Let's GET Wellington MOVING

18th May 2022

Aotea Quay Option Development and Assessment Report

Stantec supported by
FutureGroup

Final

WAKA KOTAHI NZ TRANSPORT AGENCY
greater WELLINGTON REGIONAL COUNCIL Te Pane Matua Taiao
Absolutely Positively Wellington City Council Me Heke Ki Pōneke

Document control record

Document control						
Report title		Aotea Quay Option Assessment Report				
File path						
Client		Let's Get Wellington Moving				
Client contact		Hannah Hyde	**Client reference**		TBC	
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
0	15-12-21	Draft	Alan Kerr, Sam Thornton	Phil Peet		Alan Kerr
1	04-04-22	Final	Alan Kerr	Sam Thornton		Alan Kerr
2	18-05-22	Final	Alan Kerr	Sam Thornton		Alan Kerr
Current revision		**2**				

Table of Contents

1 Table of Contents

Table of Figures

List of Tables

1 Executive Summary

This report sets out an evaluation of options to reconfigure the Aotea Quay corridor to meet the objectives of Let's Get Wellington Moving's Thorndon Quay/Hutt Road project and Kiwirail's Interislander terminal redevelopment project.

The Aotea Quay corridor forms a critical part of the Wellington transport network. It provides a connection to State Highways 1 and 2 from the city centre as well as the main access route to Centreport.

Let's Get Wellington Moving seeks to deliver improvements to the Thorndon Quay/Hutt Road corridor, targeting public transport and active travel. One of the elements of the proposed scheme is a median barrier that limits right turn and U-turn movements along Hutt Road. While this delivers safety benefits, it means that turning facilities will have to be provided at either end to maintain property access. At the southern end, the Thorndon Quay/Hutt Road project team has determined that the turnaround facility needs to be on Aotea Quay as this has the additional benefit of removing ferry traffic from Hutt Road by facilitating a direct connection to/from the motorway (State Highway 1).

The Interislander terminal upgrade is seeking to upgrade the current Kiwirail inter-island vessels to increase capacity for both road and rail and improve service reliability. This requires an upgrade to the existing ferry terminal and access arrangements in Kaiwharawhara.

A range of objectives for this study have been developed by combining the investment objectives agreed for Thorndon Quay/Hutt Road with the requirements of the Interislander terminal project. These are summarised as follows:

- Changes on Aotea Quay do not reduce the ability to deliver improved Levels of Service for bus users and seek to enhance it by reducing ferry related traffic on Hutt Road (hereafter referred to as "bus level of service")
- Improved Level of Service and reduced safety risk for people walking and cycling along and across Aotea Quay, particularly to support active mode access to the ferry terminal and adjacent land use developments (hereafter referred to as "active travel level of service and safety")
- Reduce the frequency and severity of crashes on Aotea Quay
- Maintain similar access for people and freight to the ferry terminal / Centreport

A number of options have been developed for the corridor at two different levels. The first level considered the basic functional requirements for the corridor and the second level considered the form of the intersections required to deliver the functional requirements. All options were assessed by a panel of experts against the investment objectives and an agreed set of wider effects (including a high level assessment of overall social and environmental effects, property access, fit with LGWM programme objectives and deliverability). Analysis has been undertaken using a range of qualitative and quantitative metrics (including transport modelling and a safety assessment).

This evaluation has concluded that a combination of a signalised intersection at the ferry terminal access intersection and metered roundabout at the Kiwirail CT yard access point will deliver the desired access and safety improvements for the Aotea Quay corridor. All other tested options resulted in degraded network performance, from an efficiency perspective, relative to the current situation.

The second level of assessment, which considered more detailed options consistent with the preferred option from the first level, confirmed that at the ferry terminal intersection, a signalised intersection layout that minimises additional land take, but maximises capacity for key movements is the preferred option. The compromise with this preferred layout is that it removes direct connectivity to Hutt Road, however this connection will be lightly used in the future. At the CT yard intersection, a 24m diameter metered roundabout located close to the existing signals has been identified as the preferred option. The preferred options are presented in Figure 1 below.

