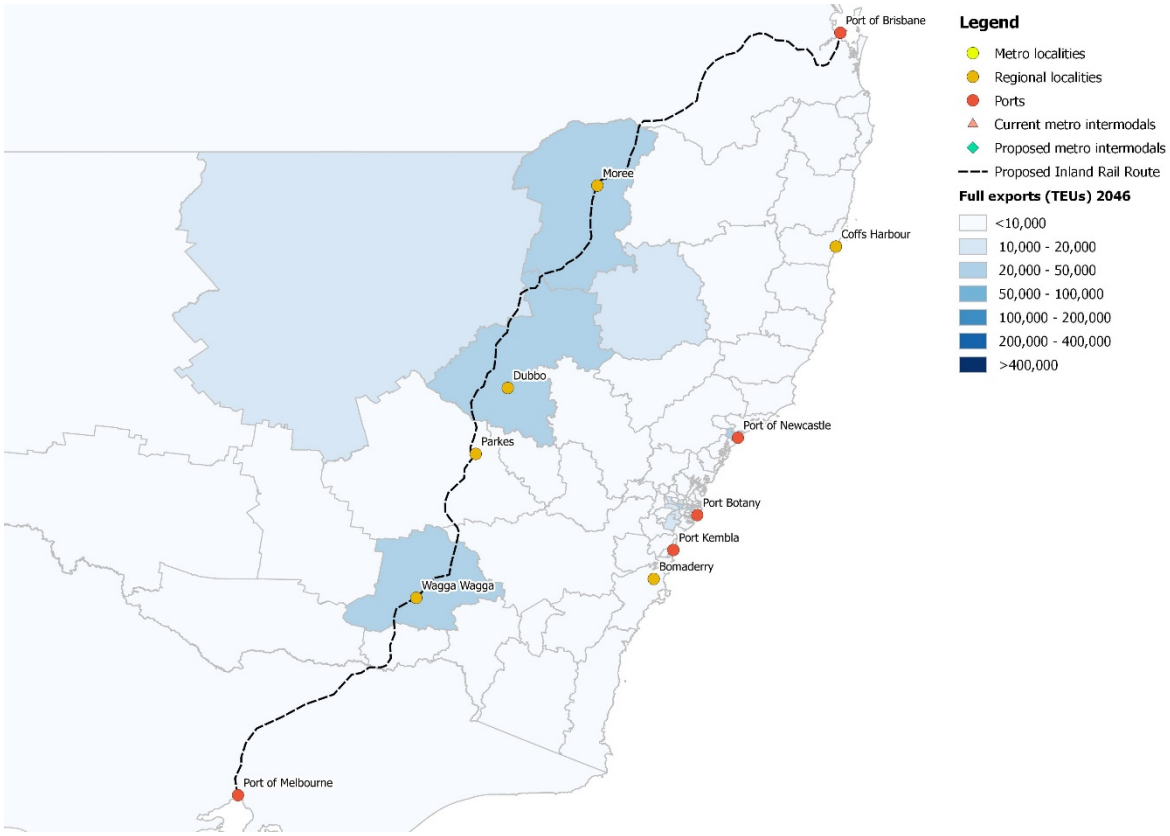
Figure 21 and Figure 22 illustrates the 2016 and 2046 distribution of full export containers in Sydney and its surrounds, as projected by SFM. Further detail on the methodology used for this analysis is contained in section 4.3.

Figure 21: 2016 full export container distribution



Source: Based on TfNSW SFM data

Figure 22: 2046 full export container distribution



Source: Based on TfNSW SFM data

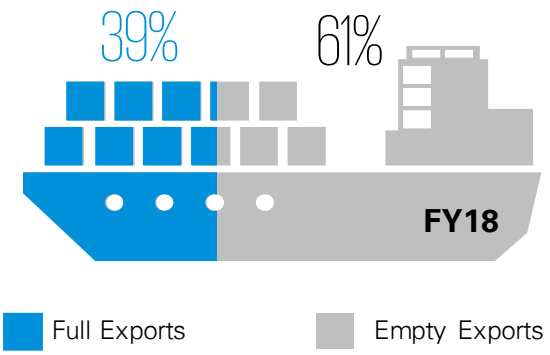
The export of empty containers

The structure of Australia's wider economy and trade profile means that the majority of exports occur through bulk ports, while imports are overwhelmingly containerised. This sees around two thirds of exported containers empty. This imbalance between full import and empty export containers place additional challenges in developing effective export supply chains.

Empty containers need to be located and stored close to port infrastructure, allowing them to be efficiently shuttled and loaded, prior to ship departure. Container parks such as the Cooks River Intermodal are critical, avoiding cluttering the port hardstand areas.

At Port Botany, empty containers accounted for approximately 61 per cent of total containerised exports in 2018 (as detailed in Figure 23).

Figure 23: Port Botany – Empty export containers as a proportion of total exports



Source: NSW Ports (2018)

03

Plans policies and processes

The overlaps created by Australia's constitutional and intergovernmental arrangements are reflected in overlapping responsibilities for freight regulation and infrastructure, across the tiers of government; in turn, this is reflected in an array of concurrent, overlapping and sometimes conflicting, freight policies and plans.

This report considers a selection of relevant plans, to inform our analysis and model assumptions about the current and future state of the NSW container market. We have reviewed:

- National Freight and Supply Chain Strategy (2018)
- Future Transport 2056 Strategy (2018) and associated plans:
  - Greater Newcastle Future Transport Plan
  - NSW Freight and Ports Plan 2018 – 2023
  - Regional NSW Services and Infrastructure Plan
  - Greater Sydney Services and Infrastructure Plan
- State Infrastructure Strategy 2018 – 2038: Building Momentum (2018)
- Greater Sydney Region Plan (2017)
- NSW Ports' 30 Year Master Plan (2015)
- Sydney Metropolitan Freight Strategy (2015)
- Port of Newcastle Port Development Plan 2015 – 2020 (2014).

In addition, the future pipeline of freight related transport infrastructure investment has been reviewed and summarised.

3.1 A brief overview of the Federal and State freight policy and plans

3.1.1 Federal freight policy and plans

Historically the Australian Government played a substantial role in the freight market, including as a dominant operator of the since-privatised Federal Government rail freight haulage business and the former government-owned shipping line. This role fell away, as competition and efficiency reforms forced the modernisation of the freight sector and saw a corollary retreat by the Federal Government from most areas of freight policy, operation and funding.

By the mid-2000s, a range of visible problems, like large queues of ships at key bulk export ports; coupled with mounting national economic and productivity impacts across the wider freight sector forced the Commonwealth to reengage on freight policy and infrastructure investment.

In the mid-2000s, the Australian Government developed and implemented the AusLink national freight and project funding policy. The agreement with the states nominated corridors that would form part of the 'National Land Transport Network'. The agreement formed the basis for ongoing Federal funding of key national freight projects around Australia. AusLink and its successor programmes have funded a range of major freight infrastructure projects in NSW, including the northern and southern Sydney freight lines and various parts of the motorway system.

Alongside Commonwealth funding for freight infrastructure, the Commonwealth remains the owner and operator of the 'below rail' national interstate rail track system, through the Australian Rail Track Corporation. This sees the Commonwealth as the owner and developer of major freight rail infrastructure projects, including the planned north south Inland Rail Corridor and the Port Botany Line Upgrade.

Following AusLink, a range of subsequent freight or related policies have been developed, across a range of Commonwealth agencies (for example, DIRDC, Infrastructure Australia and the Productivity Commission). These have largely made important and sensible recommendations, for example through rationalising heavy vehicle road user charging 'within 5 years' – each of these has tended to be relatively short-lived and have not seen major structural changes, beyond the (important) move to consistent national safety regulation.

Recently, the Australian Government has commenced a new process to develop a 'national freight and supply chain strategy', which has included guidance from an expert panel. It has made substantial recommendations that if applied, would create much greater transparency about supply chain capacity, cost and performance.

The independent expert panel recommended a raft of structural, infrastructure, pricing, competition and information/data reforms – united by a core aim to *"lift capacity and performance, in a sector prone to fragmentation"*[29]. The panel's recommendations are the basis for a new National Freight & Supply Chain Strategy which is under active development.

[29] Australian Government, Inquiry into National Freight and Supply Chain Priorities, March 2018

3.1.2 State freight policy and plans

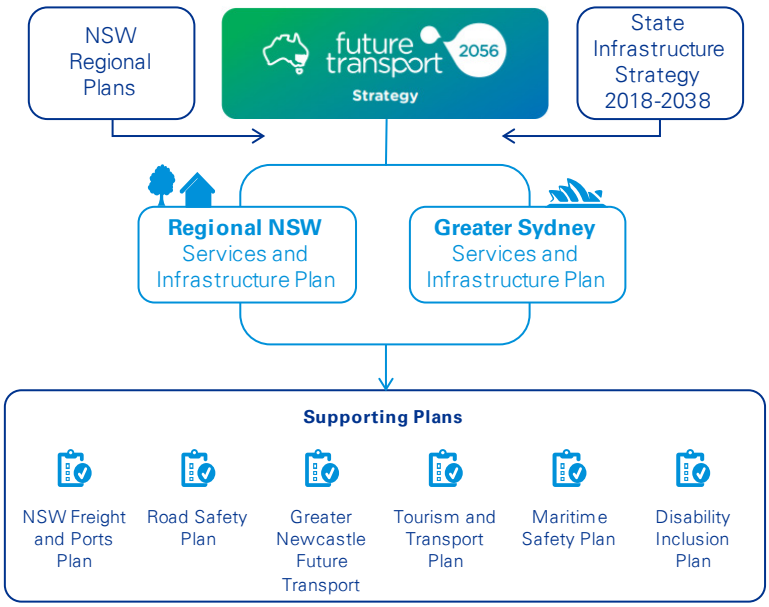
The Future Transport 2056 Strategy is the uniting transport policy for NSW – and draws on an array of supporting sectoral, regional and modal plans and dedicated funding lines, outlined in Figure 24 below.

Future Transport 2056 and its underlying plans identify Port Botany as the State's key 'growth port' for containers - followed by Port Kembla, when required in several decades time. The Strategy also identifies a substantial policy focus on driving a modal shift from roads to freight rail.

The NSW Government does not contemplate a significant role for the Port of Newcastle in meeting future container demand, stating:

"By 2056, the state will be served by high performing container ports, with Port Botany and Port *Kembla servicing our growing population centres and the Newcastle Port continuing to be our primary coal export facility as it diversifies to enable the export of other commodities".*

Figure 24: Future Transport 2056 and supporting plans



Source: TfNSW

This section considers the underlying supporting plans which are relevant to this study, being:

- Greater Newcastle Future Transport Plan (2018)
- NSW Freight and Ports Plan 2018-2023 (2018)
- Regional NSW Services and Infrastructure Plan (2018)
- Greater Sydney Services and Infrastructure Plan (2018)

While each plan sees a different emphasis or focus, common themes recur across them; from forecasts in containerised trade and continued concentration of population growth in Sydney to network inefficiencies, inconsistent regulation, and poor planning decisions around trade gateways and freight land in particular.

The plans recognise the increasing need for proper road and rail infrastructure, with intermodal terminals being the important links between different modes in the supply chain. Much attention is paid to rail links and corridors required to unlock capacity at Port Botany as well as providing important freight distribution links around greater Sydney.

Appendix A provides a more detailed analysis considering the current situation, projected growth, the port or ports that it intends to support – and particularly, the infrastructure recommendations or required to support the freight outcomes within each plan.

3.1.3 State Infrastructure Strategy

In addition to the Future Transport 2056 Strategy and the associated Plans, in February 2018 Infrastructure NSW (INSW) released the 'State Infrastructure Strategy 2018 – 2038: Building Momentum' (SIS). The SIS sets out the government's priorities for the next 20 years, and combined with the Future Transport Strategy 2056, the Greater Sydney Region Plan and the Regional Development Framework, brings together infrastructure investment and land-use planning for the cities and regions of NSW. The SIS divides the state into five cities and regions and considers the infrastructure needs based on their unique characteristics and the likely impact of combined investment across sectoral lines.

The SIS focuses on integrating land use and freight planning. It included a recommendation for the Department of Planning and Environment (DPE) to update relevant State Environmental Planning Policies by the end of 2019 to protect strategically important ports, airports, industrial lands, freight precincts and key corridors from incompatible uses to ensure continuing efficient movement of freight in Sydney and NSW.

In addition, the strategy identifies Sydney Gateway and the Port Botany Rail Duplication as key initiatives of *"national significance"* which require further funding support *"as a matter of urgency"*. The SIS identifies The Moorebank Intermodal Terminal, Port Botany Rail Duplication and policy reforms including the Port Botany Landside Improvement Strategy as the highest priority investments necessary to achieve a target of carrying 40 per cent of containerised traffic on rail to and from Port Botany.

3.1.4 Greater Sydney Region Plan

The Greater Sydney Region Plan was prepared concurrently with Future Transport 2056 and the State Infrastructure Strategy, aligning land use, transport and infrastructure planning to reshape Greater Sydney as three connected cities; Western Parkland City, Central River City and Eastern Harbour City.

The competitiveness and efficiency of freight logistics is among the main objectives of the Plan with the largest supply of manufacturing, transport and distribution centres being found at the Western Parkland City. The Plan underlines that future freight growth due to increased demand and population growth will create the need for '*an additional container port location to service Grater Sydney's freight needs*'. According to the Plan, Port Kembla is characterised as the best additional container location since the port already has "*an approval to expand its container handling capacity*" and the Western Parkland City falls within Port Kembla's catchment area.

The Plan underlines that infrastructure projects, such as the Maldon-Dumbarton rail line and road connections linking to the Outer Sydney Orbital corridor, will need to be developed to enhance new road and rail connections from Port Kembla to intermodal freight networks.

3.1.5 Port Plans

NSW Ports' 30 Year Master Plan

The *NSW Ports' 30 Year Master Plan* outlines a strategic vision for achieving sustainable and efficient port supply chains in NSW. The Master Plan suggests targeted actions and investments, by identifying NSW's continuous population growth and subsequent demand for imports as well as the port's role as Australia's premier gateway.

Increasing the movement of containers by rail is identified as a critical component of future Port Botany capacity management. NSW Ports has set a target of moving 3 million TEUs by rail by 2045, representing around 40 per cent of forecast volumes. Lands around the port are valuable and in high demand, with allocation and protection of corridors and land for intermodal connections critical to achieving this rail target. Further investment in intermodal capacity will be required across the city, with several projects already identified as in planning or delivery stages. The progressive move of industry to Western Sydney will increase the importance of securing and increasing rail capacity and efficiency over these corridors.

The Master Plan also recognises the continued reliance on the road network for freight distribution. With forecast growth in the volume of freight using the road network, investment will also be required to continue improving road network capacity.

Port of Newcastle Port Development Plan

The Port of Newcastle (PON) published Port Development Plan (PDP), outlining the port's development objectives for the 2015 – 2020 period in order to *"facilitate continued growth and development of existing and new trades in a sustainable manner"*. The PDP details key government projects relevant to the Hunter region and the port.

The PDP identifies the 'Bridges for Bush' and upgrade to the M1 to Raymond Terrace (planning phase) as being key projects which will improve freight transportation and reduce congestion on the M1, improving efficiency of freight to and from PON.

Also, the PDP supports initiatives including the Lower Hunter Freight Corridor (planning phase) and Northern Sydney Freight Corridor, which will increase capacity in the freight supply chain for future growth and facilitate more efficient freight movements to and from the Port.

Further to this, the PDP outlines key development objectives at the Port to facilitate growth and development of existing and new trades, which includes the Capital Strategic Dredging Project. The project involves the development of 12 additional berths alongside the existing shipping channel to be developed in stages over the long-term, a concept for a permanent cruise terminal at the Port and development of a fourth coal terminal at the Kooragang Precinct, known as Terminal 4. The approval of Terminal 4 is an essential investment, without which the coal throughout capacity is capped at 211Mt per annum.

Other than the land used for existing coal terminals and Terminal 4, there is no further expected need to allocate land for coal use over the next 5 years and PON is assessing alternative options for the unused land.

3.2 Future infrastructure developments

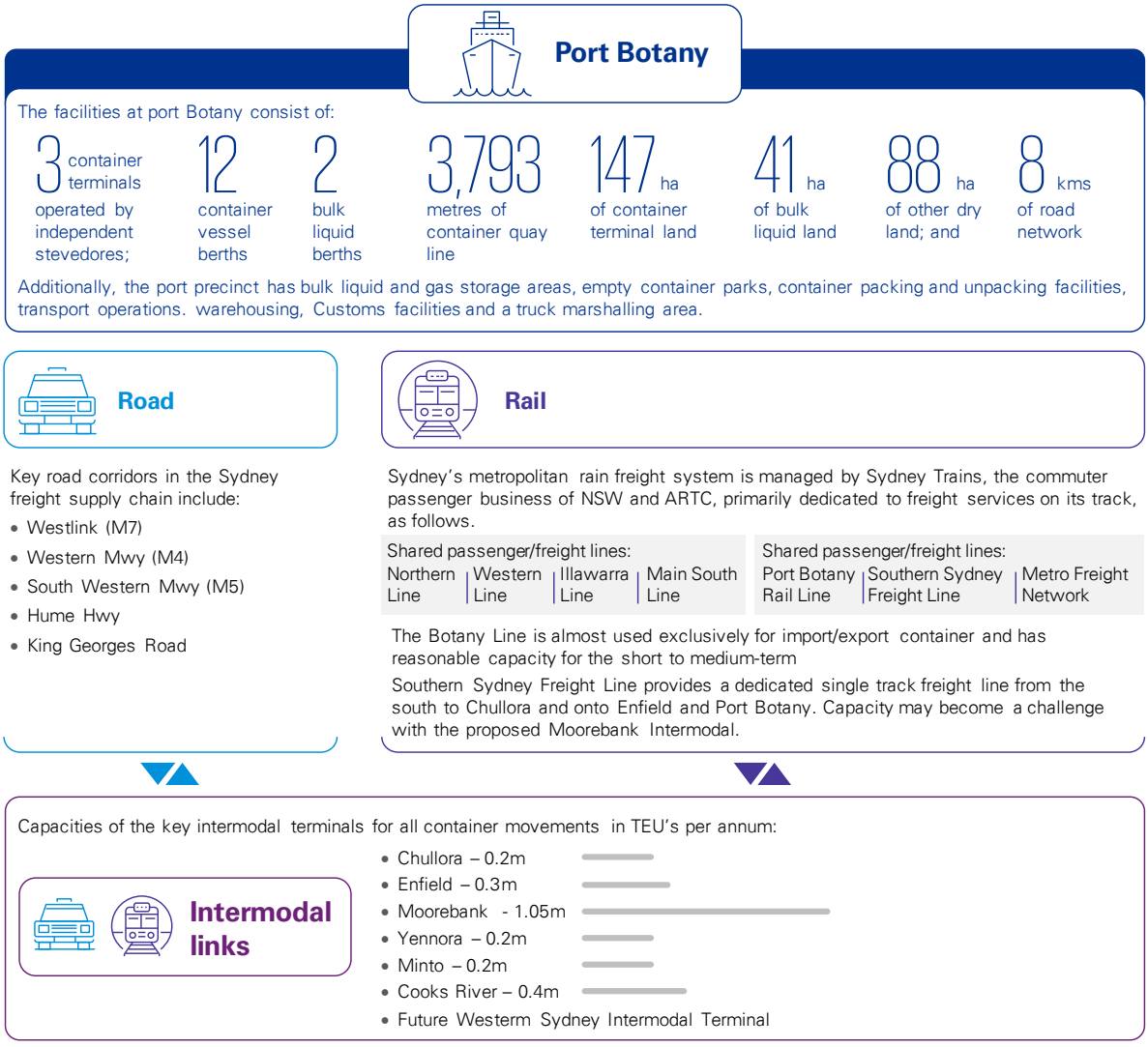
The operation of a contemporary, large-scale container facility requires extensive infrastructure to support the efficient handling of containers quayside and the quick and reliable movement of these containers to and from the port. Over time, governments and industry have invested significantly in Port Botany's capacity as well as developing an integrated freight network linking Port Botany with a range of destinations.

Port Botany has a deep water shipping channel and berths that have not required maintenance dredging since their construction in the 1970s. With targeted dredging, the channel and berths will be sufficient to handle container ships of up to 10,000 TEUs in the future. The most recent initiatives at the port have seen the introduction of a third terminal and a third stevedore, providing more capacity and choice for shippers across the state.

Port Botany enjoys a direct interface with the rail network, with connections to dedicated rail freight lines and a metropolitan intermodal network unlike its counterparts in Brisbane and Melbourne.

Figure 25 below denotes key existing infrastructure that supports the movement of freight handled through Port Botany, as well as its surrounds.

Figure 25: Existing key infrastructure at Port Botany



Source: KPMG analysis

The geographical positioning of Port Botany, close to Sydney CBD, adjacent to Sydney Airport and near Sydney's major transport corridors, provides distinct advantages as well as challenges. The density of the transport network near the port serves to provide the port and other users with good connectivity with much of the city; although general congestion can impact on movements to and from the port.

The Australian and NSW Governments are investing to increase connectivity and capacity to this important part of the Sydney. This unprecedented, coordinated investment aims to enhance the connections to Sydney's international gateways and ease chronic pinch points that serve to radiate congestion across the broader network. Investments including the New M4 and New M5 are aimed at augmenting the capacity and reliability of these corridors. The M4-M5 Link and Sydney Gateway will provide new choices for travellers to access Sydney Airport and Port Botany. Finally, the duplication of the Port Botany Line is aimed at decongesting the road network of container trucks for the benefit of general traffic.

Noting the significant infrastructure investments required to connect to/from any additional ports within NSW, it is relevant to consider the total distance between each port and key container consumption areas – as detailed in Table 8 below. We have selected the five largest container consumption areas based on the 2046 projections of full import TEUs contained within the SFM data.

Table 8: Distance between NSW ports and forecast key container consumption areas

Port	Distance to key container consumption areas (km)				
	Mount Druitt	Liverpool	Parramatta	Merrylands - Guildford	Fairfield
Port Botany	55	32	35	33	40
Port Kembla	103	76	89	85	86
Port of Newcastle	167	173	151	157	167

Source: TfNSW SFM and KPMG analysis

The geographical location of Port of Newcastle in comparison to the key projected container consumption areas requires the furthest distance to be travelled. This will impact the cost of transport to/from the port, time and reliability and the level of infrastructure investment to efficiently transport containers to/from the port if a future container terminal is developed.

Infrastructure projects and initiatives

This section distils and describes the relevant transport projects, many of which form assumptions for our model of the NSW container market, which is described across the remainder of this report. It should be noted that the primary objective for the majority of the road projects included in the analysis is to ease congestion and serve private passenger trips. While freight will also benefit from the transport network improvements, the majority of benefits accrue to private vehicle trips.

