



Image courtesy of Fremantle Ports

Fremantle presents a unique challenge for Westport

Infrastructure Australia, whose infrastructure assessment process Westport is following, requires projects to look at optimising existing infrastructure as the first step before building anything new.

It is accepted that the Inner Harbour is operating well below its berth or shipping capacity, so an assumption can be made that Fremantle should remain Perth's primary container port well into the future. Why spend billions of dollars on a new port if it's not needed?

But Westport's investigations outlined in this Beacon show a more complex picture.

It may surprise many people to see that a stand-alone Fremantle option has not made Westport's shortlist of five options. Why not?

BUT BEFORE WE BEGIN, it is very important to point out that while Westport's work shows Fremantle won't remain Perth's stand-alone container port for the long-term, the Inner Harbour will continue to be Perth's primary container port until the new port is established. Westport is now working on the trigger points and timings around when new infrastructure, including the new port, will be required. A major focus of this work will be identifying the community's tolerance levels for increasing amenity impacts, such as traffic congestion and rail noise, as well as industry's willingness to change their operating practices. However, building a new port takes time and it may take up to a decade to deliver.

Additionally, it should be noted that Fremantle Ports' jurisdiction includes both the Inner and Outer Harbours. It is envisioned that any new port facility would remain under the management of Fremantle Ports.



Defining the Inner Harbour's capacity

The Fremantle Inner Harbour has been, and continues to be, an important economic asset for Western Australia since it first officially opened on 4 May 1897. Thanks to the visionary foresight and design work of State Engineer C.Y. O'Connor, the Inner Harbour has serviced the freight needs of Perth and surrounding regions for more than 120 years.

Over the years, the Fremantle Inner Harbour has undergone many enhancements and upgrades as shipping trends and trades changed. It most significantly played a pioneering role for Australia when the international shipping container trade commenced 50 years ago in 1969. While the Inner Harbour itself has been able to adapt as required and continues to be one of Australia's most efficient container-handling ports, external factors outside of the port's control are likely to impact on the extent it is able to grow and operate efficiently. The prime coastal and riverfront land surrounding the port has become increasingly populated with residential development. While a positive for the area, this growing population has not only constrained the ability of the port to grow, it has led to vast increases in the number of passenger vehicles sharing the port's feeder roads with freight vehicles. Meanwhile, commuter trains have limited the number of freight trains that can cross the shared rail bridge to the port each day.

A comprehensive report by an independent consultancy in 2014, suggested that the capacity of the Inner Harbour could reach 2.1 million TEU (containers) without requiring major works to the port itself, but with some improvement in the heavy vehicle corridor serving it. With the Inner Harbour currently only handling just over a third of that amount – 770,000 TEU in 2017/18 – it would be easy to assume that the port's capacity would be adequate for many decades to come.

Westport reviewed and accepted the findings of the 2014 report – there is no argument that Inner Harbour berths have the capacity to handle large increases in container volumes. However, the 2014 report, along with earlier reports, failed to offer a sufficient analysis of the wider freight supply chains necessary to ensure the port's longevity – particularly the road and rail links that move cargo to and from the port. Westport's investigations have identified that these links are, in fact, the major constraints for the Inner Harbour, and will reach their capacity by the mid-2030s.

To ensure the best use of limited infrastructure funding dollars, it is important that Western Australia invests in assets that will be sustainable for the long-term. So, Westport is planning for a port that can handle between 3.8 million TEU and 5.4 million TEU by 2068. Even if the Inner Harbour can accommodate the previously mentioned 2.1 million TEU, that still leaves it several million containers short of where it needs to be in the long-term.

So, to determine whether the Inner Harbour could meet Perth's long-term freight needs as a stand-alone port, Westport investigated and then assessed in MCA-1:

- the scalability of the port's footprint;
- current and maximum road capacity;
- current and maximum rail capacity;
- other modes of transport that could be used;
- supply chain operational enhancements;
- likely social and amenity impacts on surrounding communities; and
- estimated capital expenditure.