Table 9: Transport projects that support port related infrastructure in NSW

Planned/Committed Initiatives	
WestConnex	**Sydney Gateway**
Status: Under delivery **Forecast cost: $16.8 billion** **Description:** WestConnex will provide the next evolution of the Sydney motorway network, enhancing capacity and connections between Western Sydney and the Eastern City's key economic generators by: • Widening the M4 • Augmenting capacity on the M5 East corridor • Developing new links including the M4 East and M4-M5 Link Providing the foundations for future connections to the Western Harbour Tunnel and the F6 Extension.	**Status:** Under procurement **Forecast cost: $2.4 billion** **Description:** Sydney Gateway will provide a motorway-grade road connection between the M4-M5 St Peters Interchange and Sydney Airport.
Western Harbour Tunnel	**Sydney Airport Road Upgrades**
Status: Under procurement **Forecast cost:** Not available **Description:** Western Harbour Tunnel will provide Sydney's third road harbour crossing to alleviate pressure on the Sydney Harbour Tunnel and Bridge. Current planning envisages that the Western Harbour Tunnel will connect with WestConnex at Rozelle to provide improved access to Sydney's international gateways from north of the harbour.	**Status**: Under delivery **Forecast cost:** Not available **Description:** This program is increasing the capacity of roads around the airport precinct to ease congestion pinch points and to better separate airport traffic and through traffic flows. This program has already seen the widening on Marsh Street, the removal of the General Holmes Drive level crossing and a reconfiguration of traffic flows.
Moorebank Intermodal Terminal	**NorthConnex**
Status: Under delivery **Forecast cost**: $1.8 billion **Description**: The project will deliver a major intermodal facility in South West Sydney to provide a rail 'port shuttle' between Port Botany and the Moorebank precinct.	**Status**: Under delivery **Forecast cost**: $3 billion **Description**: The NorthConnex project will fill the missing link between the southern end of the M1 Pacific Motorway and the M2 Motorway at West Pennant Hills. The completion of the link will then provide motorway connections for freight moving between Western Sydney and the north.

M4 Smart Motorway (Merrylands – Lapstone)

Status: Under delivery

Forecast cost: $470 million

Description: This project aims to increase the operational efficiency and effective capacity between the Blue Mountains and Parramatta by providing a mix of widening works and technological measures to smooth traffic flows and facilitate merging. This investment complements works being undertaken as part of WestConnex.

F6 extension, Gateway to the South

Status: Under procurement

Forecast cost: $2.4 billion

Description: This project will contribute to the long envisaged need for a motorway grade connection between Sydney and the Illawarra. The first stage will see a motorway link from WestConnex to Kogarah, with the potential for further extensions towards Miranda and Waterfall.

Lower Hunter Freight Corridor

Status: Early planning

Forecast cost: Not available

Description: The Lower Hunter Freight Corridor would provide a bypass for freight around Newcastle, avoiding the need for freight trains to pass through local communities and mix with passenger trains between Fassifern and Newcastle.

Western Sydney Infrastructure Plan

Status: Under delivery

Forecast cost: $3.6 billion

Description: The Western Sydney Infrastructure Plan is upgrading a range of strategic arterials, and developing the new M12 Motorway, to support the development of new communities, employment lands and Western Sydney Airport. This area will further enhance Western Sydney's role as a key attractor and generator of containers in Sydney.

M1 Motorway Upgrades

Status: All three stages currently under construction

Forecast cost: $391.6 million

Description: The upgrades will increase the capacity of the motorway through road widening works between Kariong and Doyalson with interchange upgrades at Kariong, Warnervale, Doyalson and Weakleys Drive.

Inland Rail

Status: Under Procurement

Forecast cost: $10.66 billion

Description: The Inland Rail will provide a direct freight rail connection between Melbourne and Brisbane, bypassing Sydney, using a combination of existing track and new track. Additional planning is being undertaken to investigate connections between Inland Rail, Port of Melbourne and Port of Brisbane.

Port Botany Freight Rail Duplication

Status: Advanced planning

Forecast cost: $400 million

Description: This project will duplicate the remaining single track section on the Port Botany Freight Line, complementing the removal of the General Holmes Drive Level Crossing. The project will be delivered in conjunction with a new passing loop at Warwick Farm on the Southern Sydney Freight Line, increasing rail capacity between the Port and the soon to be opened Moorebank Intermodal Terminal.

Initiatives for Investigation

Northern Sydney Freight Corridor stage 2

Status: Early planning

Forecast cost: Not available

Description: Planned future expansion to grade separate passenger and freight task on Sydney's congested suburban rail network. Includes the Rhodes to West Ryde quadruplication; and construction of a third track between Thornleigh and Hornsby.

Western Sydney Freight Line

Status: Early planning

Forecast cost: $2.2 billion

Description: Development of a dedicated rail freight line connecting Western Sydney to the Sydney metropolitan freight network at the Southern Sydney Freight Line, with connections to intermodal terminals to service freight moving through Western Sydney from across NSW.

Maldon-Dombarton Rail Link

Status: Planning

Forecast cost: $850 million

Description: This proposed rail link would provide a more direct link between the Illawarra and the burgeoning South Western Sydney region. While originally conceived as a link to facilitate coal movements, more contemporary assessments have considered the link for container use and to create paths for passenger use across the broader rail network.

Outer Sydney Orbital

Status: Early planning

Forecast cost: Not available

Description: Long-term road corridor, designated as the M9 to provide a future far-western corridor.

M1, Hexham, Raymond Terrace Upgrades

Status: Early planning

Forecast cost: $200 million committed to get the project ready for construction

Description: The project includes upgrades to the strategic network of primary freight routes comprising of the New England Highway, M1 Pacific Motorway through to the Pacific Highway at Raymond Terrace and the strategic junction with the New England Highway and Hexham Straight.

The NSW Government has committed $200 million under Rebuilding NSW towards the project.

Chullora Junction

Status: Early planning

Forecast cost: Not available

Description: The proposed initiative involves improvements to the current low speed at-grade junctions at Chullora, including:

- Possible duplication of the Chullora North/ Chullora West connection; and
- A possible holding road between Chullora Junction and Flemington Junction.

The proposed initiative would form part of a broader strategy designed to drive growth in rail mode share.

3.3 Challenges for new container facilities

New container facilities anywhere in NSW require careful consideration of the adequacy of road and rail links to and from Sydney and the level of public investment that would be needed to make them viable. An overview of the state of these links between Sydney and Port Kembla and Newcastle's port is outlined below.

3.3.1 Transport links to the Illawarra / Port Kembla

Rail connections

If a container terminal were developed at Port Kembla, it would require the use and expansion of rail capacity. Port Kembla enjoys good rail connectivity through the port, servicing the steel industry and wider cargo movements including grain, coal and motor vehicles.

Port Kembla is connected to Sydney's Metropolitan Freight Network and the interstate freight network via either the Illawarra line to Sydney; or the Moss Vale to Unanderra line which connects to the Main South (Sydney-Melbourne) line, at Moss Vale[30].

While Port Kembla is serviced by two existing rail connections to Sydney, the Illawarra Line is affected by growing passenger train priority and can be affected by heavy weather events; whilst the Moss Vale to Unanderra line is longer.

However, the Illawarra Line is projected to have 20 paths[31] spare, which could accommodate up to 1 million TEUs.

This may offer some opportunity to delay the development of the planned Maldon-Dombarton Rail Line (MDRL), at least in the initial years of operation. MDRL would allow for grade separation between the freight and passenger tasks, increasing the capacity and reliability of each. MDRL has been under investigation since the 1980s and was partially constructed until it was paused in the late 1980s.

Based on a single track alignment with diesel based operations, the cost of developing MDRL was estimated to be $806 million in 2013/14, approximately $850 million today[32].

Prior considerations of MDRL have considered it through the lens of coal exports; however it could offer an integrated transport solution that would:

- Allow the Illawarra Line to better handle the mix of express, limited stop and all stop passenger services and increase the frequency of these services;
- Provide a dedicated freight rail connection between Port Kembla and Sydney's consumers; and
- Ensure network redundancy for weather events that impact the Illawarra Line to Sydney.

More recent work by the University of Wollongong's SMART Infrastructure Facility go further; arguing that the rail link is the key to an integrated regional transport solution. SMART's work proposed to run passenger services on the MDRL linking South Western Sydney destinations including Campbelltown-Macarthur and Liverpool with the Illawarra. Based on both freight and passenger services on the MDRL, SMART projected an economic benefit-cost ratio of 1.13 over a 50 year period.

MDRL has been identified by *Future Transport* as a candidate for assessment over the next 20 years.

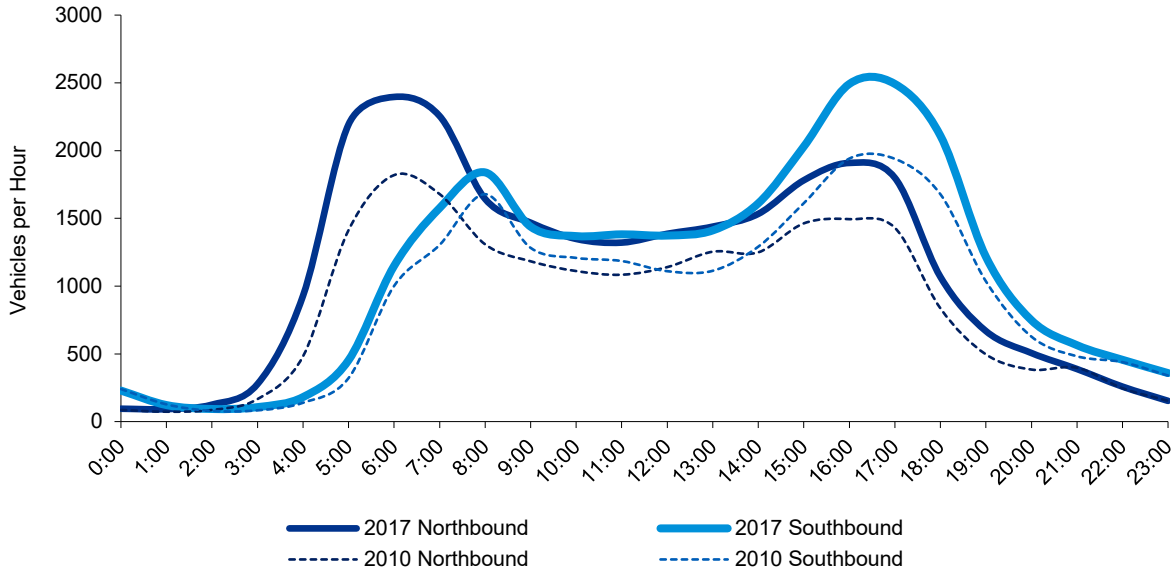
[30] http://infrastructureaustralia.gov.au/projects/files/Maldon-to-Dombarton-summary.pdf
[31] Table 4.6, TfNSW (2014), Maldon-Dombarton Rail Link Final Business Case
[32] Ibid. Costs escalated in line with movements in the 'Other Heavy and Civil Engineering Construction' price index, which forms part of the ABS Producer Price Index

Road connections

The road network connecting Sydney and Port Kembla provides broad connections to Sydney; with Picton and Appin Roads providing connections to the south west of Sydney and the M1 Princes Motorway connecting to southern Sydney.

The Illawarra escarpment poses a challenge and sees an average grade of 7 per cent, reaching 10 per cent in some sections. This means heavy vehicles are required to use low gear when traversing down. This section of the M1 Princes Motorway has two lanes southbound (downhill) and three lanes northbound (uphill). Figure 26 below provides an illustration of the distribution of traffic across a typical weekday at Mt Pleasant.

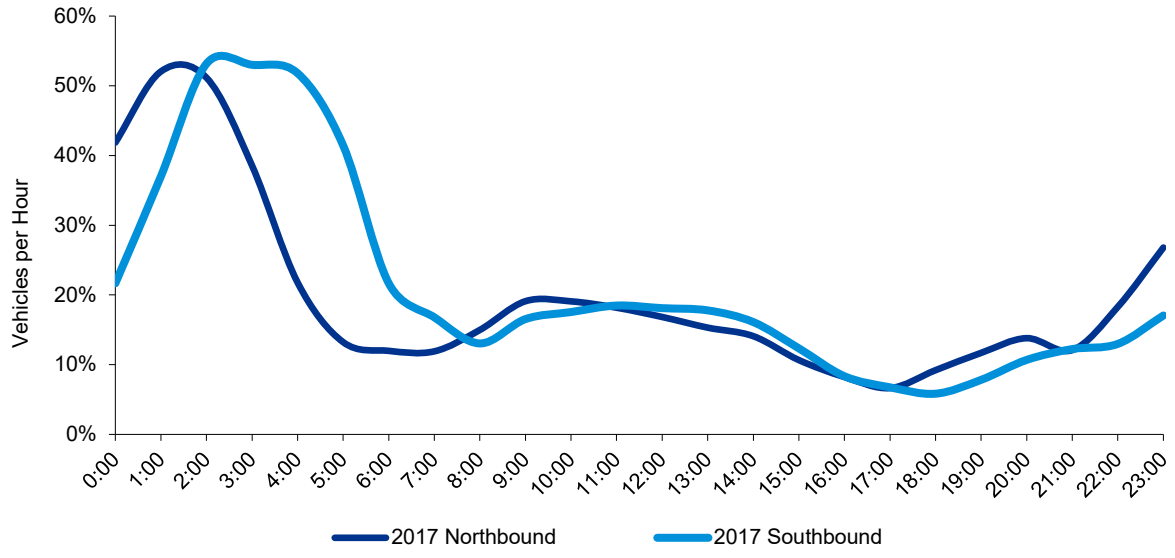
Figure 26: Weekday Hourly Profile on the M1 Princes Motorway at Mt Pleasant



Source: KPMG analysis based on RMS Traffic Volume Viewer data

The M1 Princes Motorway sees heavy vehicles account for 17 per cent of all traffic. Good road connections would complement a future container terminal investment at Port Kembla. Figure 27 overleaf illustrates the heavy vehicle split across the day by direction at Mt Pleasant. Heavy vehicles account for 14 per cent of all southbound traffic.

Figure 27: Heavy Vehicle Split by Hour on Weekdays on the M1 Princes Motorway at Mt Pleasant



Source: KPMG analysis based on RMS Traffic Volume Viewer data

Drawing on guidance from the Highway Capacity Manual and current peak period heavy vehicle volumes, the motorway's capacity has been estimated to be in the order of 1,400 vehicles per lane per hour. The steep gradients combined with high heavy vehicle volumes combine to reduce lane capacity. At historical growth rates, capacity appears to be available for approximately two decades. This said, the section of the motorway around Mt Pleasant is a pinch point, particularly so when trucks travel slowly up and down the escarpment, requiring light vehicle traffic to overtake these trucks using the right lane.

Beyond Bulli Pass, the M1 Princes Motorway is the only road thoroughfare available to access Port Kembla. The corridor is not yet resilient to incidents. A major incident that would require trucks to defer travel or divert around the Illawarra, possibly as far south as Batemans Bay to access Port Kembla. To improve resiliency, it would be desirable for an alternative route to be available.

Planning for Western Sydney Airport and the Aerotropolis

The Australian and NSW governments are intensifying their planning for the development of Sydney's 'third city', centred on the new Western Sydney Airport and adjacent 'Aerotropolis' planned across Western and South Western Sydney.

Among other things, the 'Aerotropolis' is envisaged as driving both economic development and population growth. More people means more freight and more consumption – meaning that the Aerotropolis is likely to accelerate the drift in container freight demand towards Western and South Western Sydney.

Government planning is beginning to anticipate these changes in flows, with the Western Sydney Infrastructure Plan (and the M12 Motorway) providing a direct link to the airport and Aerotropolis. Existing roads linking South Western Sydney and the Illawarra may require progressive enhancements, including the M1 Motorway and Picton Road.

RMS is currently planning improvements between Picton Road and Bulli Tops, including potential realignment of the M1, as well as grade separating Mt Ousley Road with the M1 Princes Motorway.

Picton Road was identified in Infrastructure NSW's 2018 State Infrastructure Strategy as requiring works over the next 5 to 10 years, to integrate the Illawarra more closely with South Western Sydney.

Port Kembla is circa 95 kms from Badgerys Creek and has known and relatively low cost options for rail and road connectivity to western and South Western Sydney and the Aerotropolis.

Port Kembla has been identified as the most suitable site for new container capacity in NSW – when it is needed in several decades. The focus on developing Sydney's west appears to strengthen the case further.

3.3.2 Links to the Central Coast and Newcastle

Rail connections

A container port at Newcastle faces substantial transport challenges, because of the paucity of existing rail connections to Sydney. Current spare capacity would not be sufficient to accommodate a substantial level of container movements by rail, without significant taxpayer investments.

The Federal Government's ARTC[33] estimates nine train paths are spare northbound and seven train paths are spare in the southbound direction. Inland Rail will divert some movements between Brisbane and Melbourne but is likely to only add a couple of train paths.

A high-level assessment suggests that these spare paths may realise capacity for around 400,000 TEUs[34], assuming a high level of back loading. Whether this capacity would be available to service containers from the Port of Newcastle would depend on the level of demand from other potential path users, including other freight customers such as interstate intermodal movements.

In any case, even if there was more capacity available on the Main North Line between Strathfield and Newcastle, reliability for freight services would remain an issue due to priority given to passenger rail services.

Connecting Newcastle to Sydney's logistics hubs across Western Sydney would require freight rail services to traverse the constrained Main Northern Line – and the even more constrained Main Western Line (Strathfield to Penrith). Both lines are subject to substantial and growing passenger demand, placing greater pressure on freight capacity and reliability.

It is likely that a container port at Newcastle, that delivers container volumes of any substance, would instead require a new rail link between Sydney and the Port of Newcastle. However, this would likely be as challenging as it would be expensive, due to:

- Undulating terrain, requiring extensive tunnelling and the construction of many bridges;
- Protected lands and national parks, including culturally and environmentally sensitive areas;
- The comparatively longer distance between Newcastle and Sydney's key consumption areas (shown in Table 8 above).

Determining an estimate of public expenditure required to overcome rail constraints between Sydney and Newcastle is difficult, given that transport agencies have not released their estimates.

However a new rail alignment to Sydney's north has been contemplated many times, across a range of studies. Examples include various high speed rail studies; freight and passenger service and infrastructure plans and the like. Each time, these assessments have failed because of the substantial engineering and affordability challenges.

We can safely assume that the capital cost required for the delivery of new rail infrastructure will be significant, most likely to be many billions of dollars.

The Port of Newcastle has also stated that it would seek to use longer trains of circa 1,300m. Sydney has no intermodal terminals capable of handling a train of this length – requiring it to be broken up prior to arriving in Sydney; or more likely, requiring Newcastle to use shorter trains and thus, reducing some of the assumed benefits.

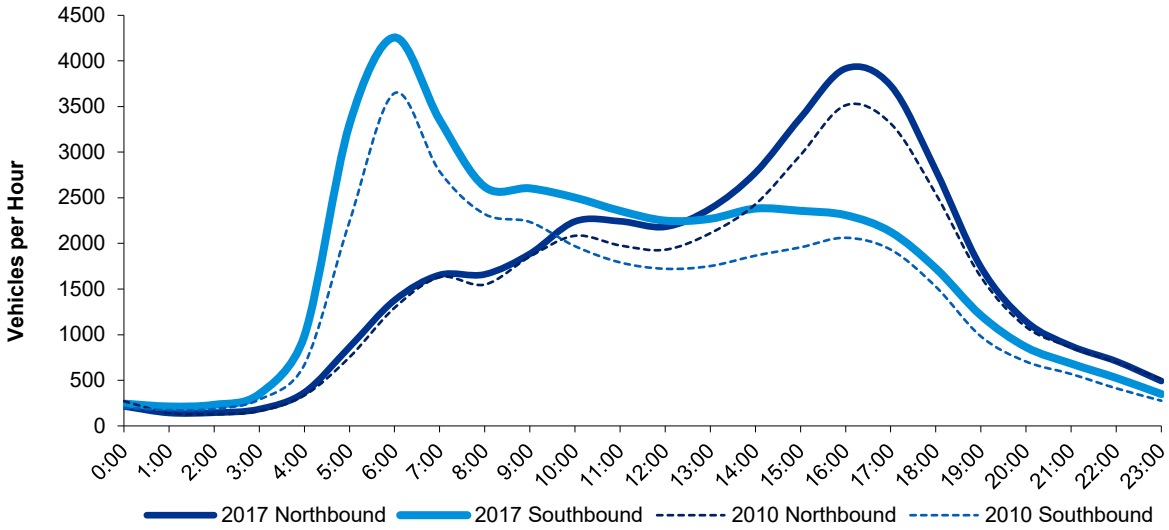
[33] ARTC (2015), *2015-2024 Sydney Metropolitan Freight Strategy*

[34] We have assumed 10 paths in each direction, 600m trains to allow these trains to use existing loops and intermodal facilities in Sydney and 70 percent slot utilisation in both directions

Road connections

As with the Sydney to Newcastle rail corridor, the M1 Motorway traverses rugged terrain and serves the growing population centres on the Central Coast. The southern part of the motorway is three lanes each way, with parts of the motorway between Gosford and Doyalson being upgraded to three lanes each way. Figure 28 provides an illustration of the distribution of traffic across a typical weekday at Mt-Kuring-gai.

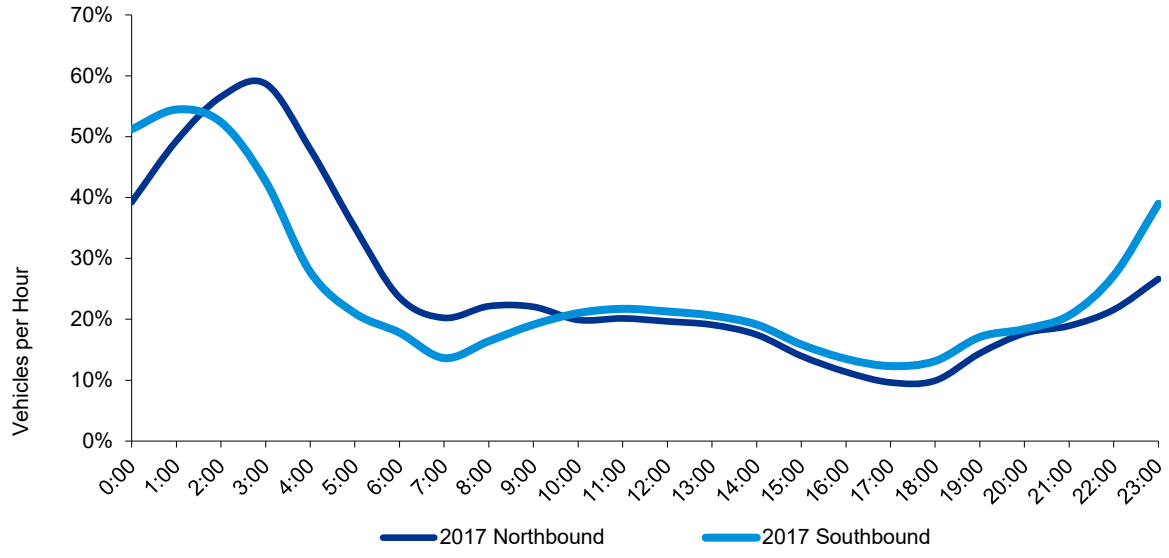
Figure 28: Weekday Hourly Profile on the M1 Pacific Motorway at Mt Ku-ring-gai



Source: KPMG analysis based on RMS Traffic Volume Viewer data

The M1 Pacific Motorway is an important conduit for freight movements, with heavy vehicles accounting for 18 per cent of all traffic. Even during the morning peak, heavy vehicles account for 18 per cent of all southbound traffic. Figure 29 illustrates the heavy vehicle split across the day by direction.

Figure 29: Heavy Vehicle Split by Hour on Weekdays on the M1 Motorway at Mt-Kuring-gai



Source: KPMG analysis based on RMS Traffic Volume Viewer data

Drawing on guidance from the Highway Capacity Manual[35] and current peak period heavy vehicle volumes, the motorway's capacity has been estimated to be in the order of 2,000 vehicles per lane per hour. At historical growth rates, capacity appears to be available for approximately 30 years notwithstanding that onward connections onto Pennant Hills Road (this will be better managed by NorthConnex) and Pacific Highway are congested currently.