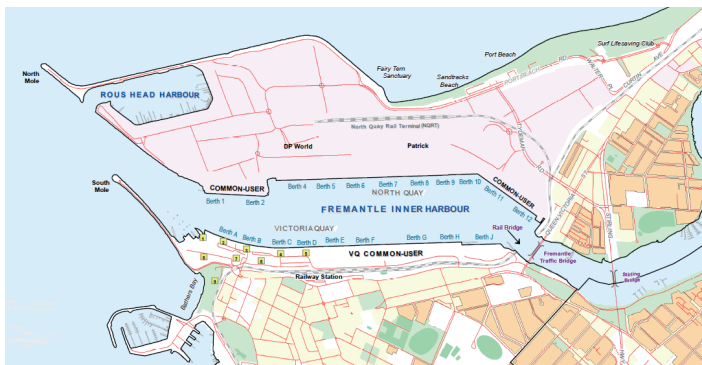


Diagram 1: Inner Harbour current state

Enhancing the Inner Harbour's capacity

Assuming the supply chain constraints could be addressed, expanding the Inner Harbour's berth-face capacity from 2.1 million TEU to handle between 3.8 million and 5.4 million TEU would also pose significant challenges. As with all options, it would need to accommodate many more ships and require water depths of up to 18 metres to handle the big ships of the future, as well as the ability to increase its throughput if container growth exceeds the forecasts.



Diagram 2: Expanded Inner Harbour footprint to handle 3.8 million TEU

Westport's team, along with Fremantle Ports, determined that Fremantle could potentially reach a capacity of 3.8 million TEU if the following enhancements, as depicted in Diagram 2, were made:

- an expanded port footprint, as depicted by the green shaded area in Diagram 2 to the left, including an infilled Rous Head Harbour;
- modifications to the existing berths along the Swan River;
- additional deep-water berths constructed along the ocean-side north-west coast of North Mole (the Swan River berths cannot efficiently reach a depth of 18m);
- dredging for these new deep berths; and
- a breakwater built in parallel to the North Mole ocean berths to protect them from waves and currents.

KEY

 Proposed Port Footprint	 Fremantle Rail Tunnel
 Berth	 Stirling Hwy and Tydeman Rd
 Breakwater	 Fremantle Rail Bridge
 Shipping Channel	

Fremantle's heavy vehicle road capacity

To determine the impacts of continuing to channel freight vehicles to the Inner Harbour through highly urbanised areas, Westport partnered with Main Roads WA (MRWA) to forecast the growth of both freight and passenger vehicles for the next 20 years, and then model the impacts on the Fremantle road network.

The model included the following *committed* and *funded* road enhancements:

- upgrading High Street between Stirling Highway and Carrington Street to a four-lane divided standard, with a new roundabout at the intersection of High Street and Stirling Highway; and
- construction of a new Fremantle Traffic Bridge and separation of the passenger and freight rail lines.

The model also assumed the following *uncommitted* and *unfunded* road projects – which appear in MRWA's long-term planning – would need to be built:

1. widening Stirling Highway to a six-lane divided standard between High Street and Queen Victoria Street, as well as duplication of the Stirling Bridge (estimated cost is \$250 million*);
2. grade separation of the Stock Road and South Street intersection (estimated cost is \$70 million*);
3. upgrading Roe Highway to a six-lane divided standard between Kwinana Freeway and Orrong Road (estimated cost is \$350 million*);
4. construction of the Curtin Avenue Link over the Fremantle passenger rail line and duplication of Curtin Avenue to a four-lane divided standard to West Coast Highway (estimated cost is \$600 million*);
5. duplication of West Coast Highway to a four-lane divided standard between Rochdale and Alfred Roads (estimated cost is \$50 million*); and
6. enhancing Stock Road to a six-lane freeway standard between Leach Highway and Rowley Road, including grade separations (estimated cost is \$1 billion*).

The total cost of these unfunded road projects, which are largely contingent on the port remaining at Fremantle, is estimated at about **\$2.3 billion***. Of these uncommitted road projects, only the cost of duplicating Stirling Bridge was directly factored into Westport's preliminary cost estimates for expanding the Inner Harbour in MCA-1.