Although container movements may have the flexibility of being moved during other times of the day, the road network does not provide a contiguous link to the Port of Newcastle. This would require container trucks to navigate the arterial road network through Wallsend or take the more circuitous route using the New England Highway. Both routes are busy during the commuter peak periods and investments on both routes are not inexpensive.

Some consideration has been given by the NSW Government to an additional Hawkesbury River crossing, which if realised would connect the northern end of the proposed Outer Sydney Orbital with the M1 Motorway around Peats Ridge. However, current planning would see this link being considered in the longer term. As with future rail upgrades between Sydney and Newcastle, such a link would be expensive and would require such an alignment to traverse national parks and through undulating terrain.

3.3.3 Required infrastructure

Of the two potential additional container ports, the Port of Newcastle would likely be the first to trigger a requirement for more infrastructure. These works would include:

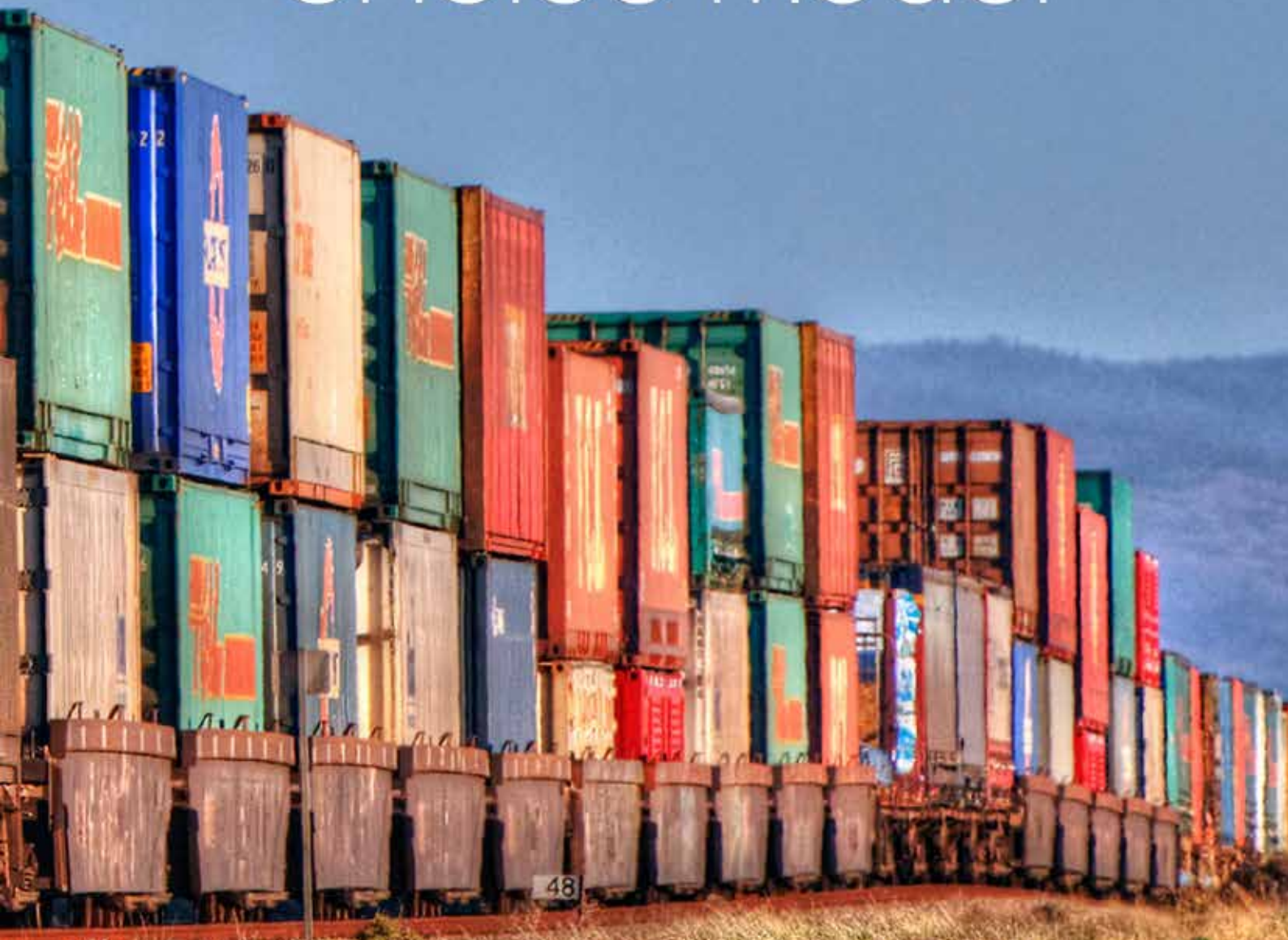
- A potential need for a dedicated rail alignment between Hexham and Fassifern to avoid container volumes impacting on local communities and passenger rail services;
- Augmentation of existing rail capacity on the Main North Line between Strathfield and Newcastle;
- Potential new rail initiatives/infrastructure to provide onward connections to Western Sydney - in its most ambitious form, a new rail alignment between Western Sydney and the Central Coast;
- Changes to the configuration of existing intermodal terminals in the Sydney region to accommodate longer trains that may serve Port of Newcastle; and
- Various road improvements on the Newcastle road network to ease the flow of container trucks through the area.

With time, additional infrastructure would be required to improve the reliability of freight flows to and from Port Kembla. Potential works would revolve around developing the MDRL, along with potential improvements to the M1 Princes Motorway, Picton Road and Appin Road. This said, existing rail links appear to have sufficient capacity to cater for volumes to and from Port Kembla. Road improvements are likely to be triggered by other demands, including safety as well as the emergence of new residential developments between South Western Sydney and the Illawarra.

[35] TRB (2016), Highway Capacity Manual, *Sixth Edition: A Guide for Multimodal Mobility Analysis*

04

Our NSW Port Choice Model



Government and industry strategies each contemplate Port Botany as NSW's principal container port until at least the 2040s; with the major freight policy focus on increasing connectivity between Port Botany and Western Sydney.

Government planning instruments identify Port Kembla as the logical location of an additional container port to provide future container capacity; but some stakeholders raise the question of the proper role for the Port of Newcastle to balance the state's container market.

Terminal and related 'on port' infrastructure is expensive, with the costs recovered through user charges. In turn, major landside network investments are also needed, to connect any additional container port into the NSW transport network.

These landside infrastructure costs will be recovered from the community, either through user charges or through direct taxation.

The ultimate decision about which port is used lies with shippers, who will consider the overall value in terms of time, monetary cost and utility of available supply chains and modes. Our strategic end-to-end NSW Port Choice Model (the Model) factors these decisions by modelling bluewater, terminal and landside transport costs, to better inform the discussion about the best choices for NSW and the nation.

4.1 NSW Port Choice Model overview

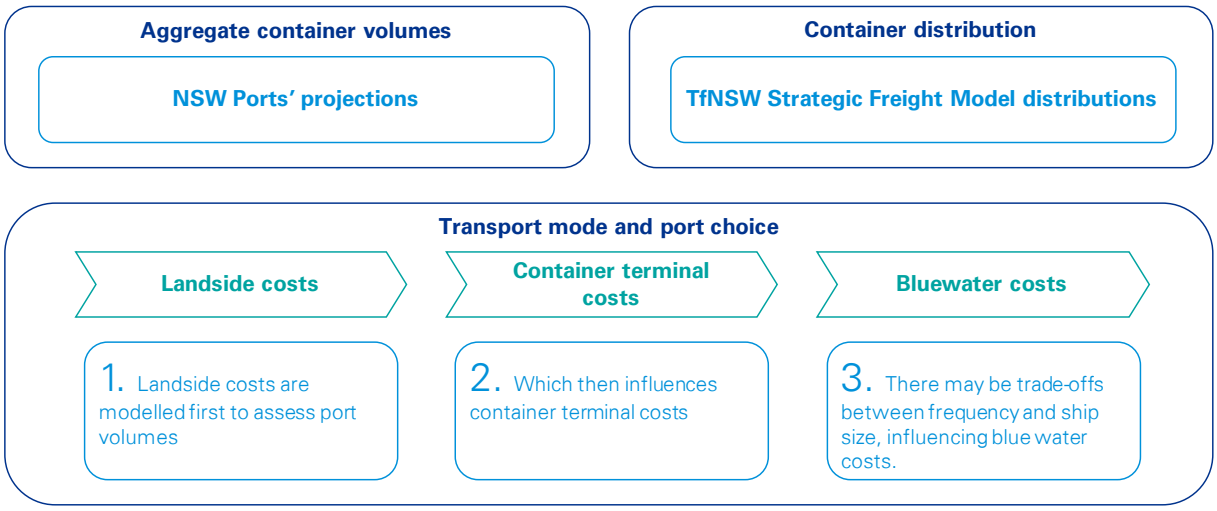
4.1.1 Key elements

In Australia, the majority of freight studies have focused on landside transport outcomes only. Land transport costs are a major component in the overall costs of moving containers. The number of times a container is handled landside and the reduction in scale combine to increase unit costs.

However, proximity to a container terminal is not the only consideration in how and where containers are handled. We developed the Model to assess the container share of up to five existing and potential container ports, including Port of Brisbane, Port of Newcastle, Port Botany, Port Kembla and Port of Melbourne.

Figure 30 overleaf provides an overview of each key component of the Model.

Figure 30: Overview of the NSW Port Choice Model



The aggregate demand and distribution of containers has been informed by inputs from NSW Ports and TfNSW. Aggregate container volume projections to 2046 were provided by NSW Ports. The distribution of import and export containers was based on the split in container volumes by SA3 area, generated by TfNSW's Strategic Freight Model (SFM). Container volumes originating or destined for a particular area were derived as a product of the NSW Ports' aggregate volumes and the shares derived from the SFM. A detailed discussion of these volumes and shares is provided in Section 5.2.3.

About the SFM

The SFM is the NSW Government's strategic modelling tool to represent freight activity and their movements across the State. The SFM forecasts the level of freight generation by commodity, drawing on various macroeconomic and demographic variables.

The benefit of using the SFM outputs is that it:

- Draws on common population and employment assumptions, key to forecasting production growth by commodity;
- Complements the existing strategic (passenger) transport models, including the Sydney Strategic Travel Model (STM); and
- Draws on transport travel times estimated within the STM, which allows for the effects of future transport network changes and investments.

A key focus of the Model was the build-up of the cost modules, which in turn influence the preference for a particular transport mode and/or particular container terminal. The functionality of each key cost component is described as follows:

- **Landside costs**: The landside cost module incorporates the cost of moving containers between the port gate and each container's origin or destination. The cost of moving these containers by road or rail as well as the wait times and lift times at intermediate points are incorporated in this module. Further detail on the landside cost module is provided in Section 1.1.
- **Container terminal costs**: The container terminal cost module includes the costs incurred between the quayside and the port gate. These costs include wharfage, navigation and pilotage charges as well as stevedore charges. The unitised costs of new container terminal infrastructure are built into the container terminal cost module. Further detail on the container terminal cost modelling approach undertaken is contained in Section 4.5.
- **Bluewater shipping costs**: Bluewater shipping costs refer to the costs incurred by container shipping lines travelling between ports. This module has the capacity to vary ship size, which in turn impacts on bluewater costs. Further detail on the bluewater cost modelling approach undertaken is contained in Section 4.6.

The Model incorporates two choice modules to assess the relative attractiveness of different transport modes and different ports. Both choice modules are described in more detail in Section 4.7. These choice modules include:

- **Road and rail choice:** Landside transport costs are a large component of the cost of moving containers. Typically, rail transport is cheaper than road transport although this differential is tighter in metropolitan areas as the distances are shorter. The road and rail choice module incorporated into the Model has been based on Douglas & Jones (2012)[36], a road-rail choice model developed specifically to model road and rail splits to and from Port Botany.
- **Port choice**: A port choice module has been incorporated to reflect shipper preferences, accounting for landside costs and travel times, as well as maritime costs and shipping line frequency.

4.1.2 Infrastructure assumptions

As detailed in Section 3, there is a broad range of committed, planned and proposed infrastructure investments which will improve the efficiency and capacity for passenger and freight movements, including container freight movements. We were able to factor a number of these projects into our modelling based on data availability. Table 10 outlines the key future land transport infrastructure investments that have been reflected in the Model's cost and time inputs.

Table 10: Infrastructure assumptions by model year

Project	Status	2016	2031	2046
Northern Sydney Freight Corridor	Completed	✓	✓	✓
WestConnex – M4 Widening	Completed	✓	✓	✓
WestConnex – M4 East & New M5	Under construction		✓	✓
WestConnex – M4-M5 & Rozelle Interchange	Planned		✓	✓
NorthConnex	Under construction		✓	✓
Sydney Gateway – connection with WestConnex	Planned		✓	✓
Port Botany Rail Line duplication	Planned		✓	✓
Western Harbour Tunnel	Planned		✓	✓

[36] Douglas and Jones (2012), *Modelling the impact of a freight charge on Sydney container traffic*, submitted to the Australasian Transport Research Forum 2012, 28-30 September 2011, Perth, Australia

Project	Status	2016	2031	2046
Southern Sydney Freight Line Upgrade	Planned		✓	✓
F6 Extension	Planned		✓	✓
Inland Rail	Planned		✓	✓
Maldon - Dombarton Railway Line	Proposed			✓
Western Sydney Freight Line	Proposed			✓

Source: KPMG

Table 11 outlines the key current and future intermodal terminal investments that have been reflected in the Model.

Table 11: Intermodal terminal assumptions by model year

Intermodal	Current status	IMEX capacity TEUs p.a.	2016	2031	2046
Yennora	Operational	200,000	✓	✓	✓
Minto	Operational	200,000	✓	✓	✓
Cooks River	Operational	400,000	✓	✓	✓
Enfield	Operational	300,000		✓	✓
Chullora	Operational	200,000		✓	✓
Moorebank	Under construction	1,050,000		✓	✓
Western Sydney	Proposed	1,000,000			✓

Source: KPMG. Note that Chullora has traditionally operated as a domestic intermodal terminal. Pacific National has proposed to augment its domestic operations with metropolitan intermodal services.

4.1.3 Policy settings

The Model has been developed assuming that key government policies and strategies remain constant in the future. The key policies reflected in the modelling assumptions are outlined as follows:

- **Heavy vehicle road pricing:** Heavy vehicle charges aim to recover heavy vehicle related expenditure on roads from heavy vehicle operators and are calculated and recommended by the National Transport Commission (NTC). These charges are a combination of an annual registration and fuel-based road user charges, which are collected by state and territory governments and the Australian Government respectively. The Model incorporates the current heavy vehicle charge regime.
- **Higher Productivity Vehicles:** The Model incorporates a semi-trailer, capable of handling two TEUs at a time, in the model. Currently, semi-trailers handle 70 per cent of containers to and from Port Botany. There is a prospect that with time, B-doubles and potentially, A-doubles, which can handle three and four TEUs respectively, may take a greater share of the road transport task although this trend will depend on advances in both regulatory arrangements and additional infrastructure investment across the road network.
- **Technology:** Technology advancements such as self-driving trucks and automation are expected to rapidly change how freight is transported worldwide. Prototype truck configurations using automation have tested truck platooning, which could see multiple TEUs being handled by one

prime mover. In keeping with the adoption of a semi-trailer as the reference vehicle, no major technological shifts have been incorporated into the Model.

4.2 Aggregate container volumes

Aggregate container projections for the Model have been based on projections provided by NSW Ports. These projections, prepared by BIS Oxford Economics, are used by NSW Ports to facilitate its planning and investment decisions. These projections do not consider capacity constraints and are based on prevailing expectations, including domestic and global economic growth rates and movements in exchange rates.

The forecast for container throughput is shown in Table 12 overleaf. It shows that container volumes are forecast the triple from around 2.2m TEUs in 2016 to 6.5m TEUs in 2046 (excluding transhipments), which equates to a compound annual growth of 3.6 per cent per annum.

Table 12: Projected container throughput at Port Botany (TEUs)

	2016	2031	2046
Full imports	1,095,000	2,096,000	3,265,000
Empty imports	11,000	3,000	3,000
Full exports	415,000	623,000	790,000
Empty exports	669,000	1,454,000	2,457,000
Total	2,189,000	4,177,000	6,516,000

Source: NSW Ports. Projections exclude transhipments

4.3 Container freight distribution

Understanding how containers move to and from Port Botany is crucial in understanding what container volumes may be captive to Port Botany versus being contestable.

Our review of the distribution of container movements has been based on origin-destination data from TfNSW's SFM and is detailed in section 2.2.1. This analysis was based on the following data provided by TfNSW:

- Metropolitan container movements in TEU terms at the SA3 level.
- Regional freight flows from regional SA3s to and from Port Botany.
- Travel distances and travel times between metropolitan SA3s.

Regional freight flows were converted from tonnages into TEUs using commodity specific conversion rates adopted within the SFM. Data was incorporated into the Model, agnostic of transport mode. This step was undertaken for confidentiality reasons but also to run the Model using the adopted road-rail choice module.

4.4 Landside transport costs

Landside transport costs play a role in driving the choice of not just transport mode but also which port a consignor or consignee wishes to use. To inform both choices, transport costs were estimated between each SA3 area and each port, incorporating the following cost components:

- In vehicle transit travel time;
- Vehicle or train operating costs;
- Unitised capital costs;
- Tolls and track access charges;
- Lift costs; and
- Ancillary time incurred for resting, loading, unloading, inspecting, etc.

For road travel between metropolitan SA3s, travel time and travel distance outputs from SFM was adopted to form the basis of the road cost estimates. For all regional related travel and all rail related travel, we developed a travel database to inform the cost modelling. This drew upon Standard Working Timetables, track diagrams and routing algorithms.

However, there is limited information on how firms arrange their logistics chain from first container drop to store. Therefore, some variation around the Model's estimates can be expected. Issues that may influence costs between consignors and consignees include:

- Desired inventory levels in store;
- Cost of rent/land;
- Cost of transport;
- Opening hours;
- Vehicle restrictions;
- Degree of automation; and
- Use of third parties.

It is also worth noting that import and export container volumes are only one part of a much larger freight task. Costs across individual supply chains may be influenced by both domestic and import-export volumes.

4.4.1 General assumptions

The average Sydney diesel price as at June 2018 less GST has been adopted. AAA & Fueltrac (2018) data suggests that the average retail price for diesel in Sydney was $1.575, per litre inclusive of GST or $1.432 per litre excluding GST. Noting the link between fuel taxes and the national heavy vehicle charging regime, the diesel fuel rebate has also been incorporated into the Model with a higher rebate rate applicable for rail.

Table 13: Fuel and oil prices

Item	Value	Source
Fuel price excluding GST	$1.432/L	AAA & Fueltrac (2018)
Fuel tax rebate for trucks	15.4c/L	ATO
Fuel tax rebate for rail	41.2c/L	ATO
Oil price	$6.00/L	Assumption

4.4.2 Reference vehicles and trains

A semi-trailer has been adopted as the reference truck, noting that 70 percent of containers travel on the back of a semi-trailer, which has the capacity to carry two TEUs[37]. The remaining proportion are generally carried by B-doubles although A-doubles are used for some containers being moved around the port precinct. Mass restrictions on the road network currently limit a broader adoption of B-doubles and A-doubles particularly for (heavier) exports, which can carry three and four TEUs respectively.

Table 14 outlines the operating parameters of these semi-trailers. Based on our analysis of NSW Ports' data, an average payload of 13.5t per TEU has been adopted.

Table 14: Semi-trailer operating parameters

Operating parameters	Value
Gross vehicle mass	42.5 tonnes
Maximum payload	27.5 tonnes
Number of slots	2 TEU
Slot utilisation	60%
Average vehicle kilometres	86,000 km
Effective life - prime mover	7.5 years
Effective life - skel trailer	10.0 years

Source: ATAP (2016)[38], ATO

Effective lives are in line with statutory caps under the Laws Amendment (2005 Measures No. 1) Act 2005[39]. These caps require vehicle assets to be depreciated faster than safe harbour guidance previously provided by the Tax Commissioner.

A broader range of reference trains have been adopted within the Model. The reference train selected for Port Botany and Port Kembla is a 650m train with two locomotives and slots for 75 TEUs. This is consistent with NSW Port's strategy and fits with the strategy of the intermodal facilities being developed and planned for Sydney.

For Newcastle, a longer 1,300m train has been adopted in recognition of the configurations submitted as part of Port of Newcastle Corporation's 2009 proposal. Longer trains will trigger a need for infrastructure upgrades along the Main North Line, including the lengthening of existing loops and new loops to provide refuge from faster passenger services. When reaching intermodals in Sydney, these trains will need to be split in the marshalling yard before entry into the intermodals can be made.

For trains using Inland Rail to travel to or from Port of Brisbane or Port of Melbourne, a 1,300m single stack train configuration has been assumed. Noting that Inland Rail has focused on domestic opportunities to date, limited planning has centred on the role of IMEX trains on this corridor. The current configuration of interfaces at the Port of Brisbane and Port of Melbourne pose some challenges, particularly in relation to train length and double-stacking.

While we are aware of proposals to ease these constraints at both ports, we have assumed for the time being that trains would be single stacked. A somewhat 'shorter' train set has been assumed albeit that these trains will need to be broken up and consolidated together upon arrival and departure respectively.

Table 15 outlines the configuration for each of these reference trains.

[37] NSW Ports (2015), *Navigating the Future: NSW Ports 30 Year Master Plan*
[38] ATAP (2016), PV2 Road Parameter Values
[39] https://www.ato.gov.au/Business/Depreciation-and-capital-expenses-and-allowances/In-detail/effective-life/statutory-cap/capital-allowances--statutory-caps-on-the-effective-life-of-buses,-light-commercial-vehicles,-minibuses,-trucks-and-truck-trailers/

Table 15: Train set configuration assumptions

Variable	Port Botany & Port Kembla	Port of Newcastle	Port of Brisbane & Port of Melbourne with Inland Rail
Train length	650m	1,300m	1,300m
Locomotive type	3000hp	4500hp	4500hp AC
Number of locomotives	2	4	4
Tare weight per locomotive	130t	130t	130t
Economic life	30 years	30 years	30 years
Number of wagons	25	50	50
Number of slots (TEUs)	75	150	150
Tare weight per wagon	20t	20t	20t
Economic life	30 years	30 years	30 years

Source: KPMG assumptions, NSW Ports and Port of Newcastle

4.4.3 Cost of capital

Two post-tax Weighted Average Cost of Capital (WACC) rates have been adopted, one for domestic land transport operations and one for port related operations. Based on high-level assumptions on the cost of debt and equity, a post-tax WACC of 6.3 per cent and 6.9 per cent for land transport and port operations respectively have been adopted.

Appendix B provides an outline of the parameters used to inform the WACC calculation.

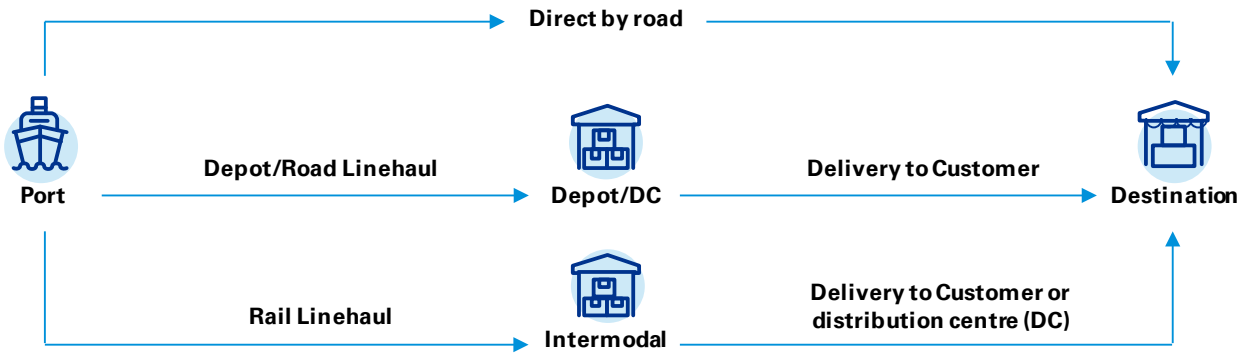
4.4.4 The container chain

Land transport costs are one of three major cost components considered within the Model. Although containers globally are transported by a variety of means, including river barge and coastal shipping, containers domestically are moved by road or a combination of road and rail. For the Port Botany container task, the Model considers three means by which containers are moved:

- **Direct by road:** Containers are transported directly between the port and the consignor/consignee by truck.
- **By road via depot:** Containers are dropped off at an intermediate location prior to being transported to their final destination. This option may be used due to mismatches in operating hours or where the consignor/consignee outsources the transport task. This option may also be used to facilitate consolidation.
- **By rail via an intermodal terminal:** Containers are transported by rail between the port and an intermodal facility. Containers may be transported between their ultimate origin/destination by road. They may also be transported to an adjacent warehouse on-site, to be unpacked prior to being distributed to end users.

Each approach is illustrated in Figure 31 overleaf.

Figure 31: Landside logistics approaches

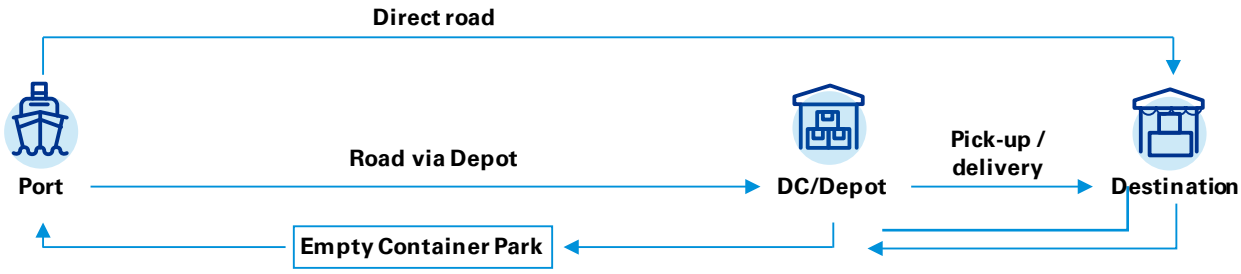


Source: KPMG

With variations in the origin of full export containers and the destination of full import containers, combined with the imbalance between full import and export containers, there are higher transport requirements associated with the container task. The imbalance creates an empty container issue, which requires these containers to be stored at an empty container park to either use for exporting goods or returning the empty container for repositioning. These container parks are used in lieu of directly returning these containers to the port as it is cheaper to store empty containers at these parks.

However, the transportation of empty containers gives rise to additional lifts. As depicted in Figure 32, an additional pair of lifts are required to store an empty import container prior to its return to the port. This issue, known as the triangulation issue, requires the incorporation of additional time and costs to drop empty import containers back at the port.

Figure 32: Triangulation of containers



Source: KPMG

Intermediate points also result in additional handling. Drawing on Shipping Australia's (2011) research, $100 per TEU per point has been incorporated into the cost modelling to account for handling and storage at a road depot, intermodal facility and at the end destination.

4.4.5 Lift costs

Loading and unloading containers are a feature of the container chain. While the portability and transferability of containers is a distinct reason for the rise of global containerisation, each pick up and drop off incurs additional costs.

Table 16 provides an outline of the number of lifts assumed by mode. Rail requires additional lifts relative to a direct road only trip, as additional lifts are required at the intermediate depot/terminal.

A composite lift cost of $16 per TEU per lift was adopted, based on lift costs presented in Shipping Australia (2011)[40].

Table 16: Road and rail lifts on a round trip

Description	Port-Road Direct	Port-Road via Depot	Rail
Total (round trip)	8 lifts	10 lifts	10 lifts

Source: KPMG assumptions

4.4.6 Lift and turnaround times

Road and rail lift and turnaround times are presented in Table 17 and Table 18 respectively. Road lift and turnaround time assumptions broadly reflect lift times in Shipping Australia (2011) and truck turnaround times in BITRE's Waterline series.

Table 17: Road load and unload times (round trip)

Description	Port-Road Direct	Port-Road via Depot
Total – round trip	180 minutes	210 minutes

Source: Assumptions based on a review of BITRE Waterline 61 data, Shipping Australia (2011)

Additional travel time allowances for mandatory rest periods have also been built into the modelling. The rest periods broadly align with the solo driver rest requirements, and are detailed in Appendix B. Rail turnaround times reflect performance data collated by TfNSW[41], which indicates an average of 40 lifts per hour for rail at Port Botany. A slightly higher load time for import containers has been allowed for, to incorporate time for quarantine inspections.

Table 18: Rail load and unload times (Port Botany & Port Kembla)

Description	Import containers	Export containers
Total – one way	220 minutes	190 minutes

Source: Assumptions based on a review of performance data collated by TfNSW

For the Port of Newcastle, Port of Brisbane and Port of Melbourne, the longer reference trains require longer inspection and load/unload times. Dwell times at these ports have been increased proportionally.

For trains arriving and departing Port of Melbourne and Port of Brisbane, additional travel time associated with breaking trains and the consequential mandatory brake inspection have not been incorporated into assumed travel times. An additional 30 minutes has been assigned for shunting and decoupling, 30 minutes for shunting and recoupling and 30 minutes for a mandatory brake inspection.

[40] Shipping Australia (2011), *Metropolitan Intermodal Terminal Study*

[41] https://www.transport.nsw.gov.au/data-and-research/freight-data/freight-performance-dashboard/other-freight-measures/port-botany

4.4.7 Road transport time related costs

In competitive road transport markets, prices charged for transport services are highly correlated to the costs of provision. The value of occupant time is based on the prevailing award rates for each vehicle class as specified in the Road Transport and Distribution Award with allowances for the following on-costs added:

- Superannuation;
- Work care levy;
- Long service leave;
- Leave loading;
- Uniform allowance; and
- Payroll tax.

Ordinary time costs for road transport have been estimated to be approximately $31 per hour. Noting the round-the-clock nature of road transport movements, allowances were added to account for weekend work.

4.4.8 Vehicle operating costs

A bottom up construction of vehicle operating costs has been undertaken to capture capital and operating costs as they relate to the container freight task. Table 43 in Appendix B provides valuations for:

- Capital costs, based on prevailing market prices;
- Vehicle registration costs, based on the current charges[42];
- Repair and maintenance rates from ATAP guidance[43];
- Tyre cost rates from ATAP guidance; and
- Insurance and tyre wear assumptions.

Fuel and oil consumption has been based on the stop-start (urban) and free-flow models presented in ATAP guidelines. To inform the fuel consumption model, an average speed of 40km/h has been adopted based on SFM data. In regional areas, an assumption of 60km/h was assumed. For the reference vehicle, this implies a fuel consumption rate of approximately 0.9L/km in urban localities and 0.45L/km in regional areas. For oil consumption, a rate of 0.003L/km has been adopted, drawing on Austroads guidance[44].

4.4.9 Tolls

The land transport cost module includes an allowance for toll payments in Sydney, albeit that these costs are more than offset by travel time savings, higher journey time reliability and lower vehicle operating costs relative to using the arterial road network.

The Sydney motorway network will see major additions to the network in the near term including the M4 East, NorthConnex, New M5, M4-M5 Link, Rozelle Interchange and Sydney Gateway and with the prospect of the Western Harbour Tunnel and F6 Extension being progressed to delivery.

For a range of new toll roads, assumptions are required to establish an appropriate toll rate for container trucks. Of pertinence, the capped price toll on the WestConnex network will likely see almost all truck trips triggering the cap. Given that this cap applies on the use of the entire WestConnex network on a given trip, except the M5 Motorway west of King Georges Road, all truck

[42] https://www.ntc.gov.au/heavy-vehicles/heavy-vehicle-charges/registration-charges-for-heavy-vehicles-2018-19-and-2019-20/
[43] Ibid
[44] Austroads (2005), *Harmonisation of Non-Urban Road User Cost Models*, AP-R264/05

trips using any part of the WestConnex network are assumed to be charged the capped toll. This toll is triggered once the M4-M5 link or the New M5 is used within the Model.

Heavy vehicles are generally charged a multiple of three relative to light vehicles, although there are some exceptions e.g. M7 Motorway. Of note however is that the value of travel time savings and vehicle operating cost savings more than outweigh the cost of toll payments relative to using the 'free' arterial road network.

Appendix B incorporates the truck toll schedule used for all current and future motorways.

4.4.10 Rail freight transport costs

Rail transport cost rates within the Model are driven by a number of fixed components and variable components that vary based on speed and train kilometres travelled with costs reflecting:

- Crewing costs;
- Fuel consumption costs;
- Locomotive and wagon capital and maintenance costs; and
- Corporate and administrative costs.

Changes in total rail freight transport costs are based on the change in volumes and change in rail transport costs. The following high level parameters have been used to inform the estimation of rail freight costs and are broadly reflective of rates used in previous studies. These rates are shown in the table below.

Table 19: Rail freight cost rates

Variable	Port Botany & Port Kembla	Port of Newcastle	Port of Brisbane & Port of Melbourne with Inland Rail
Locomotive capital cost	$4.33m	$4.33m	$5.44m
Wagon capital cost	$133,255	$133,255	$133,255
Crew cost	$329 per train hour		
Insurance	$150,000		
Repair and maintenance	$1.94 per loco km $0.07 per wagon km		
Fuel consumption	5L per loco km		
Oil consumption	0.04L per loco km		
Slot Utilisation (import)	70%	70%	70%
Slot Utilisation (export)	50%	50%	50%

Source: TfNSW (2018)[45]

A slightly higher locomotive cost has been adopted for Inland Rail runs to ensure alignment with the rolling stock assumed for domestic intermodal runs in current planning for Inland Rail.

[45] TfNSW (2018), *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*

4.4.11 Track access charges

Track access charges vary depending on the track manager, section of track used as well as the train characteristics. Track access charges published by ARTC, John Holland Rail and Queensland Rail have been incorporated into the model.

However, assumptions are required to derive a rate applicable to new track and the Metropolitan Rail Network, managed by TfNSW.

The Metropolitan Rail Network (MRN) is the (shared) rail network bounded by Lithgow, Broadmeadow, Macarthur and Bomaderry. Passenger movements account for a majority of movements on this network, through the two government operating agencies NSW Trains and Sydney Trains. Large parts of the MRN are shared between freight and passenger services, although parts closer to the city are generally used only by passenger services.

The pricing structure for access on the MRN is understood to be on a per train km basis only, with this rate varying by train length. This reflects the marginal impact of freight services in terms of reducing the number of train paths available for other passenger/freight services. These rates are not publicly released however.

Appendix B provides a full list of track access charge rates adopted within the Model.

4.5 Container terminal costs

A high-level container terminal cost has been developed to capture the incremental capital cost of new container terminal investments. These costs in turn have been annuitised and assumed to be passed on in full to consignees and consignors through a per TEU charge. This incremental cost includes:

- Recovery of all capital costs;
- Return on capital; and
- Return on operating costs.

Capital cost estimates were provided by SMART for both Port Kembla and Port of Newcastle. Due to commercial considerations, the exact capital costs have not been disclosed in this Study although these costs range between $1.5 billion and $2.5 billion per port. These capital costs were profiled to ensure operations commence from 2031. Total capital charges were annuitised using the parameters in Table 20, allowing for nominal price increases in line with inflation. Charges were assumed to be set to ensure capital cost recovery prior to the conclusion of leases at all NSW ports.

Table 20: Container terminal general parameters

Variable	Value	Source
Profit margin: terminal operations	30%	IBISWorld
Nominal growth in unit charges	2.5%	Assumption

Ongoing costs will also need to be recovered. Table 21 outlines recurrent costs that have been allowed for within the cost module:

Table 21: Container terminal operating parameters

Variable	Value	Source
Assumed incremental employee cost per TEU	$10	Based on KPMG analysis
Ratio between employee and other expenses	1.0	Based on KPMG analysis
Margin on costs	15%	Based on IBISWorld analysis

The effect of including these costs on top of existing wharfage charges at Port Kembla and Port of Newcastle would see wharfage charges increasing by a factor of 1.5 at Port Kembla and 2.3 at the Port of Newcastle relative to existing wharfage charges. Existing wharfage charges by container type have been pro-rated using these factors and are outlined in Appendix B.

The container terminal cost module also includes the following charges which vary with the assumed reference ship size:

- Wharfage, navigation and pilotage charges; and
- Stevedore charges.

Appendix B contains a full list of charges by port.

4.6 Bluewater costs

The bluewater cost module is the third and final key cost module. The development of the bluewater cost model has been based on the structure and parameters provided in Stopford (2009). The container ship cost model incorporates three key cost elements including:

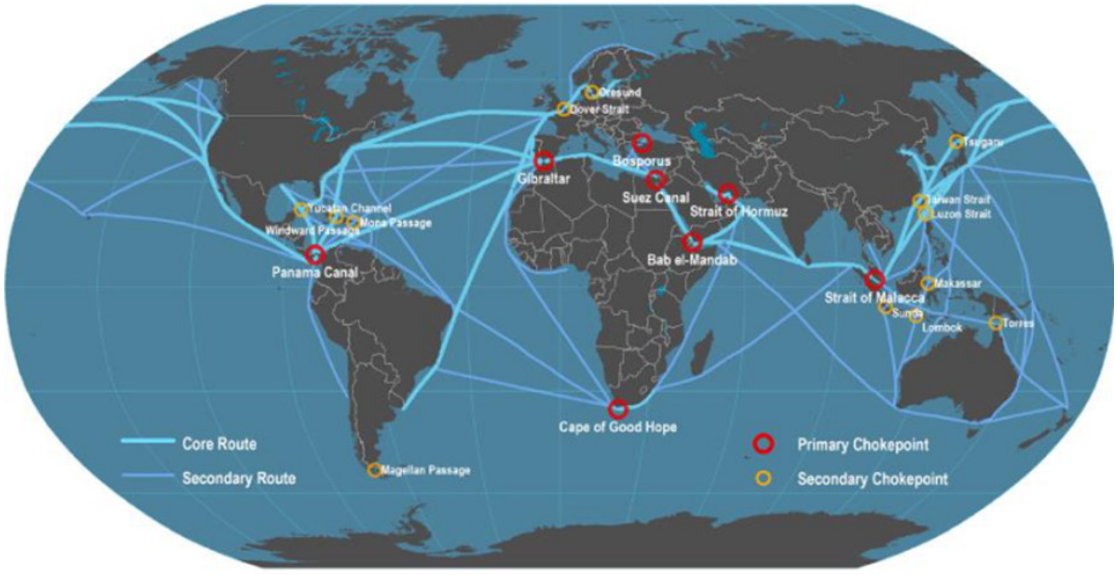
- Unitised capital costs;
- Bunker fuel costs; and
- Miscellaneous costs including administration, crewing and overheads.

Appendix B provides a detailed list of container cost shipping parameters incorporated into the bluewater cost module.

4.6.1 Reference shipping routes

While shipping lines serve a range of destinations across Asia, Europe and the Americas from Port Botany, Asia accounts for the highest proportion of trade. Figure 33 illustrates the pattern in the context of other major global trading routes. For the purposes of simplifying the modelling, two reference shipping routes, one from North Asia and one from East Asia were integrated into the cost module.

Figure 33: Major shipping routes to/from Australia



Source: Jean-Paul Rodrigue (2017)[46]

[46] Jean-Paul Rodrigue (2017), The Geography of Transport Systems 4th Ed., New York: Routledge

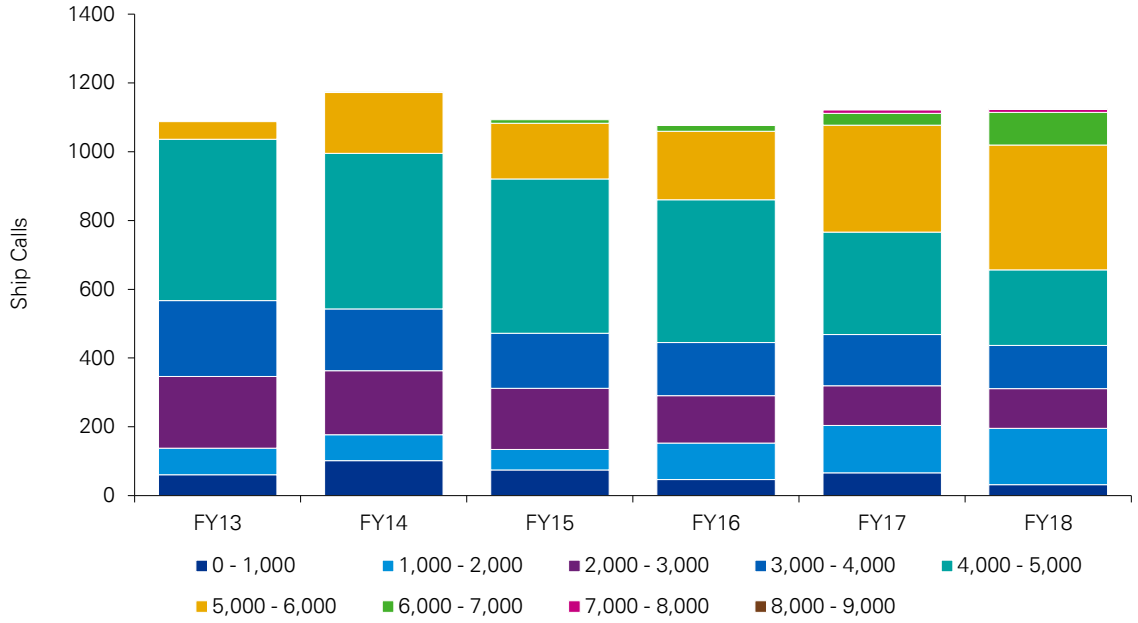
Scheduled container ship visits have been generally organised to call at a number of Australian ports on the same journey. These, most-often, weekly services are considered by shipping lines to be the economic network solution for the Australian market. Both reference shipping routes are assumed to call at Melbourne, Sydney and Brisbane before returning to Asia.

4.6.2 Reference ship

The container shipping market has been driven by a long-term drive to increase scale to reduce unit costs. As an example, the world's largest container ships have a capacity in excess of 20,000 TEU. These capacities will approach 23,000 TEU by the end of this decade. By comparison, the largest container ship in service was 14,000 TEU at the beginning of the decade.

Although Australian routes do not receive the largest container ships, slightly older ships are cascaded as the largest ships are allocated onto the busiest routes. This means that Australia will receive larger ships over time. This is evidenced by the distribution of container ship sizes that have visited Port Botany since 2013, particularly in the 5,000 to 6,000 TEU range, as detailed in Figure 34 below.

Figure 34: Historic ship sizes visiting Port Botany



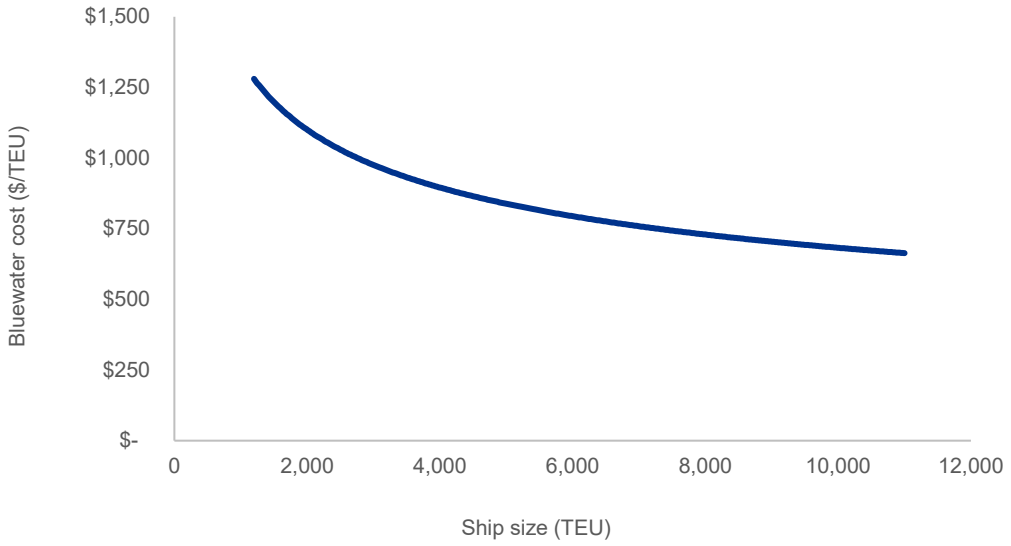
Source: NSW Ports

Given the trend of increasing ship sizes, the Model incorporates a reference container ship size of 4,000 TEUs in 2016, increasing to 5,500 TEUs and 8,000 TEUs in 2031 and 2046 respectively. These reference ship sizes have been assumed across all ports, including Port Kembla and Port of Newcastle. While this ensures that the bluewater cost of servicing a non-capital city container terminal remains the same across all scenarios, this module provides the flexibility to undertake sensitivity tests to vary ship sizes to increase service frequency at Port Kembla and Port of Newcastle, at the cost of lower capacity and higher bluewater unit costs.

Figure 35 overleaf illustrates the application of the bluewater cost module. It indicates that there are cost advantages in increasing scale.

The module projects that the bluewater cost rate falls from approximately $900 per TEU to approximately $750 per TEU with an increase in ship size from 4,000 TEUs to 8,000 TEUs.

Figure 35: Bluewater costs for Australia to Asia



Source: KPMG analysis

4.7 Road and rail choice

The majority of the current container freight task is handled by the road network. With a clear majority of containers originating or destined somewhere within the Sydney metropolitan area, the short distances involved results in transport by road being quicker, more flexible and reliable despite rail being cost competitive to many destinations in Sydney.

With the advent of major investments in the metropolitan intermodal network, connected by dedicated rail freight track, some of the barriers to a broader adoption of rail by consignors and consignees are being removed.

To measure the potential shifts between road and rail, the Model has integrated a road-rail model developed by Douglas & Jones (2012). This choice model was developed specifically to measure changes in rail mode share to and from Port Botany in response to infrastructure charges on containers moved by road.

The choice model draws on the land transport costs derived using the approach and assumptions outlined in Section 4.3. To facilitate the derivation of a composite road cost, it has been assumed that 30 per cent of containers travel directly between the port and consignors/consignees. This assumption is based on work undertaken previously by Shipping Australia (2011)[47].

The choice model adopts the following parameter values:

$$\begin{aligned} U_{rail} &= -1.682 - 0.023CRT \\ U_{road} &= -0.023Road\ tariff \end{aligned}$$

[47] Shipping Australia (2011), *Metropolitan Intermodal Terminal Study*

4.7.1 Port choice

There are a variety of factors that influence shipper port choice, and also shipping line choice including:

- Port characteristics e.g. draught;
- Maritime costs;
- Port costs;
- Port turnaround times;
- Landside transport costs and time; and
- Volumes.