The MRWA model demonstrates that, using current circumstances and assuming average annual growth, even with construction of the six assumed road projects, road network servicing the Inner Harbour reaches unacceptable inefficiency by the mid-2030s. At certain times of day, journey times to the Inner Harbour may even triple. For the freight industry, this is an unworkable situation.

The Fremantle road network has shown remarkable resilience to date. Better management has increased freight vehicle efficiency, and recent data released by MRWA shows that the average travel speeds have improved on nearly every metric over the past three financial years.

However, while the Fremantle road network is currently operating efficiently according to the metrics, there are several key points to note:

1. Concerns about safety are becoming an increasing issue from both the community and truck drivers as vehicle numbers across the Fremantle road network continue to escalate.
2. Leach Highway, Stirling Highway, High Street and Curtin Avenue run through highly populated urban areas. Residents living adjacent to these roads face growing impacts on their amenity, including diesel fumes and other emissions, noise and vibration.

(continued overleaf)



*Preliminary working cost estimates only. The costs of the other projects MRWA's model assumed would be built were not directly factored into the MCA-1 comparisons between options.

3. The MRWA modelling shows that while the Fremantle road network will continue to operate efficiently in the near-term, once the tipping point has been reached, conditions deteriorate quite quickly. Now that this has been identified, steps can be taken to address this before it becomes an issue, including re-routing the port traffic to an alternative destination.
4. The car continues to be Perth's primary method of transport; as such, passenger vehicle numbers continue to increase across the metro area. While users of the Fremantle road network may feel like they are bearing a disproportionate increase in congestion due to the visibility and slow speeds of the container trucks, in fact, many main roads across Perth are experiencing similar increases in congestion. A key factor in trying to solve this will be steering people away from driving their cars and using alternative forms of transport instead.

The MRWA road modelling demonstrates that the current Fremantle road network will be unable to service growing freight and passenger traffic beyond the next 20 years. In combination with the growing community concerns over safety and amenity, this highlights that the status quo will become untenable in the foreseeable future.

It makes more sense to redirect the freight traffic away from residential areas, and channel it to an industrial zone instead. This will deliver better outcomes for both the community and freight industry. This reasoning partially explains why the Kwinana options scored better than Fremantle in Westport's MCA process.



Expanding Leach Highway

Leach Highway currently serves as the main freight route for heavy vehicles accessing the Inner Harbour, and will remain a vital road corridor moving forward.

Westport set out to establish whether the highway could be enhanced to allow it to continue serving the Inner Harbour as an effective freight route long-term.

Working in partnership with MRWA, a concept to upgrade Stirling Highway, Leach Highway and Kwinana Freeway was designed (see Diagram 3 below). This concept included:

- four lanes of unimpeded two-way transit from Kwinana Freeway to Canning Highway;
- grade separations (overpassing intersections) along Leach and Stirling Highways between Kwinana Freeway and Canning Highway to remove all traffic lights;
- a six-lane Stirling Bridge;

- additional traffic management systems to address congestion; and
- new access roads.

While serving its purpose as a direct freight route to the port, the Leach Highway upgrade design has significant downsides, including:

- high capital cost;
- impacts on some properties;
- nine current standard intersections are changed to 'left in, left out' intersections (i.e. cars can only turn in from the left, and only exit to the left);
- significant reductions in access to Leach Highway for residents; and
- significant reductions in access to the Melville commercial precinct.

In addition to these drawbacks, modelling showed that while the Leach Highway upgrade would significantly improve port access for a time, as private and freight vehicle numbers continue to increase, its efficiency declines. So essentially, the Leach Highway upgrade would not be a long-term solution for improving heavy vehicle access to the port.

It is worth noting that Westport did consider many other alternative ways to access the port by road, including tunnels under Leach Highway. However, these were found to be unviable as there are other significant engineering challenges that would hamper tunnelling access, and the costs are prohibitive.