While the notion of competition between ports domestically is fairly novel, with the exception of some regional areas, competition between ports in Europe and Asia is far more prevalent. To inform the port choice in the model, the findings from Mueller (2014) were adopted[48]. We have simplified the model to exclude the rail dummy variable given that Mueller (2014) postulates that (European) ports with rail interfaces tend to experience high levels of unreliability. In any case, all ports in this study will have a rail interface, meaning that this variable will have no effect. We have also converted parameters denominated in Euros into Australian dollars. Based on these changes, the following utility function has been adopted[49]:

$$U_{Port\ i} = -0.0083\ LAND\ TRANSPORT\ COST\ (\$) - 0.0416\ MARITIME\ COST(\$) \\ - 0.151\ LAND\ TRANSPORT\ TIME(days) + 0.025\ PORT\ CALLS\ (per\ week)$$

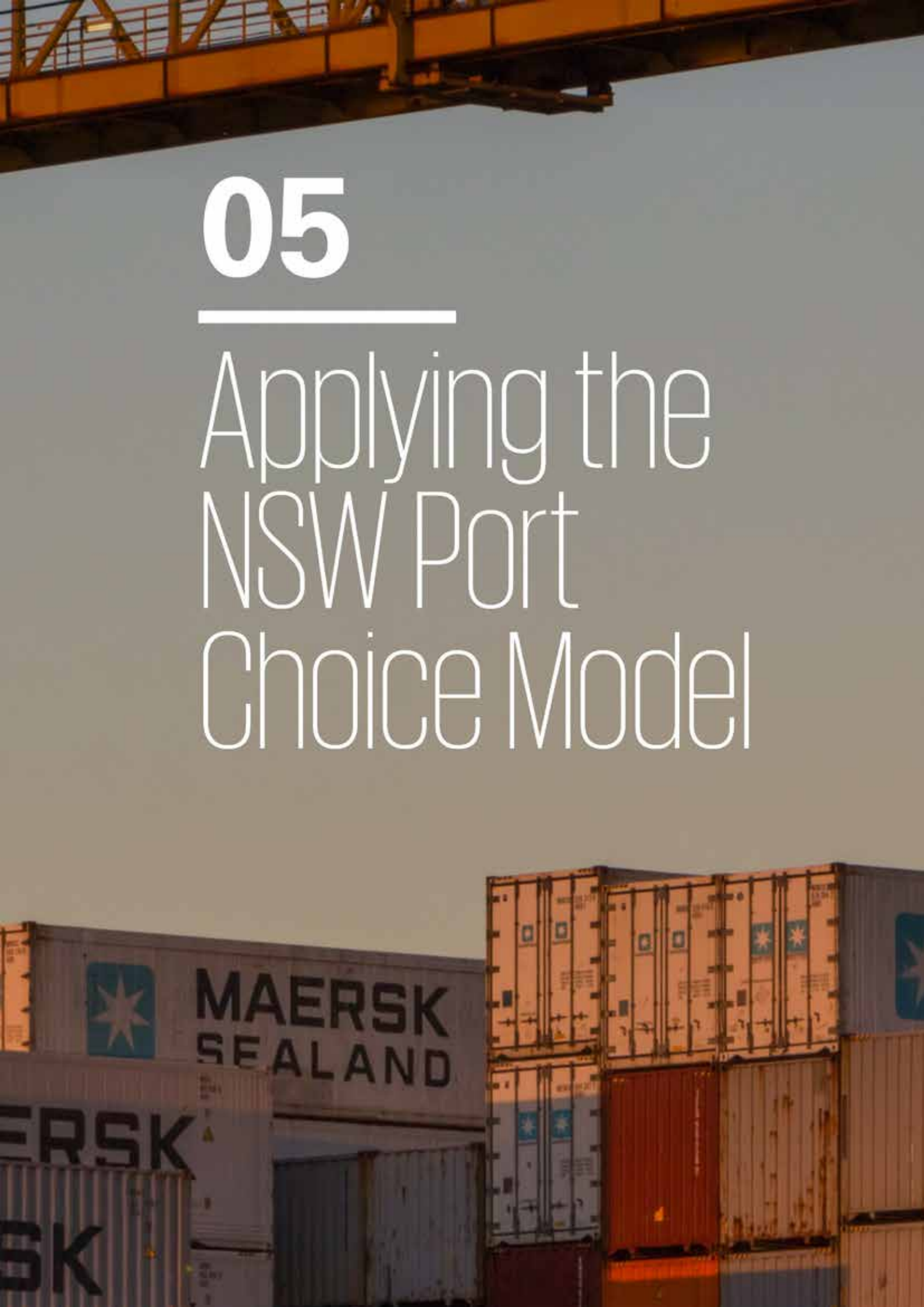
The model incorporates landside transport costs, maritime transport cost, landside transport time as well as service factors for the number of calls and the provision of rail. The model implies that maritime costs are weighted more heavily than land transport costs, with maritime costs weighted five times higher than land transport costs. This may not be entirely surprising given, that the financial viability of container shipping is volatile with long periods of unprofitability. Cost reductions are always being sought within the industry and where shipping lines are given the choice, shipping lines can be expected to be sensitive to charges applied by port owners and stevedores.

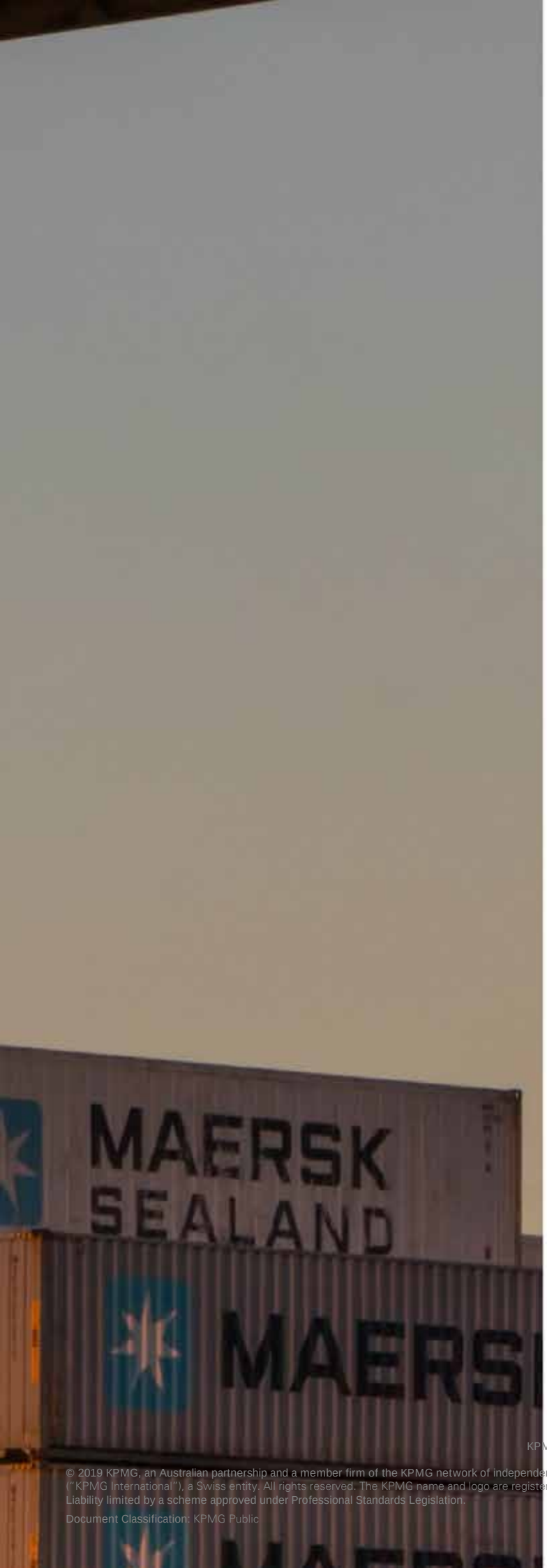
To inform the model, it is necessary to estimate the number of calls each port receives. Given the adoption of a common reference vessel for all container ports, frequency has been adjusted so that capacity matches demand.

[48] Mueller (2014), Container Port Development: A Port Choice Model for the European Mainland
[49] Note EUR values have been converted to AUD using the prevailing conversion rates published on ATO.

05

Applying the NSW Port Choice Model





To provide an indication as to whether the effect of competition impacts port shares, four model scenarios have been developed to test changes in port shares and port volumes. These scenarios consider the impact of a new container port at either Port Kembla, Port of Newcastle or together.

5.1 Scenarios

The prospect of additional competition between different container terminals within NSW has been tested by developing four competition scenarios (see Table 22). These scenarios consider a 'no new ports' scenario, which is the basis for establishing what the effect of building a container terminal at either Port Kembla or Port of Newcastle would have on container movements. This is undertaken to determine the impact from the introduction of either port in isolation. For completeness, the final scenario assumes container terminals are developed at both Port Kembla and the Port of Newcastle.

Table 22: Model scenarios

Ports	Current	2031	2046
"No New Ports" Port Botany, Port of Brisbane, Port of Melbourne	✓	✓	✓
"With Port Kembla"		✓	✓
"With Port of Newcastle"		✓	✓
"All ports" Port Botany, Port of Brisbane, Port of Melbourne, Port Kembla and Port of Newcastle		✓	✓

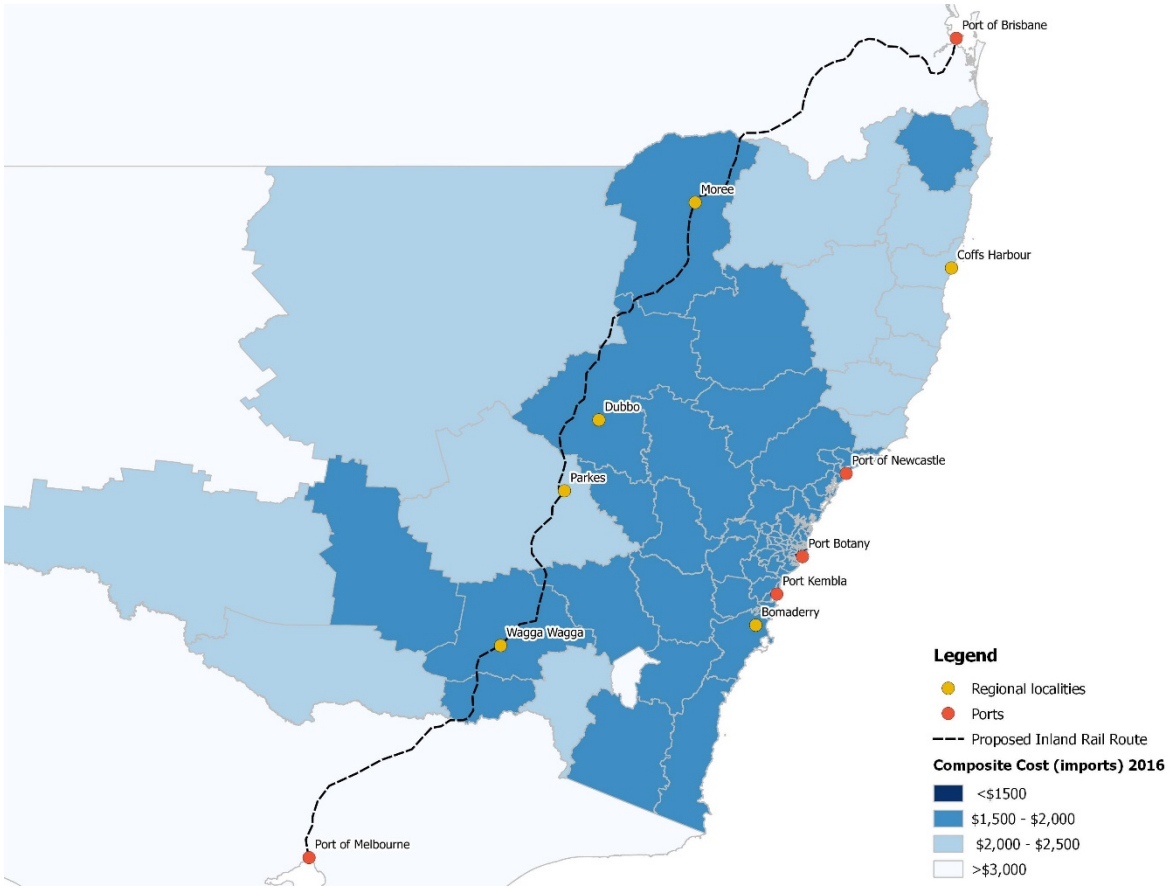
5.2 'No new ports' scenario

5.2.1 Today's costs

The Model provides outputs on the whole of container chain costs, including bluewater costs, costs incurred at domestic container terminals then on the land transport network. Much of the variation in costs will be driven by landside and terminal costs. In the case of the former, while road transport costs will be high from locations further away from a given port, rail's lower marginal cost will mean that rail will tend to take a greater share of the task from these areas.

Figure 36 illustrates the projected cost of moving a container to or from Port Botany for all SA3s in NSW in 2016. Within the metropolitan area, whole of container chain costs of moving a container from Port Botany to Mt Druitt and Liverpool are in the order of $1,670 and $1,550 per TEU respectively in today's prices. By comparison, the costs of moving containers from Port Botany to Wyong and Kiama are in the order of $1,750 and $1,680 per TEU respectively.

Figure 36: Whole of container chain cost map per TEU from Port Botany in 2016

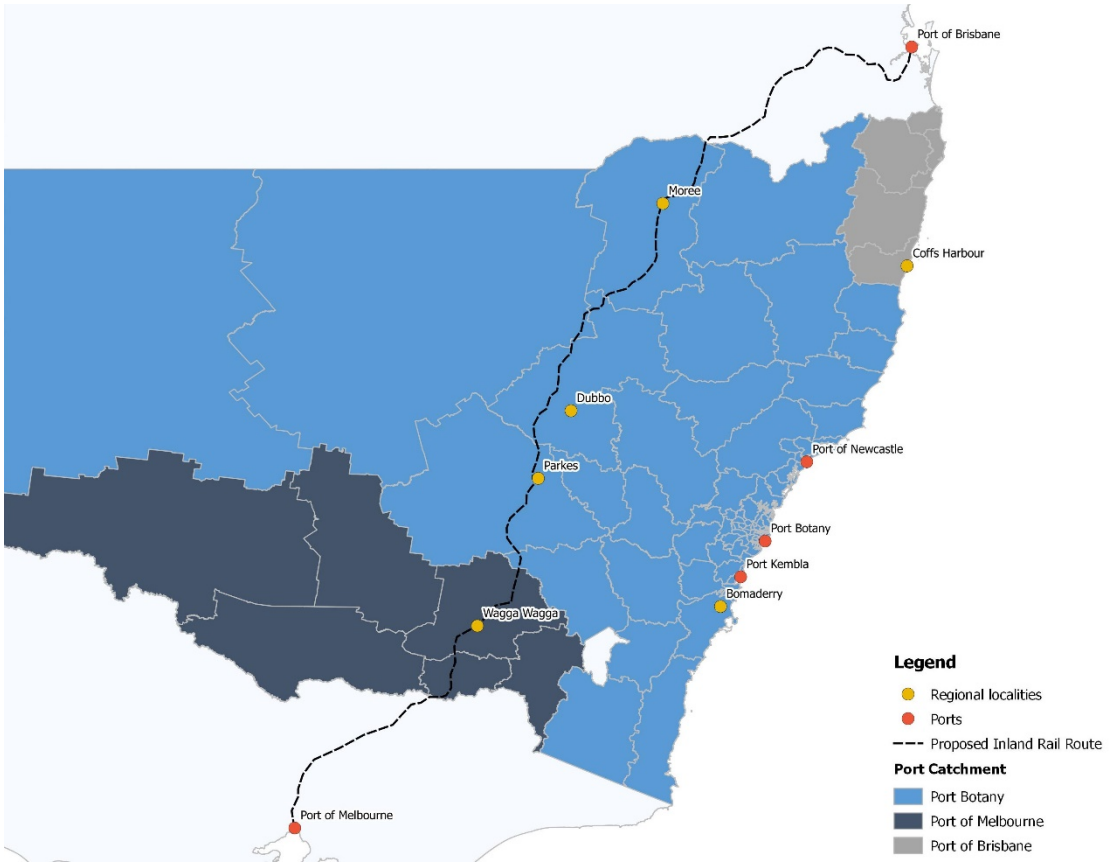


Source: KPMG analysis. Transport costs include bluewater, terminal and land transport costs

Based on the transport costs for Port Botany as well as the Port of Brisbane and Port of Melbourne, much of the state would incur lower costs by transporting their containers through Port Botany. Intuitively, areas of the state between Queensland and Coffs Harbour and Victoria and Wagga Wagga may have lower transport costs if freight is routed via Brisbane and Melbourne respectively.

Figure 37 illustrates the catchment by port based purely on lowest composite transport costs. It should be noted that the illustration merely shows which port offers the lowest cost. In practice, cost differentials may not be significant in particular in areas around the boundary of each catchment. It can be expected that in these areas, container volumes would be highly contestable.

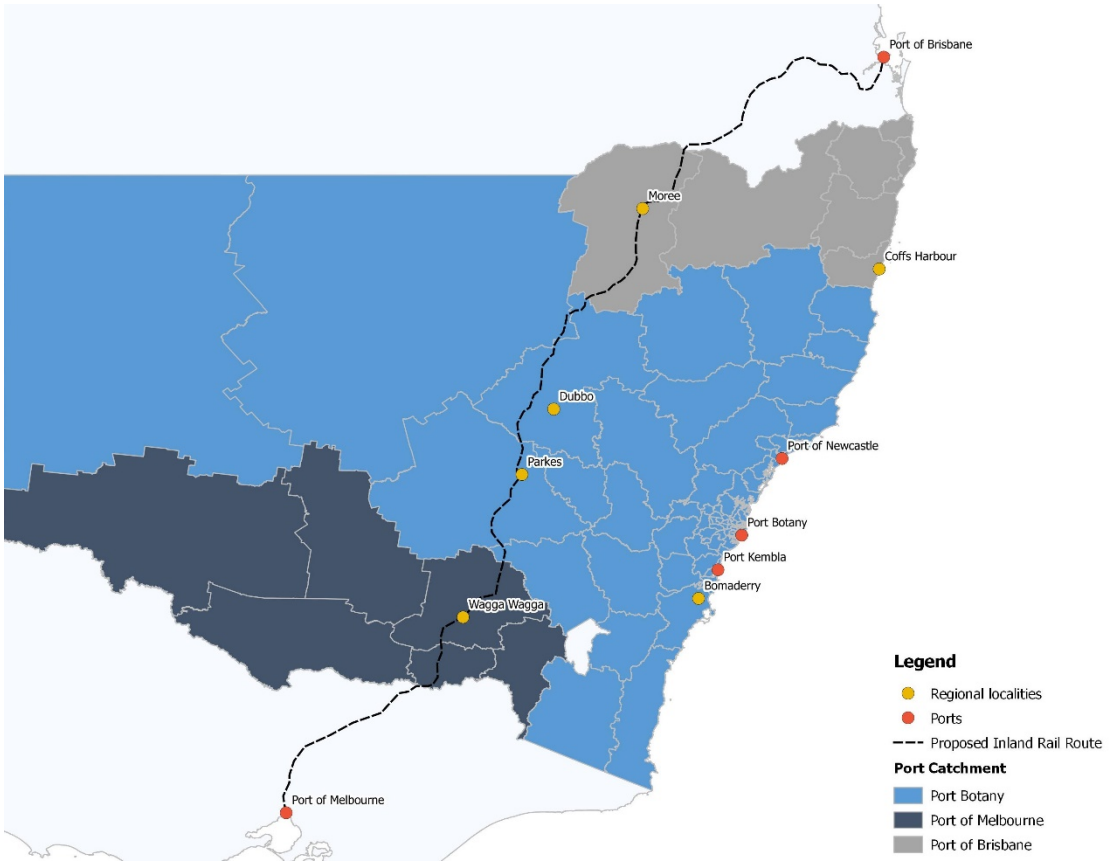
Figure 37: 2016 catchment map based on lowest whole of container chain costs under 'no new ports' scenario



Source: KPMG analysis. Whole of chain costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

Figure 38 overleaf shows the potential catchment area for the Port of Brisbane and the Port of Melbourne in 2046, reflecting the impact of Inland Rail.

Figure 38: 2046 catchment map based on lowest costs under the 'no new ports' scenario



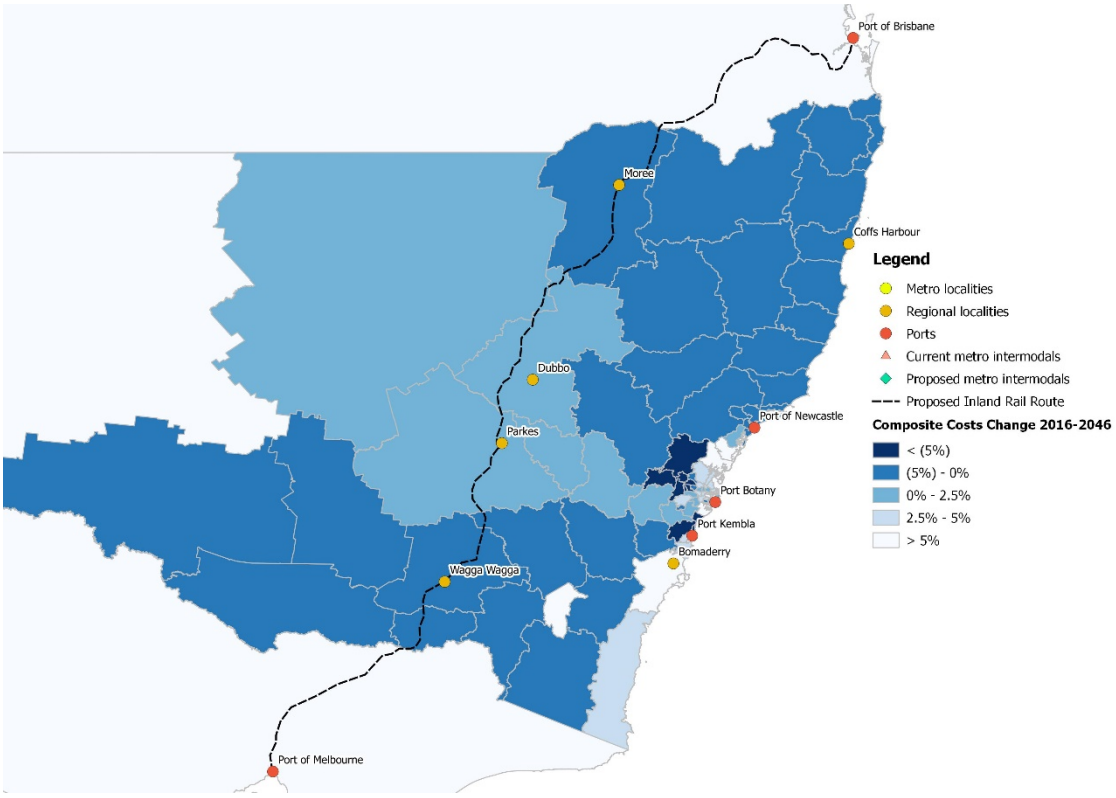
Source: KPMG analysis. Costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

5.2.2 Future year costs

In real terms, costs in 2046 are projected to be broadly in line with today's costs. Even into the future, the positive benefits of road transport infrastructure projects for movements between Port Botany and Western Sydney are evident. This is despite the cost modelling also reflecting 30 years of growing congestion on other parts of the road network.