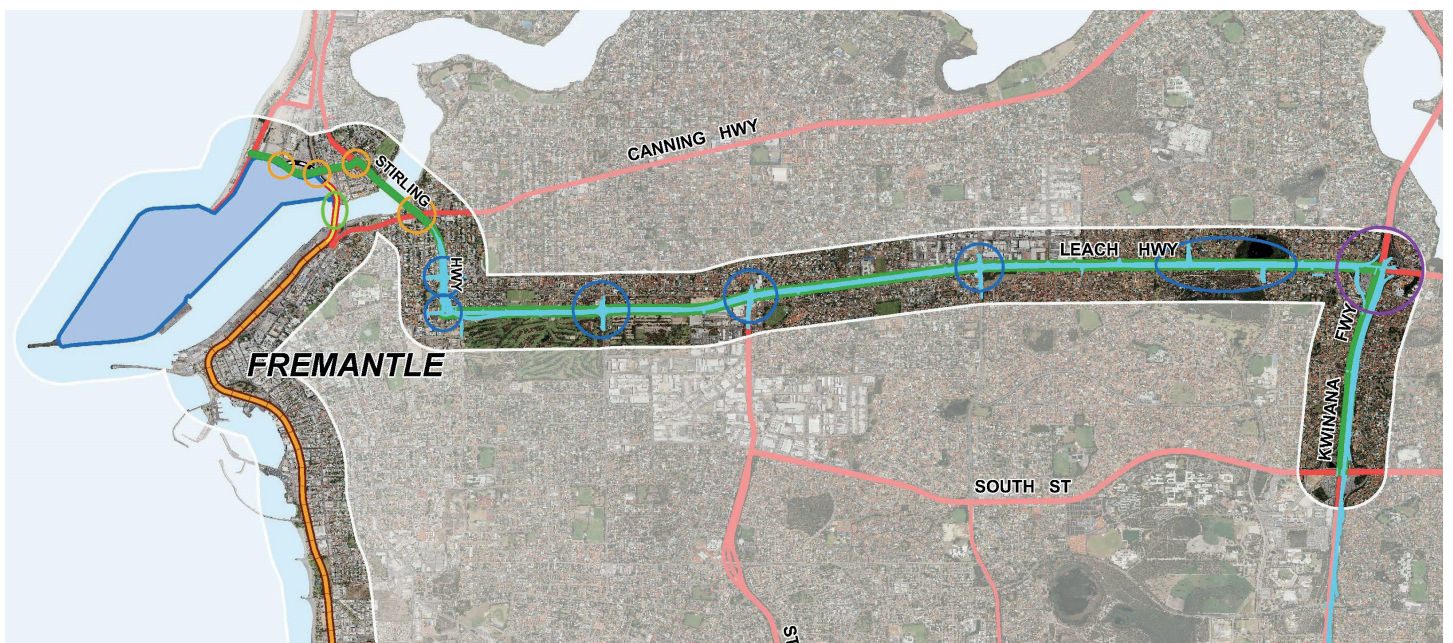


Diagram 3: Leach Highway upgrade concept extending from Kwinana Freeway to Canning Highway, with grade separations circled in blue (and possible grade separations circled in yellow)

Fremantle's rail capacity

The State Government's policy to increase freight on rail saw the subsidy for containers transported on rail, first introduced in 2006/07, increased from \$30 per TEU to \$50 per TEU on 1 January 2018. This higher subsidy has been very successful.

The percentage of containers being shifted on rail has grown from 15.5 per cent in the 12 months prior to the subsidy being raised, to a record high of 23.7 cent in April 2019 – the highest percentage in Australia – which equates to approximately 150,000 TEU annually. There were up to five rail services into and out of the Inner Harbour each day in 2018.

However, rail access to the Inner Harbour is also becoming increasingly constrained. A major bottleneck is the Fremantle rail bridge, which is shared with passenger trains that take priority over freight trains during morning and afternoon peak periods. This leaves limited windows for freight trains to cross the bridge and restricts their numbers.