Figure 39 shows the change in whole of container chain costs over time from 2016 to 2046. The one-way composite trip costs of moving a container from Port Botany to Liverpool and Mt Druitt are in the order of $1,415 and $1,450 per TEU respectively in today's prices. By comparison, the costs of moving containers from Port Botany to Wyong and Kiama are in the order of $1,620 and $1,540 per TEU respectively.

Figure 39: Change in whole of container chain cost per TEU from Port Botany between 2016 and 2046 under 'no new ports' scenario



Source: KPMG analysis. Costs include bluewater, terminal and landside transport costs

5.2.3 Estimated port shares & volumes

Table 23 and Table 24 provide a breakdown of the estimated share and volume of containers by port under the 'no new ports' scenario. Between 2016 and 2046 the forecasts container shares between the three ports broadly remains constant. Inland Rail plays a role in solidifying the volume of containers to the Port of Brisbane and Port of Melbourne.

Table 23: Share of NSW's containerised IMEX freight by % under the 'no new ports' scenario

Ports	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	95.4%	0.0%	0.0%	1.4%	3.2%
2031	92.6%	0.0%	0.0%	2.1%	5.3%
2046	92.1%	0.0%	0.0%	2.2%	5.7%
Full exports					
2016	91.6%	0.0%	0.0%	0.7%	7.7%
2031	82.7%	0.0%	0.0%	6.3%	11.0%
2046	81.7%	0.0%	0.0%	7.3%	11.0%
All containers					
2016	95.9%	0.0%	0.0%	0.9%	3.2%
2031	93.0%	0.0%	0.0%	2.2%	4.8%
2046	93.0%	0.0%	0.0%	2.2%	4.8%

Source: KPMG analysis

Table 24: Share of NSW's containerised IMEX freight by volume (TEU) under the 'no new ports' scenario

Ports	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,868,000	0	0	43,000	107,000
2046	2,999,000	0	0	73,000	184,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	503,000	0	0	38,000	67,000
2046	640,000	0	0	57,000	86,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	3,739,000	0	0	87,000	195,000
2046	6,047,000	0	0	142,000	311,000

Source: KPMG analysis

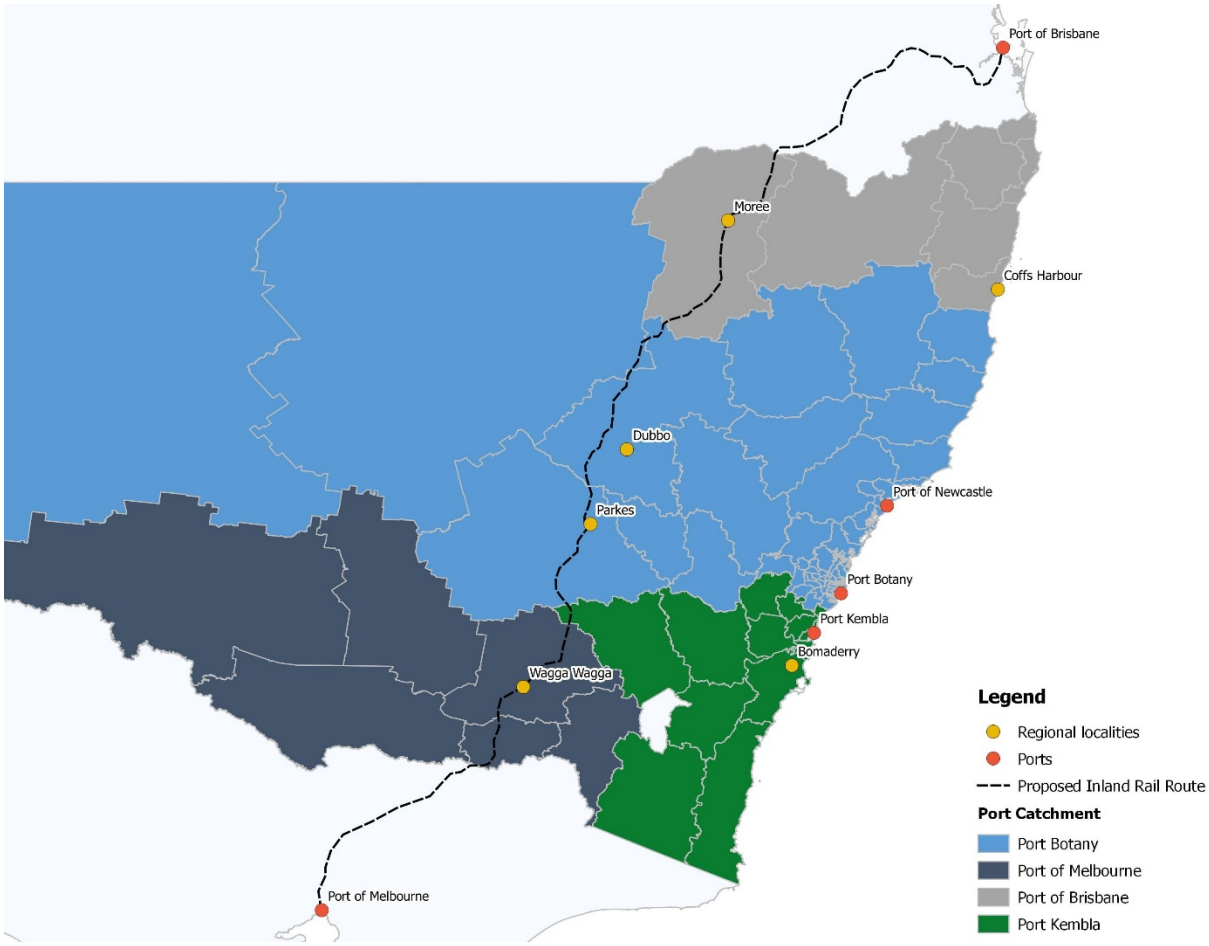
5.3 'With Port Kembla' scenario

The second scenario tests the introduction of Port Kembla as an additional container port. This scenario tests Port Kembla's attractiveness to shippers when Port Botany is not constrained i.e. prior to 2046.

Figure 40 shows that an expansion at Port Kembla would be an attractive option for localities in southern NSW, including the South Coast, the Illawarra and around the Capital region.

It is important to note that these results assume that the capital expenditure at Port Kembla, if undertaken by NSW Ports, would be annuitised over the combined container volume of both Port Kembla and Port Botany's catchment.

Figure 40: 2046 Port Kembla catchment map based on lowest whole of container chain costs under 'with Port Kembla' scenario

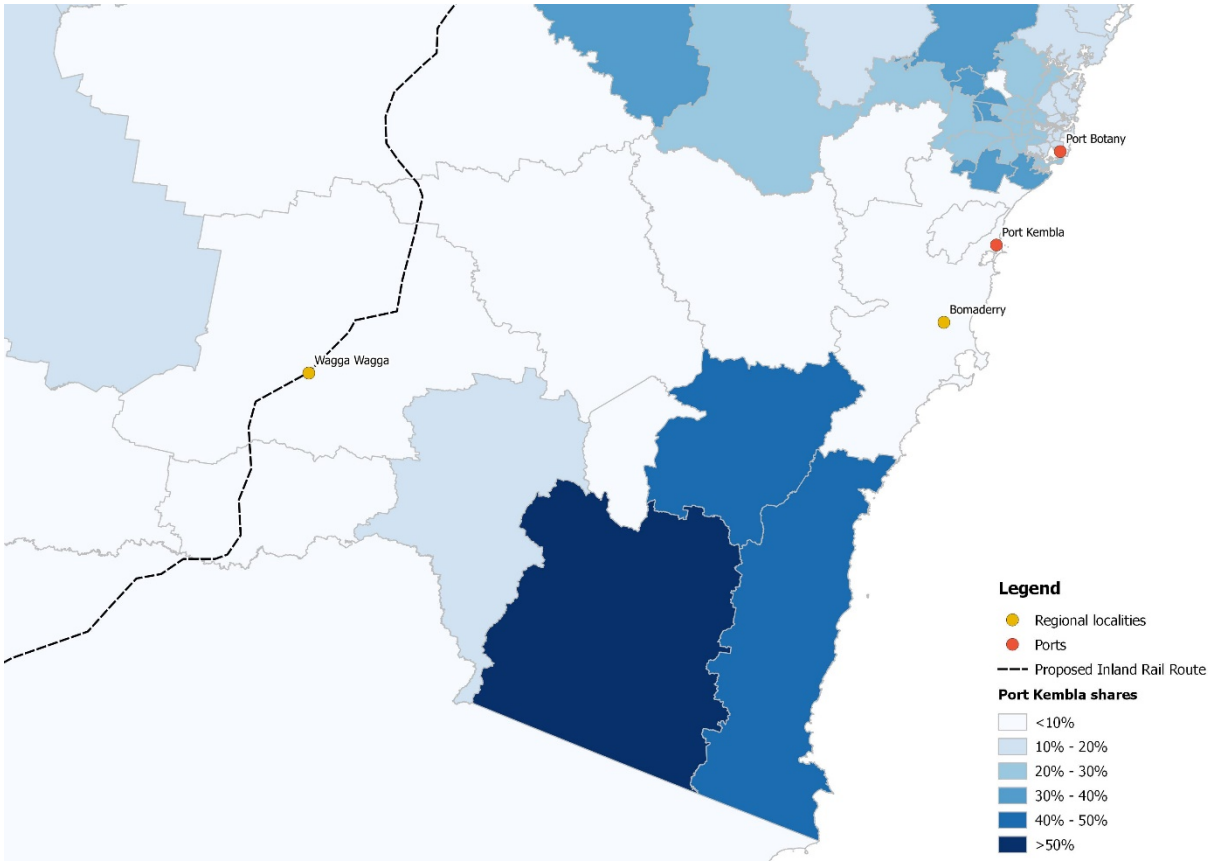


Source: KPMG analysis. Whole of container chain costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

The estimated Port Kembla shares for each location in NSW are shown in Figure 41. In real terms, Port Kembla could be expected to compete for container volume with Port Botany within metropolitan Sydney. Naturally, the attractiveness for routing containers towards Port Kembla is higher within the southern and south western Sydney with developments including Maldon-Dombarton Rail Line and F6 Extension serving to reduce the land transport cost margin between Port Botany and Port Kembla. Port Kembla wins market share from Port Botany rather than Port of Melbourne from the South Coast of NSW and as far west as Young-Yass. There are a number of metropolitan fringe areas that fall into Port Kembla's catchment when containers originating in Port Botany are assumed to be transported by road direct rather than rail from Port Kembla. Even so, the cost of sending a container from Port Botany to Campbelltown, accounting for maritime costs, is estimated to be $50 per TEU cheaper relative to sending it from Port Kembla.

It is expected that Port Botany would continue to attract a large part of the Sydney market, owing to the higher ship call frequency and proximity for most of the high volume destinations within Sydney.

Figure 41: 2046 Port Kembla shares under the 'with Port Kembla' scenario



Source: KPMG analysis. Whole of container chain costs include bluewater, terminal and land transport costs

5.3.1 Port shares & volumes

Table 25 and Table 26 provides a breakdown of the estimated share of containers by port under the with Port Kembla scenario. Under this scenario, Port Kembla is projected to win approximately 11 per cent of NSW container throughput in 2046.

Table 25: Share of NSW's containerised IMEX freight by % under the Port Kembla scenario

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	95.4%	0.0%	0.0%	1.4%	3.2%
2031	78.1%	14.4%	0.0%	2.1%	5.4%
2046	79.9%	11.9%	0.0%	2.3%	5.9%
Full exports					
2016	91.6%	0.0%	0.0%	0.7%	7.7%
2031	72.7%	10.0%	0.0%	6.4%	10.9%
2046	73.6%	7.8%	0.0%	7.5%	11.1%
All containers					
2016	95.9%	0.0%	0.0%	0.9%	3.2%
2031	79.9%	13.0%	0.0%	2.2%	4.9%
2046	82.1%	10.7%	0.0%	2.3%	5.0%

Source: KPMG analysis

Table 26: Share of NSW's containerised IMEX freight by volume under the Port Kembla scenario

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,576,000	290,000	0	43,000	109,000
2046	2,602,000	386,000	0	76,000	192,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	441,000	61,000	0	39,000	66,000
2046	576,000	61,000	0	59,000	87,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	3,213,000	522,000	0	89,000	198,000
2046	5,334,000	694,000	0	148,000	324,000

Source: KPMG analysis

5.4 'With Port of Newcastle' scenario

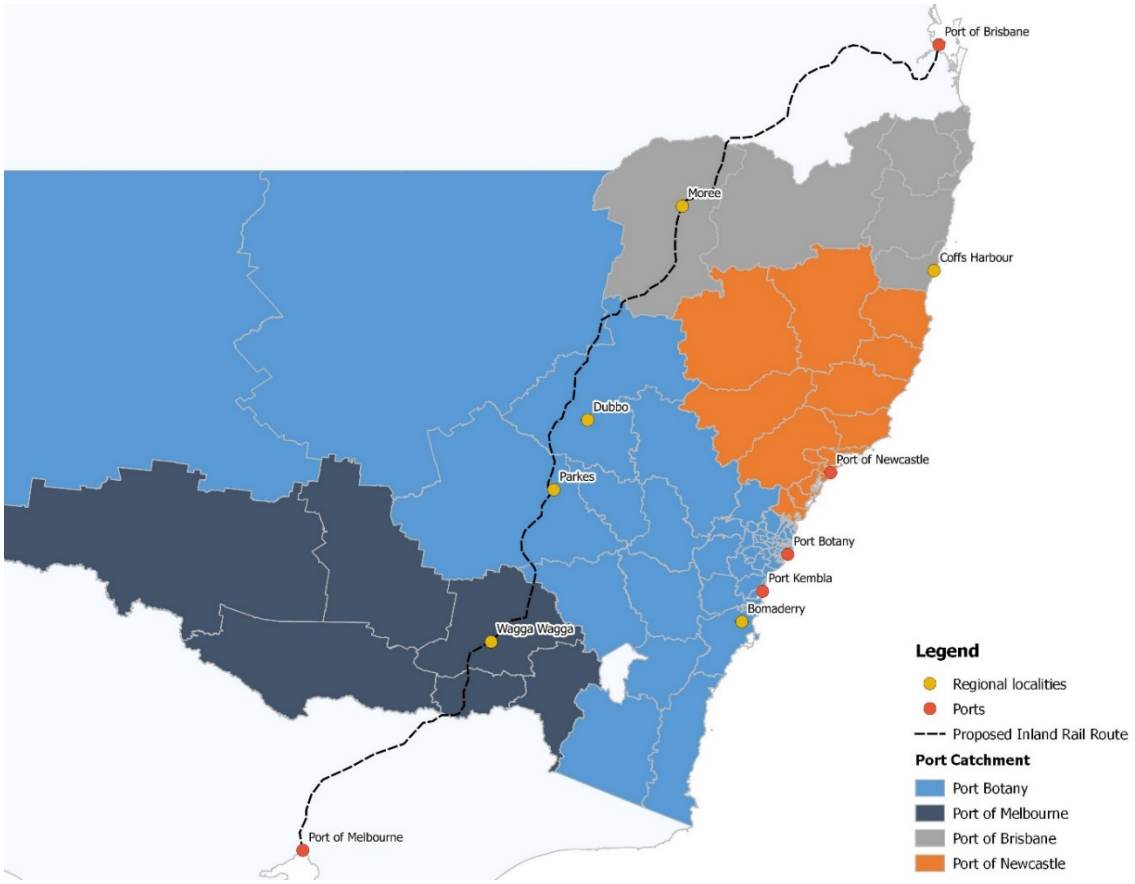
The third scenario tests the potential introduction of Port of Newcastle as an additional container port. This scenario tests Port of Newcastle's attractiveness to shippers when Port Botany is not constrained i.e. prior to 2046.

Figure 42 shows the potential catchment area based on composite costs in 2046. This shows that the Port of Newcastle would be preferred by consignors and consignees north of Sydney. It is projected that the Port of Newcastle would be able to draw market share from as far south as Gosford to as far north as Moree and Kempsey.

Although the Port of Newcastle will draw volumes from the Central Coast, Newcastle and the Hunter region, it will still be an area that would be subject to competition with Port Botany. Although the region's proximity to the Port of Newcastle is an advantage, as with Port Kembla, Port Botany will still remain attractive for a portion of the market given is ability to offer more ship calls and lower wharfage vis-à-vis Port of Newcastle as shown in Figure 43. For instance, once maritime costs are accounted for, the cost differential between Port Botany and Port of Newcastle to Wyong is $110 per TEU.

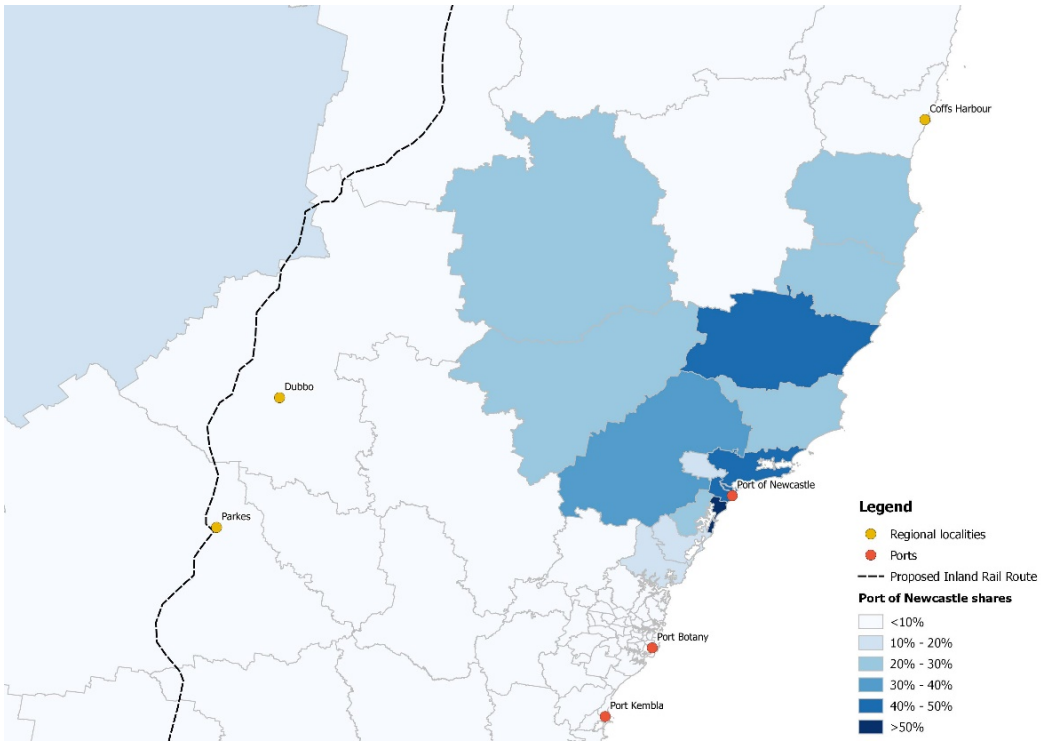
In addition, the Port of Newcastle will need to contend with competition from the Port of Brisbane. The proximity of the Port of Brisbane to the Northern Rivers region as well as Inverell and Moree, will see these areas continue to be served from Brisbane.

Figure 42: 2046 catchment map based on lowest costs under 'with Port of Newcastle' scenario



Source: KPMG analysis. Costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

Figure 43: 2046 Port of Newcastle shares under 'with Port of Newcastle' scenario



Source: KPMG analysis

5.4.1 Port shares & volumes

Table 27 and Table 28 provide a breakdown of the estimated share of containers by port under the 'with Port of Newcastle' scenario. Under this scenario, Port of Newcastle is projected to win approximately 5 per cent of NSW container throughput in 2046. However, absolute volumes in 2046 are projected to be under 400,000 TEUs only. These volumes also serve to raise the wharfage required to cover the costs of construction considerably.

Table 27: Share of NSW's containerised IMEX freight by % under the 'with Port of Newcastle' scenario

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	95.4%	0.0%	0.0%	1.4%	3.2%
2031	86.7%	0.0%	6.3%	2.0%	5.0%
2046	87.2%	0.0%	5.3%	2.1%	5.4%
Full exports					
2016	91.6%	0.0%	0.0%	0.7%	7.7%
2031	70.5%	0.0%	13.9%	5.3%	10.4%
2046	71.0%	0.0%	12.1%	6.4%	10.5%
All containers					
2016	95.9%	0.0%	0.0%	0.9%	3.2%
2031	86.3%	0.0%	7.2%	1.9%	4.6%
2046	87.6%	0.0%	5.8%	2.0%	4.6%

Source: KPMG analysis

Table 28: Share of NSW's containerised IMEX freight by volume under the 'with Port of Newcastle' scenario

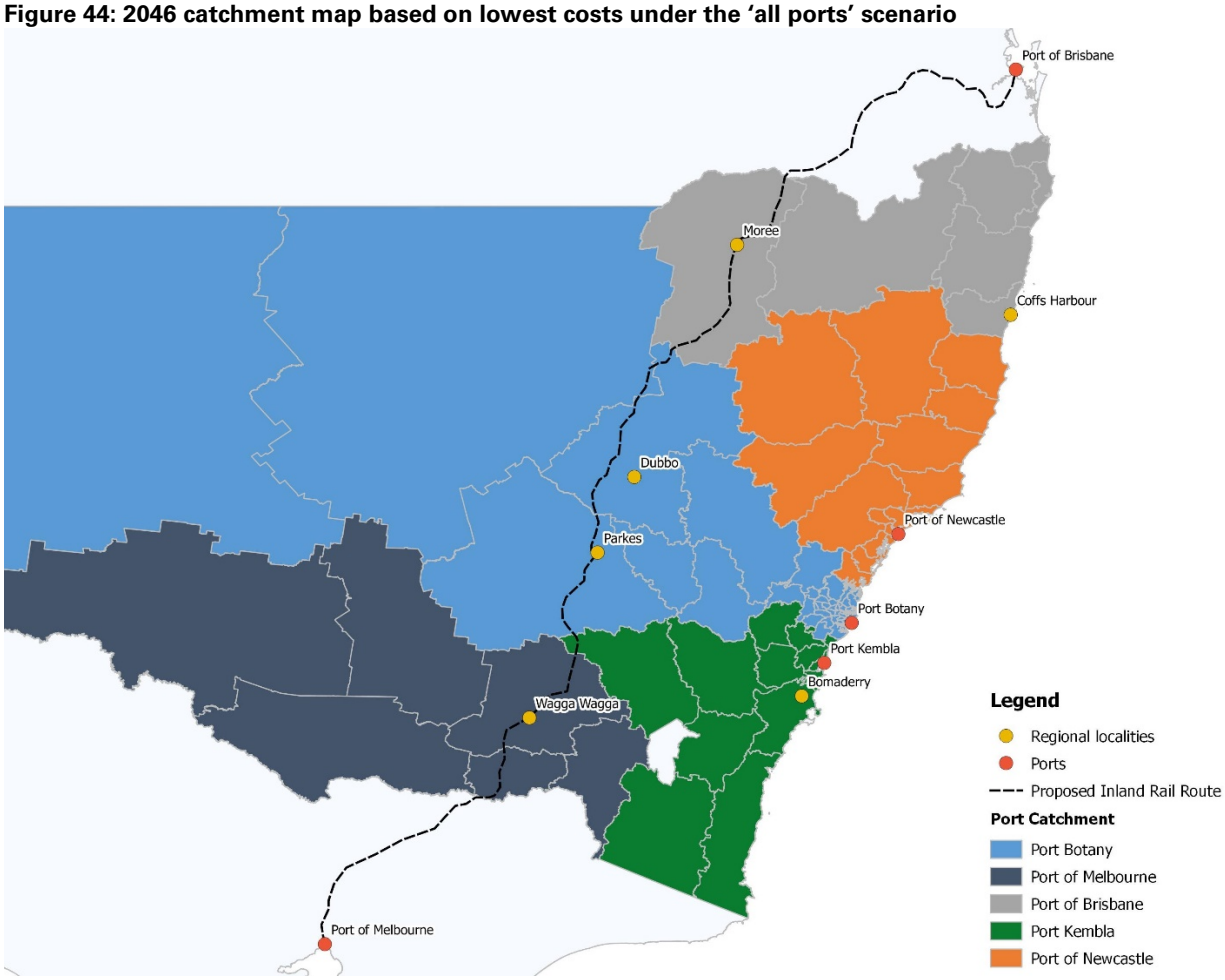
Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,750,000	0	127,000	40,000	101,000
2046	2,841,000	0	172,000	69,000	175,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	427,000	0	84,000	32,000	63,000
2046	556,000	0	95,000	50,000	82,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	3,470,000	0	289,000	78,000	184,000
2046	5,694,000	0	379,000	131,000	296,000

Source: KPMG analysis

5.5 'All ports' scenario

The final scenario assumes that both Port Kembla and Port of Newcastle container terminals are developed by 2031. Figure 44, Table 29 and Table 30 provide the potential catchments and a breakdown of the estimated share of containers by port under the 'all ports' scenario. This scenario seeks to test whether the shares of Port Kembla and Port of Newcastle may be affected by each other's presence in the market. When all ports are considered, the shares for Port Botany and Port Kembla are not materially different from the other scenarios.

Figure 44: 2046 catchment map based on lowest costs under the 'all ports' scenario



Source: KPMG analysis. Costs include bluewater, terminal and land transport costs
Note: Catchment assignment in the above figure is based on lowest cost. In practice, ports may compete for volumes outside of their natural catchments.

Table 29: Share of NSW's containerised IMEX freight by % under the All Ports scenario

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	95.4%	0.0%	0.0%	1.4%	3.2%
2031	72.6%	13.9%	6.5%	2.0%	5.0%
2046	75.0%	11.6%	5.6%	2.2%	5.5%
Full exports					
2016	91.6%	0.0%	0.0%	0.7%	7.7%
2031	61.6%	8.4%	14.2%	5.4%	10.4%
2046	63.6%	6.6%	12.6%	6.5%	10.6%
All containers					
2016	95.9%	0.0%	0.0%	0.9%	3.2%
2031	73.6%	12.4%	7.5%	2.0%	4.6%
2046	76.6%	10.4%	6.2%	2.1%	4.7%

Source: KPMG analysis

Table 30: Share of NSW's containerised IMEX freight by volume under the All Ports scenario

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Full imports					
2016	1,068,000	0	0	16,000	36,000
2031	1,465,000	281,000	131,000	40,000	101,000
2046	2,444,000	379,000	183,000	71,000	180,000
Full exports					
2016	370,000	0	0	3,000	31,000
2031	374,000	51,000	86,000	33,000	63,000
2046	498,000	52,000	99,000	51,000	83,000
All containers					
2016	2,200,000	0	0	21,000	74,000
2031	2,960,000	498,000	300,000	79,000	185,000
2046	4,979,000	676,000	406,000	135,000	305,000

Source: KPMG analysis

An additional port may well lead to an increase in costs across the container supply chain. Compared to the 'no new ports' scenario, costs across the container supply chain would be at least $21 million per year higher by 2046 if one additional container port was developed. This cost increases to $75 million per year by 2046 with two additional container ports. This demonstrates the efficiency that may be gained from using existing port infrastructure as opposed to developing new port infrastructure, the costs of which need to be recovered from users (or potentially taxpayers). These costs do not include the broader impacts of higher costs on the economy, including the additional transport infrastructure that would be required to support any new container port.

Table 31 outlines the projected aggregate container chain costs for movements to and from all NSW container ports in 2046.

Table 31: Whole of container chain costs to and from all NSW container ports by scenario

Scenario	Projected container chain cost in 2046	Difference in 2046	Containers displaced from Port Botany relative to 'no new ports'	Extra cost per displaced TEU
No new ports	$8,728m			
With Port Kembla only	$8,749m	$21m	713,000	$30
With Port of Newcastle only	$8,773m	$45m	353,000	$128
With all ports	$8,803m	$75m	1,068,000	$70

Source: KPMG analysis. Costs include bluewater, terminal and landside transport costs

5.6 Potential variations

Sensitivity analysis was undertaken to assess the potential variation in port shares and volumes under different parameter settings. The following tests were undertaken including:

- **Lower transport costs**: assumes a real decline in land transport costs;
- **Lower demand forecasts**: adopts the TfNSW government forecasts for containers (which is lower than the forecast from NSW Ports);
- **Cap at Port Botany under high demand forecasts:** assumes capacity at Port Botany is constrained to 7M TEUs with a realisation of high NSW Ports demand forecasts; and
- **Higher cost sensitivity:** increases the cost sensitivity implied within the port choice model.

The results of the sensitivity tests are discussed in the following sections.

5.6.1 Decline in transport costs

The longer term land transport costs are trending downwards on per unit costs basis due to the prominence of higher productivity vehicles. The advent of automated vehicle technology may further lower transport costs.

This test incorporates a one per cent per annum decline in real land transport costs over time to capture the effects of potential future productivity improvements.

Lower land transport costs has the potential to widen the catchment for all ports, and thus reducing the impact of distance. Table 32 provides a comparison of the test results and the core Model results under the 'with Port Kembla' and 'with Port of Newcastle' scenarios. This advantages the existing container ports (i.e. 'no new ports' scenario), however it disadvantages Port Kembla due to its closer proximity to Port Botany.

Table 32: Share of NSW's containerised IMEX freight by volume in 2046 with land transport productivity test

Ports	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Original shares					
With Port Kembla	5,334,000	694,000	0	148,000	324,000
With Port of Newcastle	5,694,000	0	379,000	131,000	296,000
With both	4,979,000	676,000	406,000	135,000	305,000
Under test					
With Port Kembla	5,321,000	637,000	0	175,000	368,000
With Port of Newcastle	5,652,000	0	363,000	153,000	332,000
With both	4,980,000	623,000	392,000	159,000	346,000

Source: KPMG analysis

5.6.2 SFM forecasts

In the recently released NSW Freight and Ports Plan, TfNSW projects a lower set of container forecasts relative to NSW Ports. By 2046, the SFM projects that Port Botany would handle 4.9 million TEUs relative to NSW Ports' projection of 6.4 million TEUs (excluding transhipments).

Table 33 provides a comparison of the test results and the core Model results under the With Port Kembla and With Port of Newcastle scenarios. This test lowers the expected container volumes for all ports.

Table 33: Share of NSW's containerised IMEX freight by volume in 2046 with TfNSW forecasts

Ports	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Original shares					
With Port Kembla	5,334,000	694,000	0	148,000	324,000
With Port of Newcastle	5,694,000	0	379,000	131,000	296,000
With both	4,979,000	676,000	406,000	135,000	305,000
Under test					
With Port Kembla	4,009,000	589,000	0	120,000	262,000
With Port of Newcastle	4,340,000	0	291,000	107,000	241,000
With both	3,743,000	573,000	308,000	110,000	246,000

Source: KPMG analysis

5.6.3 Seven million TEU cap at Port Botany

This scenario tests an extreme planning combination, whereby capacity at Port Botany is set at a lower 7 million TEUs per annum and the NSW Ports' high container volume projections are adopted. In the case of the latter, in line with the 2015 NSW Ports Master Plan, a high container throughput scenario would see container volumes reach 8.5 million by 2046. Table 34 provides a comparison of the test results and the core Model results under the 'with Port Kembla' and 'with Port of Newcastle' scenarios. Were the higher forecasts to arise, much of the incremental growth would continue to be serviced through Port Botany, with some spill over into either Port Kembla or Port of Newcastle depending on the scenario.

Table 34: Share of NSW's containerised IMEX freight by volume in 2046 with 7M TEU cap and high container throughput test

Ports	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Without constraint					
With Port Kembla	7,025,000	894,000	0	192,000	418,000
With Port of Newcastle	7,472,000	0	498,000	172,000	388,000
With both	6,565,000	871,000	524,000	175,000	394,000
Under test					
With Port Kembla	6,999,000	911,000	0	195,000	425,000
With Port of Newcastle	7,000,000	0	720,000	248,000	561,000
With both	6,534,000	887,000	532,000	177,000	400,000

Source: KPMG analysis. Note that the without constraint estimates are based on a higher growth scenario of 8.5m TEUs by 2046

5.6.4 Higher cost sensitivity

For this Study, we have drawn from Mueller (2014) to project container shares between competing ports. No adjustments to the parameter values have been applied, apart from converting Euro denominated parameters into Australian dollars. Post-model analysis indicates that while the land transport cost elasticity is within reasonable bounds at approximately -0.20, it is at the lower end of what may be considered typical. For instance, BITRE quote a range between -0.30 and -0.60 for intercity road transport costs.

Were a higher elasticity to be 'applied', this effect can be obtained by scaling all parameters by the same multiple. In this case, a factor of three could be applied to increase the transport cost elasticity from -0.20 to -0.60. The effect of doing so means that market shares for a given port decrease faster as distance from the port increases. As Table 35 overleaf illustrates, if shipper cost sensitivity is higher, Port Botany's share of containers will be higher than projected in the main case.

Table 35: Share of NSW's containerised IMEX freight by volume in 2046 with higher transport cost elasticity's

Year	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Original shares					
With Port Kembla	5,334,000	694,000	0	148,000	324,000
With Port of Newcastle	5,694,000	0	379,000	131,000	296,000
With both	4,979,000	676,000	406,000	135,000	305,000
Under test					
With Port Kembla	6,348,000	26,000	0	52,000	75,000
With Port of Newcastle	6,301,000	0	78,000	51,000	71,000
With both	6,250,000	29,000	95,000	51,000	75,000

Source: KPMG analysis

06

Quay conclusions

Premature port investments = higher costs for NSW

Our key finding is that new container terminal capacity is not needed in NSW for several decades at least – and that premature development of a new terminal would increase costs across the entire NSW supply chain because it would:

- **Duplicate existing, lowest cost container capacity that is less than half full:** Port Botany has three competing stevedores who moved 2.7 million TEUs in 2017/18, within a theoretical capacity of over 7 million TEUs per annum – meaning it is less than half full.
- **Attract low volumes, because of higher costs:** User choice modelling shows that until Port Botany's stevedores near capacity, both Port Kembla and Port of Newcastle would struggle to attract enough users – because of their higher costs in recouping capital invested and higher landside transport costs to reach fewer users. Our modelling shows that under different scenarios where Port Kembla and/or Port of Newcastle are developed, by 2046, these ports will only account for circa 10 per cent and circa 6 per cent of total containerised trade respectively.
- **Require massive public investment to fund landside freight infrastructure:** 80 per cent of import containers are consumed within 40 km of Port Botany. Less than 1 per cent of full import containers were destined for regional areas; and 2 per cent destined for the Central Coast, Newcastle and Hunter regions. This means that most containers will need to travel to or from Sydney; in turn requiring many tens of billions in public funding to upgrade road and rail capacity.

Maximising the use of Port Botany will ensure that the benefits are harnessed from existing and committed investments made by the Australian Government, the NSW Government and businesses including WestConnex, the Southern Sydney Freight Line, Moorebank Intermodal Terminal and Sydney Gateway.

Port Botany's role as the container 'growth port' also ensures continuing alignment to the supporting supply chain investments made by businesses including NSW Ports, stevedores and warehousing and logistics assets developed by major customers.

Port Kembla makes the most sense for containers, but only once Port Botany nears capacity

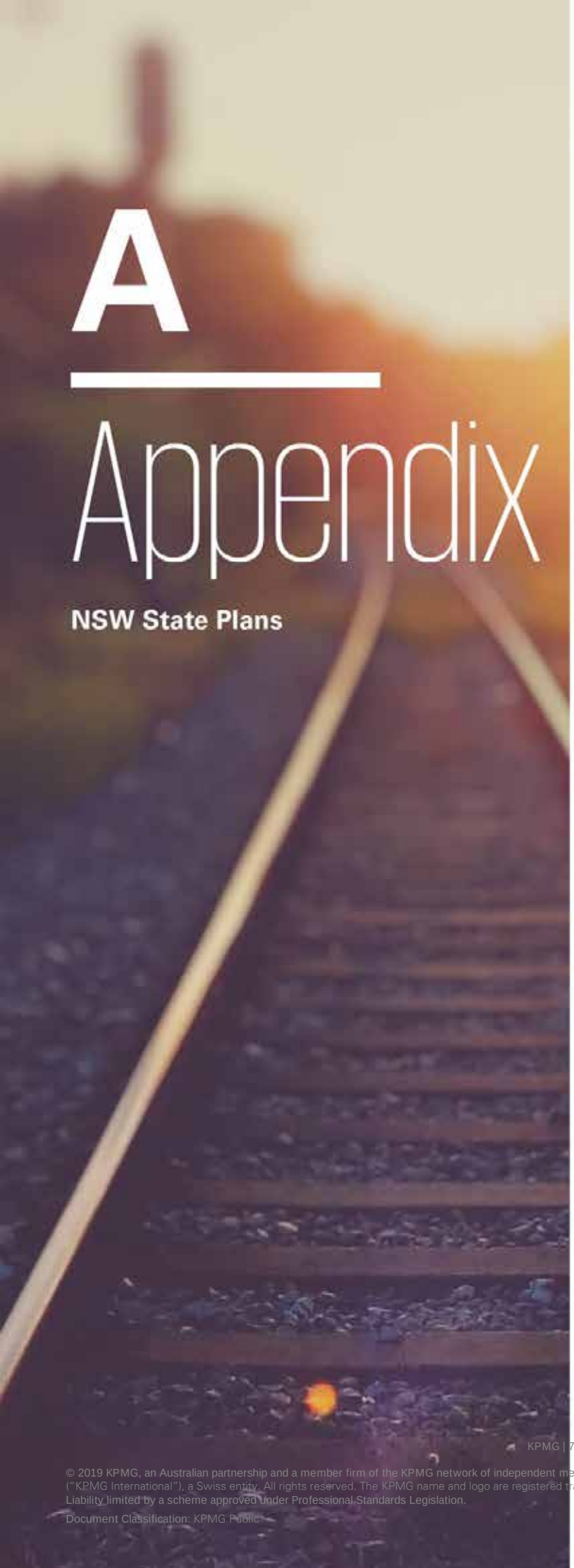
Our next finding confirms that Port Kembla offers the lowest overall costs and highest overall benefits for an additional container port – but only when it is needed in several decades – because:

- Port Kembla's proximity to the population and employment growth areas in Greater Western Sydney and South Western Sydney enhance its attractiveness as a second container port, when required.
  - Analysis of census data shows that Sydney is home to 70 per cent of all transport, postal and warehousing jobs across the state, compared to 9 per cent collectively for the Central Coast, Newcastle and Hunter region. By 2046, this density is expected to increase in the Western Sydney Employment Area, west of Eastern Creek.
  - Port Kembla is circa half the distance relative to Newcastle from the five largest container consumption areas in 2046, as projected by TfNSW – which all reside in Western and South Western Sydney.
- Port Kembla enjoys better existing and planned transport connections to customers in Sydney's south west and west, which are known and substantially less costly than similar connections to the Hunter. For example, the South Coast Line is projected to have 20 paths spare, and if utilised for containers, the spare existing capacity may be able to handle up to 1 million TEUs.
- It supports consensus State and Australian Government planning involving the Western Sydney City Deals and the Aerotropolis.
- Our modelling shows that by 2046, Port Kembla would attract throughput of almost 700,000 TEUs, around 70 per cent more than the Port of Newcastle.
- However, premature development of Port Kembla would impose supply chain costs across NSW, $21 million per year higher by 2046 if one additional container port were developed. The Port of Newcastle imposes more than double, increasing the total to $75 million per year if both ports were developed. These costs may well be higher once the cost of additional public investment is added. This demonstrates the efficiency of using existing port infrastructure – when there is available capacity – as opposed to developing new port infrastructure, the cost of which needs to be recovered from users.

Containers at the Port of Newcastle makes the least sense for NSW

Despite the current public affairs focus, detailed analysis shows that developing a container terminal at the Port of Newcastle would impose the highest overall costs, and offer the lowest overall benefit, because:

- Newcastle is the furthest from Greater Western Sydney and South Western Sydney – which are the key growth areas for transport and logistics and supported by consensus Federal-state investment and planning.
- Newcastle's road and rail links to Sydney are the most constrained, with the rail line offering less than 10 train paths in and out of Sydney per day; and the connections to the M1 (F3) road corridor on both the Sydney and Newcastle ends suffering from high levels of commuter congestion.
- Port of Newcastle is heavily constrained on the landside by its location adjacent to Newcastle's CBD requiring trucks to navigate the arterial road network though Wallsend or take the more circuitous route using the New England Highway; and on the waterside by the need for expensive dredging and realignment of the channels – seeing higher chargers to imports and export trade.
- Our modelling shows that by 2046, Port of Newcastle would only attract throughput of around 400,000 TEUs – while Port Kembla attracts around 70 per cent more trade.
- Developing the Port of Newcastle would benefit some exporters within its catchment area, however that number is slightly less than 100,000 TEUs by 2046 – a tiny proportion of the overall export task.



A

Appendix

NSW State Plans

Greater Newcastle Future Transport Plan 2056

The Greater Newcastle Future Transport Plan 2056 (GNFTP) outlines transport priorities for the Hunter region to 2056 and is designed to be read in concert with the NSW Freight & Ports Plan 2018-20232.

The GNFTP is largely concerned with passenger transport, reflecting both strong population growth and major transport and land use changes offered by the Newcastle Light Rail project and ongoing population growth.

The GNFTP's brings a light focus to freight – and is limited in its freight-specific project priorities. It nominates future investigation of additional export volumes beyond coal, but is all but silent on the issues of containerised freight with a single mention of containerised freight as an option for investigation in the future.

Now	Future Growth	Supporting Ports	Recommendations	Major Identified Investments
• 176 million tonnes of freight in 2016. • Hunter valley coal chain sees highest freight rail share in NSW • Increasing demand for airfreight	• Freight will grow by 18 per cent by 2036	• Newcastle Port	• Protection of rail/road corridors • Protection of first/last mile delivery • Improvements to Newcastle Port	• M1 upgrades around Hexham and Raymond Terrace • Lower Hunter Freight Corridor Preservation • M1 (Pacific Highway) Smart Motorway

The GNFTP identifies the need to protect a 'Lower Hunter Freight Corridor' – which allows for straightening of the main north line and future provision of additional passing loops. This is described as providing more effective interstate freight and potentially, higher speed regional passenger transport.

The GNFTP also identifies an examination of alternative east – west rail capacity across the Great Dividing Range, as a potential (presumably very) long-term option to open up additional freight connectivity between regional NSW and the Port of Newcastle.

It also identifies a range of road initiatives that will impact the distribution of freight to and from Newcastle along the M1 corridor.

The NSW Government also has proposed a Port Efficiency, Access and Integration Package. No details are available on the components of this package at the time of this report, however it is expected that the Package will target 'pinch point' and 'last mile' issues on access routes to Port of Newcastle.

NSW Freight and Ports Plan 2018-2023

The NSW Freight and Ports Plan 2018-2023 builds upon the NSW Freight and Ports Strategy of 2013, the first long-term freight vision to be produced for NSW. The Plan recognises the valuable investments benefiting road and rail freight transport operators, but identifies the need for further investment to meet the projected strong growth in the NSW freight task expected over the next 20 years.

Current Situation	Future Growth	Supporting Ports	Recommendations	Major Identified Investments
• NSW Ports contribute $1.3 trillion to the NSW economy • Over 480 million tonnes of freight move through NSW • Freight related activities contribute $66 billion to the NSW economy	• Freight increase by 28 per cent by 2036	• Port Botany primary container port • Port Kembla alternative container port	• Upgrade road/rail network • Better freight measurement • Improve efficiency, connectivity and access • Maximise capacity across the supply chain network • Increase safety and sustainability	• Sydney Gateway • Sydney Airport Road Upgrade • Port Botany Rail Duplication • Main West Rail Line • Coffs Harbour Bypass • Western Sydney Freight Line Corridor Preservation

The Plan reinforces the importance of rail as a distribution channel for freight in NSW, and the comparative benefits of increasing rail mode share in Greater Sydney over roads, particularly given growing road congestion. The Plan cites the criticality of intermodal terminals in underpinning this

change in modal share with the NSW Government's role in identifying, protecting, and zoning land for intermodal terminals and access highlighted in the Plan.

The Freight and Ports Plan recognises that, with further development to increase capacity, Port Kembla will be a future container terminal to augment capacity at Port Botany, with the overflow not expected until at least 2040. The plan also restates Infrastructure Australia's identification of the provision of freight rail access to Port Kembla as an initiative of national priority.

The Plan also recognises that Port of Newcastle will diversify its offering beyond coal as a destination for bulk liquids, cement and general cargo. However, it identifies medium to long-term constraints on the expansion of Port of Newcastle including pressures on the shared rail network in the Upper Hunter Valley, and access via the New England and Golden Highways.

Regional NSW Services and Infrastructure Plan

The Regional NSW Services and Infrastructure Plan provides a detailed transport planning pipeline for each NSW region with a target to decrease inefficiencies in the regional transport network, impacting freight costs. The Plan commits towards a renewed focus on east-west connectivity between regional centres west of the Great Dividing Range, and critical inland freight connections for NSW's gateways, including Inland Rail.

Current Situation	Future Growth	Supporting Ports	Recommendations	Major Identified Investments
• Hunter rail corridors move the majority of freight	• Rail freight forecast to increase in the Hunter, Illawarra and Sydney • Road Freight expected to grow along the Pacific, Hume and Newell Highway corridors • Road fright forecast to continue along north-south and east-west corridors	• Port of Newcastle • Port Kembla	• Preservation of freight corridors • Enable growth in intermodal terminals • Improve road/rail connections • Improve ports' efficiency • Improve last mile connections • Improve road freight safety and productivity • Improve separation of freight/passenger trips	• Inland Rail • M1, Hexham, Raymond Terrace upgrades • Lower Hunter Freight Corridor Protection • Illawarra – Shoalhaven Upgrades • Coffs Harbour Bypass • Newell Highway Heavy Vehicle Bypass • Riverina Murray upgrades

The Plan supports the investigation towards the future cargo diversification of Port of Newcastle, while it identifies that certain infrastructure projects (i.e. Maldon-Dombarton rail line), will support the potential future growth of container movements to and from Port Kembla, with Port Kembla acting as an 'overflow facility' once Port Botany reaches capacity.

The Great Western Highway and Main Western Rail Line is identified in the Plan as the primary freight corridor connecting western regions to Port Botany, Port Kembla, the Port of Newcastle, and future Western Sydney Airport and Western Parkland City. In addition to the three main NSW ports, both Port of Melbourne and Port of Brisbane's growing importance to the Riverina Murray and Northern NSW regions is considered respectively.