Other constraints include:

- amenity impacts on residences lining the rail corridor has restricted freight rail operations during evening hours;
- regular, essential track maintenance and repairs;
- a single metropolitan intermodal terminal (IMT) available for container use, located in Forrestfield; and

- loading and unloading times at the Forrestfield IMT and North Quay Rail Terminal (NQRT) at the Inner Harbour.

Westport worked in partnership with Arc Infrastructure and the Public Transport Authority to determine how many TEU the Inner Harbour's rail links would be able to manage. The results were:

- based on the current circumstances (no operational changes or capital investment) the rail service to NQRT will begin to near its capacity in coming years; and
- by investing in a dedicated freight rail line to NQRT (which is now a funded commitment), noise mitigating strategies to alleviate impacts on local residents, introducing additional IMT capacity to the metropolitan area, and operational changes involving a significant investment in rolling stock by the rail service providers, the Inner Harbour's rail capacity could be increased to 350,000 TEU annually, which is the anticipated volume by 2031.

(continued overleaf)



The challenge of increasing the number of TEUs that could be transported to the Inner Harbour by rail up to 1.2 million – consistent with the Government’s goal of 30 per cent of the 3.8 million TEU the port would be handling by 2068 – presented a number of major issues:

- there is only one freight rail corridor to the Inner Harbour, which runs through Fremantle’s West End heritage and tourism precinct;
- the operational integrity of the rail corridor has been significantly impeded by urban encroachment;
- to accommodate the 25-or-more freight paths a day, the rail lines would need to be duplicated;
- the amenity impacts on properties lining the rail corridor, even with noise mitigation in place, would be significant; and
- freight trains require a very shallow gradient due to their weight, so tunnelling options directly to the Inner Harbour proved impossible due to the steep gradient required for the trains to come up on the North Quay side within the port precinct.

Once all of these issues were considered, only one viable rail solution was identified. This solution involved sinking the rail line in an 8-metre-deep covered trench along the existing rail corridor through

Fremantle to avoid the noise impacts on residents and businesses in the surrounding area. The tunnel would gradually get shallower until the trains surface just past the Cliff Street roundabout at the Victoria Quay precinct. The duplicated freight rail line would then run along Victoria Quay where the current rail line is located and follow the existing path over the rail bridge to the port. Diagram 4 below shows part of the proposed concept.

However, this rail enhancement comes with significant issues, including:

- extremely high capital investment;
- the need to close the freight rail route to the port for several years while the construction takes place;
- the inability to redevelop Victoria Quay for tourism, community or commercial purposes as the duplicated rail corridor would cut it off from the city centre;
- possible impacts on the Roundhouse and other heritage buildings during construction of the tunnel, as well as from the ongoing vibrations of the passing trains; and
- the inability to stage the roll-out of this infrastructure – it would all need to be done at one time.

Rail back to ground level, running along

Heritage buildings including the Roundhouse, Commissariat building and Wilhelmsen House (Barwil House)



Trench shown at 15m width and assumes filling. Anything significantly larger will impact nearby heritage areas

Curve devised at 150m radius to avoid tunnelling under any heritage buildings

Diagram 4: Victoria Quay where the freight trains will emerge from the tunnelled section of track (shown in green) and travel along the existing rail line at surface level (shown in yellow)

An existing port doesn't mean it's a cheaper option

One of the most common arguments used against building a new port in the Outer Harbour has been the cost, with \$6 billion often quoted by interest groups as the assumed figure. The assumption underpinning that argument is that, by comparison, keeping operations at Fremantle would be a low-cost or even no-cost option. Westport's work shows that is not the case.

Here is a high-level breakdown of the main infrastructure enhancements required to achieve a 3.8 million TEU handling capacity at the Inner Harbour:

- expanding the port footprint, including building a new breakwater and dredging;
- grade-separating and expanding Leach Highway to eight lanes;
- duplicating Stirling Bridge;
- some Fremantle road network upgrades;
- duplicating, sinking and enclosing the freight rail line; and
- intermodal facility upgrades.

The total high-level cost estimates for these infrastructure upgrades, as determined for the purposes of MCA-1, came to just over \$5 billion*.

This cost estimate **did not** include the \$2.3 billion of uncommitted, unfunded road projects listed on page 4, apart from the Stirling Bridge duplication.

In comparison, building a new port at the Outer Harbour would require the following infrastructure upgrades:

- duplicating the South West Main rail line from Cockburn Triangle to Kwinana Industrial Area;
- expanding Rowley or Anketell Roads from Tonkin Highway to the port location;
- building the new port itself, including dredging; and
- intermodal facility upgrades.

The total high-level cost estimates for these infrastructure upgrades, as determined for the purposes of MCA-1, came in at just under \$4 billion*.

There are also other benefits associated with moving the port out of Fremantle in the longer term that must be factored in:

- removes freight vehicles from the Fremantle and Western Suburbs' road networks, freeing up more capacity for growth of passenger vehicles;
- removes the need for the freight rail line running through Fremantle and perhaps allowing it to be re-purposed for passenger rail;
- opportunity to redevelop the port land at both Victoria and North Quays, the sale of which could recoup some of the expenses involved in building new infrastructure while unlocking economic and social enhancement opportunities for Fremantle;
- a port in Kwinana would be largely unimpeded by residential development, thereby limiting social impacts, while potentially unlocking further industrial development opportunities;
- a new port can utilise the latest technology and innovations to improve operational and cost efficiencies, and possibly even environmental outcomes; and
- resilience to climate change, sustainability and ability to upscale capacity can also be built into the design.

*Please note that these figures are preliminary working estimates only, based on information available to Westport for MCA-1. Westport will be undertaking more detailed cost analysis during the next stages of the project.

Would Roe 8 have enabled Fremantle to make the shortlist?

Westport did not consider the Roe 8/9 road corridor in our technical studies as the State Government made a firm commitment not to build it at the last State election. However, we are conscious that the public discussion around Roe 8 continues.

Given the level of public interest, it is relevant to ask whether Roe 8/9 would have solved Fremantle's road constraint issues, enabling it to feature on Westport's shortlist of options.

In Westport's view, due to the cumulative impact of major social and economic impediments, Fremantle would have rated poorly in the multi-criteria analysis on the long-list of options, even if Roe 8/9 were included in the supply chain designs. As such, **Fremantle still would not have made the shortlist of options, even with Roe 8/9 considered.**

Through the MCA process, the Fremantle options were compared against Kwinana options that offered far superior outcomes in relation to the key assessment criteria:

- Kwinana offers better road and rail corridors for freight;

- Kwinana is a safer option for road users, as it will provide better separation between heavy freight vehicles and passenger vehicles;
- Kwinana will improve social outcomes for the community by moving freight out of urban areas;
- Kwinana offers better options for scalability and future-proofing; and
- Kwinana has more scope for industrial and economic development.

Further to this, Roe 8/9 is a more expensive and environmentally-impactful road corridor than the Leach Highway upgrade option that was used in the multi-criteria analysis. Additionally, the \$2.3 billion of uncommitted, unfunded road projects listed on page 4 would still need to be built in addition to Roe 8/9. To that end, including Roe 8/9 in the technical studies may have potentially caused the Fremantle options to score even lower in the MCA.

Westport's conclusion

The high cumulative capital costs, concerns over the long-term sustainability and scalability and large levels of social impact, meant that the two stand-alone Fremantle options in Westport's long-list (Option 1 and Option 3) performed poorly in the MCA-1 ratings when assessed against other options. Consequently, these two options will not proceed any further in Westport's process.

However, the two shared Fremantle options, Option 2 and Option 4, have proceeded to the shortlist, with Option 4 mainly being considered as a transition state. They will be rigorously tested in MCA-2 and the cost-benefit analysis.

The focus now for Westport's work on the Inner Harbour will be to determine the maximum financially and socially-acceptable capacities of the road and rail networks, mainly utilising operational changes to limit capital spend.