Further strategic examinations are suggested to develop alternate options to improve road and rail freight connections across the Blue Mountains, namely considering existing roads such as Great Western Highway, Bells Line of Road, Golden Highway, Lachlan Valley Way, Castlereagh Highway and Mid-Western Highway, as well as rail corridors Main Western, Dubbo-Newcastle, Cowra lines (including Blayney-Demondrille), and Gulgong to Maryvale.

Greater Sydney Services and Infrastructure Plan

The primary focus of the Greater Sydney Services and Infrastructure Plan (the Plan), released in support of the Future Transport Strategy 2056, is in support of the 'Three Cities' concept.

Port and freight related initiatives are implicitly reflected in the application of the place and movement framework and in support of the Plan's customer outcome for *efficient and reliable freight journeys supported by 24/7 rail access between key freight precincts with convenient access to centres.*

Current Situation	Future Growth	Supporting Ports	Recommendations	Major Identified Investments
• Sydney is one of the top 10 fastest growing cities in the world • Current number of daily trips is 11 million • 15Mt of container goods moved per annum in Greater Sydney • Passenger trains take priority to freight train	• Growing population, expected to reach 8 million by 2056 • Container freight task projected to be 39Mt per annum by 2056 • Daily trips expected to be 15 million in 2036	• Port Botany container movements	• Improved separation of freight and passenger trains • Improve last mile transport in the Harbour CBD • Improve Road Safety • Improve freight Efficiency	• F6 Extension Stage 1 • North-South Rail Link • South West Rail Link Extension • Outer Sydney Orbital • Western Sydney Freight Line • Bells Line of Road – Castlereagh Connection • M4 Smart Motorway • WestConnex • NorthConnex • Western Sydney Infrastructure Plan

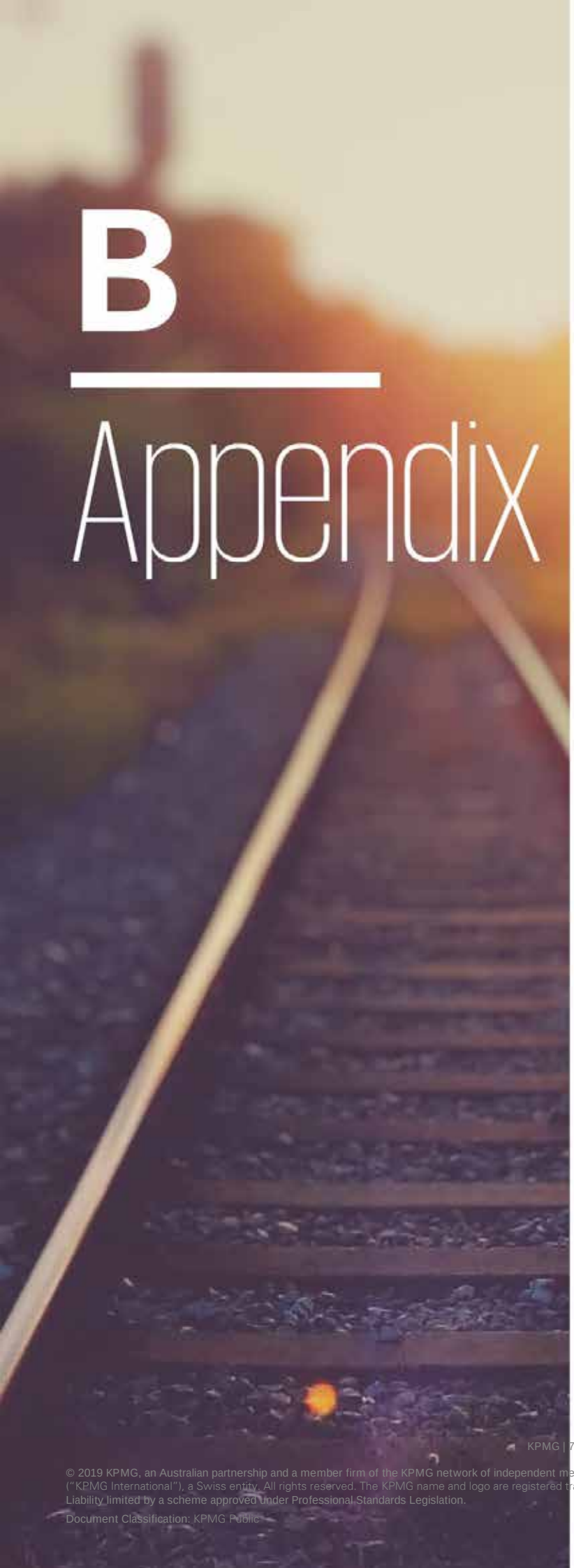
The Plan commits to enable the efficient and reliable movement of freight by providing freight customers with 24/7 rail access on key strategic freight networks, including corridors that connect the trade gateways of Port Botany and Sydney Airport with freight precincts, intermodal terminals and centres across Greater Sydney.

WestConnex and Sydney Gateway are two of a number of initiatives which are committed or being investigated to alleviate commuter congestion whilst also having a positive impact on the freight network. The above mentioned projects will effectively extend the M4 corridor to Port Botany and boost capacity on the M5 corridor, better connecting Port Botany and freight precincts in Western Sydney.

Also, initiatives including the Western Harbour Tunnel, Beaches Link and the F6 Extension will serve to improve the north-south connections in the most congested parts of the Eastern Harbour City by enabling freight traffic to bypass centres and busy roads.

In the longer term, the Plan identifies initiatives for investigation:

- The 2026 network initiatives include investigations to improve access to the airport and the Western Sydney Infrastructure Plan, with the aim to provide improved access to trade gateways in the emerging western city and protection of future corridors;
- The 2036 network, with initiatives for investigation including the Western Sydney Freight Line, will enable 24/7 freight rail access between ports and intermodal terminals; and
- The 40 year visionary freight network initiatives, including the Sydney Outer Orbital corridor preservation, will provide new north-south and east-west links in the Western Parkland City as it continues to grow.



B Appendix

General parameters

WACC

Mathematically, the WACC formula is expressed as follows.

$$Post-tax\ nominal\ WACC = r_e \frac{E}{V}\frac{1-t}{\left(1-t(1-\gamma)\right)} + r_e \frac{D}{V}(1-t)$$

A basic WACC assessment has been undertaken, drawing on RBA data on market yields to derive the risk free rate and spread. A desktop review of ASX listed transport, infrastructure and logistics companies was undertaken to derive an equity beta. Finally, a corporate tax rate of 30 per cent was adopted for land transport operations and 15 per cent for port operations, noting that NSW Ports are largely owned by superannuation companies.

Table 36 outlines the parameters adopted to inform the WACC calculation.

Table 36: WACC parameters

Variable	Land transport	Port operations	Basis
Cost of debt			
Risk free rate	4.60%	4.60%	IPART's long term rate used in their determinations
Spread to government yields for a BBB rated bond, 3-year target	1.5%	1.5%	Analysis of RBA BBB spreads
Tax rate	30.0%	15%	Assumption
Cost of debt	4.27%	5.19%	
Cost of equity			
Risk free rate	4.60%	4.60%	As above
Beta	0.8	0.8	Assumption
Gamma	0.0	0.0	Assumption
Risk premium	6.00%	6.00%	IPART's long term premium used in their determinations
Cost of equity	9.40%	9.40%	
Leverage			
Debt: value	60%	60%	Assumption
WACC	6.32%	6.87%	

Based on KPMG analysis of IPART, RBA data and ASX listed transport company data

Average payloads

The following average payload estimates have been adopted in the Model:

Table 37: Average payload by container type

Container Type	TEUs	Mass Tonnes	Mass Tonnes per TEU
Full imports	1,220,046	10,932,915	9.0
Full exports	415,285	11,120,745	26.8
Average	1,635,331	22,053,660	13.5

Source: KPMG analysis based on NSW Ports data

Land transport cost parameters

Cost per lift

Lift costs cover the cost of equipment required to lift containers as well as the labour required to operate the equipment.

Lift rates presented in Shipping Australia (2011), which provide a costing of $30 to lift a full container and $10 to lift an empty container. A composite lift cost of $16, based on the number of TEUs per container (about 55 percent of containers are 40ft) and the proportion of full and empty containers (about 25 percent of containers are empty).

Table 38. Lift costs

Description	Value	Basis
Cost per lift – full container	$30	Shipping Australia (2011)
Cost per lift – empty container	$10	Shipping Australia (2011)
Weighted average per container	$25	
Per TEU	$16	

Lift costs will vary depending on the nature of the operation, technology deployed and the scale of the operation. Of the data available publicly, lift costs vary significantly, as evidenced in Wiegmans & Behdani (2018)[50].

2Number of lifts by mode

Table 39 provides an outline of the number of lifts assumed by mode.

Table 39: Road and rail lifts on a round trip

Description	Port-Road Direct	Port-Road via Depot	Rail
At the port	2	2	2
At the terminal/depot		2	2
At the customer	2	2	2
At the empty container terminal	2	2	2
At the port	2	2	2
Total (round trip)	8 lifts	10 lifts	10 lifts

Load and unload times

Table 40 and Table 41 provides the load and unload times for road and rail that have been incorporated into the Model.

Table 40: Road load and unload times (round trip)

Description	Port-Road Direct	Port-Road via Depot
Port waiting time	15 minutes	15 minutes
Port turnaround time	30 minutes	30 minutes
Depot/terminal turnaround time ***Drop off***		15 minutes
Depot/terminal turnaround time ***Pick-up***		15 minutes

[50] Wiegmans, B. & Behdani, B. (2018), A review and analysis of the investment in, and cost structure of, intermodal rail terminals, Transport Reviews, 38:1, 33-51

Customer turnaround time ***Drop off***	30 minutes	30 minutes
Customer turnaround time ***Pick-up***	30 minutes	30 minutes
Empty container turnaround time ***Drop off***	15 minutes	15 minutes
Empty container turnaround time ***Pick up***	15 minutes	15 minutes
Port waiting time	15 minutes	15 minutes
Port turnaround time	30 minutes	30 minutes

Assumptions based on a review of BITRE Waterline 61 data, Shipping Australia (2011)

Table 41: Rail load and unload times (Port Botany & Port Kembla)

Description	Import containers	Export containers
Time to move into port siding	10 minutes	10 minutes
Quarantine inspection	30 minutes	Nil
Load time	90 minutes	90 minutes
Unload time	90 minutes	90 minutes
Total	220 minutes	190 minutes

Rest times

Rest times outlined by the National Heavy Vehicle Regulator[51] have been incorporated into the modelling. The 'travel under 12 hour' and 'travel over 24 hours' categories have been aligned with the 11 hour and 24 hour requirements.

Table 42: Rest periods

Shift time	Rest period
Travel under 12 hours	0.50 hours every 5 hours
Travel between 12 hours and 24 hours	4.00 hours
Travel over 24 hours	7.00 hours

Vehicle cost parameters

The vehicle cost parameters are presented in Table 43.

Table 43: Vehicle cost parameters

Variable	Value
Capital cost	
Prime mover with skel trailer	$350,000
Registration costs	
Prime mover (3 axle)	$4,512
Skel trailer (3 axle)	$571 per axle or $1,713
Insurance costs	$10,000
Repairs & maintenance	22.8 cents per km

[51] https://www.nhvr.gov.au/safety-accreditation-compliance/fatigue-management/work-and-rest-requirements/standard-hours

Tyres	
Number of tyres	22
Price per tyre	$686
Tyre life – prime mover	100,000km
Tyre life – trailer	180,000km
Tyre life – blended average	140,000km

Fuel consumption has been based on the stop-start (urban) and free-flow models presented in ATAP guidelines.

$$Fuel\ consumption\ (\frac{L}{100km}) = \begin{cases} 45.5089 + \frac{535.1584}{V} & for\ speeds\ less\ than\ 60km/h \\ 32.0378 - 0.2949V + 0.0040V^2 & for\ speeds\ greater\ than\ 60km/h \end{cases}$$

To inform the fuel consumption model, an average speed of 40km/h has been adopted based on SFM data. In regional areas, an assumption of 60km/h was assumed. For the reference vehicle, this implies a fuel consumption rate of approximately 0.9L/km in urban localities and 0.45L/km in regional areas.

Toll schedule

Table 44 outlines the toll schedule adopted for the 2031 and 2046 model years.

Table 44: Toll schedule

Tolling point	Toll
M5 West - Main Plaza	$14.00
M5 West - Fairford Road	$14.00
WCX: M5 East or New M5	$19.29
M7 Motorway	$24.24
WCX: M4 West	*See M4-M5*
Eastern Distributor	$14.77
Harbour crossings	$9.00
Lane Cove Tunnel	$10.26
M2 Motorway - Windsor Road	$7.76
M2 Motorway - Pennant Hills Road	$10.96
M2 Motorway - Main Plaza	$21.91
Cross City Tunnel	$11.40
WCX: M4 East	*See M4-M5*
WCX: M4-M5	$26.85
WCX: Rozelle	*See M4-M5*
Western Harbour Tunnel	$9.00[52]
Beacheslink	$15.00
F6 Extension	$24.00[53]

[52] https://www.smh.com.au/national/nsw/revealed-8-tolls-each-way-planned-for-new-roadway-tunnels-to-sydneys-north-20170718-gxdawm.html

[53] http://www.abc.net.au/news/2017-07-25/f6-freeway-toll-to-be-most-expensive-in-sydney/8738342

NorthConnex	$21.89[54]
Military Road e-ramps	$5.13

The following assumptions have been used to derive toll rate for a range of new toll roads:

Table 45: Tolling assumptions

Toll facility	Notes
WestConnex (excluding M5 West)	• Travel on the WestConnex network is subject to a capped price • Given this, to avoid applying tolls more than once in the model, the capped toll has only been applied on M4-M5 and New M5 • Trucks are charged at three times the car rate
WestConnex M5 West	• From December 2026, the WCX M5 West Deed is activated[55] • Tolls will be set at $4.44 (July 2015 prices) each way as per Clause 11 • Tolls indexed using Australian CPI as per Schedule 45
Harbour crossings	• It is assumed that once the Western Harbour Tunnel is built, a new toll schedule will be introduced • Cars would be charged at $5 per direction • Trucks would be charged at three times this rate i.e. $15 per direction, in line with current TfNSW road pricing policy
Western Harbour Tunnel & BeachesLink	• For cars $3 for WHT and $5 for Beacheslink • Trucks would be charged at three times this rate, in line with current TfNSW road pricing policy
Indexation	• Indexation on new toll roads are generally subject to CPI growth • This said, some legacy toll roads are subject to a minimum rate, or a combination of CPI and NSW average weekly earnings growth • It has been assumed that tolls remain constant in real terms, noting that toll roads that will be traversed by trucks e.g. WestConnex and M7 Motorway are subject to CPI indexation

[54] https://www.smh.com.au/national/nsw/government-deciding-on-level-of-fines-for-trucks-that-fail-to-use-northconnex-20170918-gyjkaa.html

[55] http://www.rms.nsw.gov.au/documents/business-industry/partners-and-suppliers/tenders-contracts/contracts-awarded/westconnex-m5-project-deed-schedules.pdf

Track access charges

Track access charge assumptions are outlined in Table 46. For track managed by ARTC, John Holland Rail and Queensland Rail, track access charges have been set at publicly available rates. For new track and for the Metropolitan Rail Network, the table outlines the assumed track rates.

Table 46: Track access charges

Track Access Segment	Flagfall per train	Flagfall $/km	Variable $ per 000GTK
ARTC			
Acacia Ridge to Islington		$1.11	$3.83
Cootamundra to Parkes Junction		$1.14	$4.22
Goobang Junction to Werris Creek		$0.12	$2.68
Maitland to Muswellbrook		$0.52	$4.08
Muswellbrook to Merrygoen		$0.56	$3.60
Muswellbrook to Werris Creek		$0.52	$4.08
The Gap to Boggabilla		$0.59	$2.77
SSFL		$3.86	$5.79
Tottenham to Macarthur		$1.20	$3.01
UMVL		$1.20	$4.85
Parkes Junction to Broken Hill		$1.18	$4.29
John Holland Rail (Country Rail Network)		$0.51	$2.45
ARTC (Metropolitan Freight Network)			
MFN - Port Botany (Metro trains)	$337.82	$3.86	$5.79
MFN - Port Botany (Regional trains)	$337.82	$5.65	$1.88
MFN (Metro trains)		$3.86	$5.79
MFN (Regional trains)		$5.65	$1.88
Queensland Rail			
Port of Brisbane to Acacia Ridge			$17.26
Others			
Inland Rail		$1.16	$3.92
MRN		$0.66	$5.81
MDRL		$3.86	$5.79

Source: ARTC, JHR, Queensland Rail and KPMG assumptions

Container terminal costs

Wharfage

Current wharfage charges at Port Botany, Port of Brisbane and Port of Melbourne are outlined in Table 47. Charges at Port of Brisbane are inclusive of a port access charge.

Table 47: Wharfage charges at Port Botany, Port of Brisbane and Port of Melbourne ($/TEU)

Container type	Port Botany	Port of Brisbane	Port of Melbourne
Full imports	$123.10	$41.48	$109.31

Empty imports	$13.12	$11.49	$17.44
Full exports	$81.94	$41.48	$95.80
Empty exports	$13.12	$11.49	$17.44

Source: NSW Ports, Port of Brisbane, Port of Melbourne

Table 48 outlines current and projected wharfage charges at Port Kembla and Port of Newcastle. The projected charges have been uplifted to account for the incremental capital investment required to deliver a new container terminal.

Table 48: Current and projected wharfage charges ($/TEU)

Container type	Current		Future	
	Port Kembla	Port of Newcastle	Port Kembla	Port of Newcastle
Full imports	$65.85	$57.55	$99.85	$134.50
Empty imports	$11.30	$10.55	$17.13	$24.66
Full exports	$65.85	$57.55	$99.85	$134.50
Empty exports	$11.30	$10.55	$17.13	$24.66

Source: NSW Ports, Port of Newcastle and KPMG assumptions

Navigation

Navigation rates for NSW ports are outlined in Table 49.

Table 49: Navigation rates at NSW ports

Port	Threshold	Fixed	Marginal rate per GT
Port Botany	No threshold	-	$0.59
Port Kembla	From 50,000 GT	$25,000	$1.22
Port of Newcastle	From 50,000 GT	$23,605	$1.06

Source: Port Authority of NSW

Port of Brisbane navigation rates are charged on a TEU basis. No harbour dues are applicable on empty import containers.

Table 50: Navigation rates at Port of Brisbane ($/TEU)

Container type	Per TEU
Full imports	$53.53
Empty imports	$0
Full exports	$53.53
Empty exports	$6.10

Port of Melbourne channel fees are charged based on draught and a combination of shared and dedicated channel charges. Dedicated charges apply north of Fawkner Beacon, or approximately seven percent of the journey across Port Philip Bay. The weighted rates have been adopted in the Model.

Table 51: Channel fees at Port of Melbourne

Draught	Shared	Dedicated	Weighted
(Summer) draught up to 12.1m	$0.1888	$0.3690	$0.2020
Over 12.1m	$0.2014	$0.4308	$0.2182

Pilotage

Table 52 outlines the pilotage rates across all five ports. A multiplier of 1.40 has been applied to the base pilotage rates at the Port of Newcastle to reflect the longer travel distance between the mouth of the Hunter River and Mayfield, a potential container terminal site.

Table 52: Pilotage rates

Category	Fixed charge	Marginal charge
Port Botany		
30001 - 55000 GT	$4,602.49	$0.0227
Over 55000 GT	$5,169.99	$0.0075
Port Kembla		
25001 - 50000 GT	$3,482.75	$0.0488
50001 - 78000 GT	$4,702.25	$0.0108
Over 78000 GT	$5,004.65	$ -
Port of Newcastle		
34001 - 55000 GT	$3,070.93	$0.0379
Over 55000 GT	$3,866.83	$0.0142
Location multiplier		1.4000
Port of Brisbane		
151m to 200m	$5,597.70	$44.15
201m to 250m	$7,805.20	$35.30
More than 250m	$9,570.20	$30.90
Port of Melbourne		
20001 - 30000 GT	$5,686.79	$0.0572
30001 - 50000 GT	$6,258.79	$0.0354
Over 50000 GT	$6,966.79	$0.0330

Stevedores charges

A flat rate across all ports has been adopted for modelling purposes. Additional charges have been applied over and above the following rate at Port Botany, Port Kembla and Port of Newcastle to allow for capital expenditure expected to be incurred by stevedores.

Table 53: General container ship parameters

Variable	Value
Stevedore revenue per TEU	$170.00

Source: ACCC[56]

[56] https://www.accc.gov.au/system/files/2016-17%20Container%20Stevedoring%20Monitoring%20Report%20-%20Supplementary%20Industry%20Data.xlsx

Summary of charges

The following table summarises all terminal charges applied at each port for the 2046 model year. The table summarises the charges on a TEU basis applied to the assumed reference ship, based on the rates shown between Table 47 and Table 53.

Table 54: Summary of terminal charges in 2046 by port ($/TEU)

Component	Port Botany	Port Kembla	Port of Newcastle	Port of Brisbane	Port of Melbourne
Wharfage	$77	$69	$93	$30	$73
Navigation	$11	$15	$13	$36	$4
Pilotage	$1	$1	$1	$2	$2
Stevedores	$179	$206	$204	$170	$170
Tonnage	$0	$0	$0	$0	$1
Conservatory	$0	$0	$0	$4	$0
Other charges	$11	$11	$11	$17	$11
Total per call	**$279**	**$302**	**$323**	**$260**	**$261**

Bluewater cost parameters

Table 55 outlines the common parameter values used to annuitise capital costs and convert various US dollar denominated metrics into Australian dollars.

Table 55: General container ship parameters

Variable	Value	Basis
EUR to AUD	$1.54	ATO
USD to AUD	$1.32	ATO
Profit margin	30%	Stopford (2009)
Economic life	20	Stopford (2009)

Table 56 outlines fuel consumption, cycle times, capital cost and operating cost parameters by container ship size. A power function links design speed, design fuel consumption and actual speeds with actual fuel consumption. Capital costs were reduced by 30 per cent to reflect movements in container ship capital costs since 2009.

Table 56: Fuel, capital and operating cost assumptions by ship size (in TEUs)

Variable	1,200	2,600	4,300	6,500	8,500	11,000
Design speed (knots)	18.3	20.9	23.8	25.2	25.5	25.5
Design fuel consumption (t/sailing day)	42	79	147	214	230	240
Assumed speed (knots)	17.4	19.9	22.6	23.9	24.2	24.2
Fuel consumption (t/sailing day)	36.1	68.2	125.9	182.6	196.6	205.1
Cost of BW180 bunker fuel (US$/t)	500	500	500	500	500	500
Average time at anchorage (hours)	10	10	10	10	10	10
Slot utilisation	85%	85%	85%	85%	85%	85%
% of capacity exchanged per port	70%	70%	70%	70%	70%	70%
Ship rate (TEUs/berth hour)	55	55	55	55	55	55
Capital cost, as per Stopford (2009) in US $m	25	48	67	89	110	130
Imputed capital costs (today's prices) in US $m	17.3	33.2	46.4	61.6	76.2	90.0
Operating cost per day (US$/day)	4,643	5,707	6,000	6,500	7,000	7,500

Contact us

Brendan Lyon
Partner
blyon@kpmg.com.au

Ben Ellis
Partner
benellis@kpmg.com.au

Matt Yi
Director
myi1@kpmg.com.au

Dr Persa Paflioti
Manager
ppaflioti@kpmg.com.au

James Hallab
Manager
jhallab@kpmg.com.au

KPMG.com.au