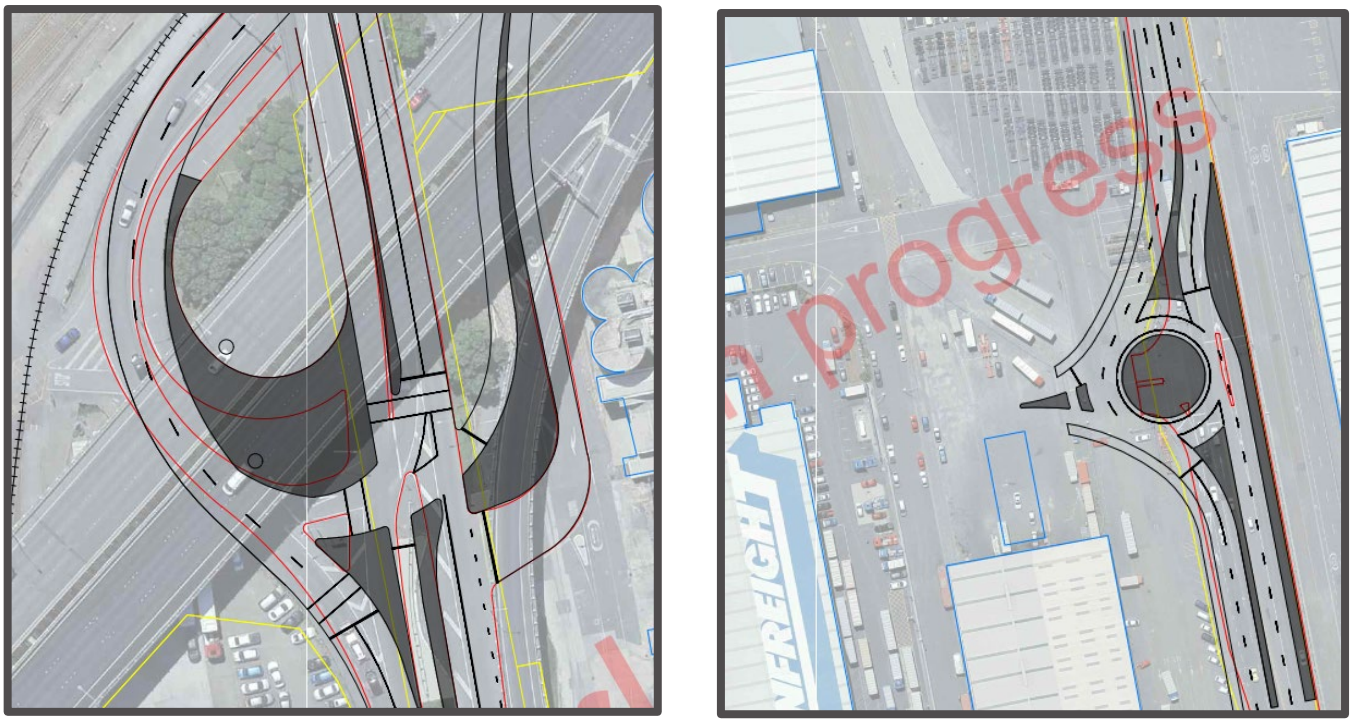


Figure 1 - Preferred intersection arrangements

The next stage will be the development of detailed designs for the corridor based on the preferred options.

Discussions between KiwiRail, LGWM and Waka Kotahi over March and April 2022 have confirmed that:

- LGWM expect to build the roundabout, subject to funding, land and approvals
- KiwiRail will need to improve the ferry intersection prior to the first sailing of the new, bigger ships
- If LGWM have not constructed the roundabout, KiwiRail will need to mitigate the effects of the larger ships prior to any adverse impact on the traffic network.

2 Introduction

This document summarises work undertaken to determine the optimal configuration of the Aotea Quay corridor. Aotea Quay is an important corridor for traffic as it serves the port and ferry terminals as well as the CBD. As part of the Let's Get Wellington Moving (LGWM) Thorndon Quay/Hutt Road (TQHR) project, it also needs to provide a turnaround facility for large vehicles that will be unable to use the breaks provided in the proposed median barrier along Hutt Road. This turnaround facility also provides an opportunity to improve access to and from the Interislander ferry terminal, thereby removing some ferry related traffic from Hutt Road. It is anticipated that this facility will be provided at an existing intersection on Aotea Quay.

Alongside the LGWM project, Kiwirail is planning on upgrading the Interislander ferry terminal to accommodate two larger rail enabled ferries that will be arriving in 2025 and 2026. Larger ferries will place additional demand onto the network and the changes along Aotea Quay will need to be developed cognisant of these effects.

The document is structured as follows:

- Objectives of the Aotea Quay project in the context of LGWM TQHR and the Interislander ferry terminal upgrade.
- Option development – this is structured at two levels. The first level considers the requirements in terms of functionality and connectivity, the second level considers the implication of the functional requirements on intersection layout.
- Option assessment – again, this is structured to report on the evaluation of the functional options first before considering the relative performance of the different intersection options
- Conclusions and next steps.

3 Background and objectives of the Aotea Quay project

The study area is show in Figure 2 below. This highlights the Aotea Quay corridor (red line) in the context of the LGWM TQHR project corridor (blue line) and the Interislander terminal (yellow oval). It also highlights a number of other key features referred to later in this document.

Figure 2 - Study Area

The Aotea Quay corridor forms a critical part of the Wellington transport network. It provides a connection to State Highways 1 and 2 from the city centre as well as the main access route to Centreport (via the main gate on Hinemoa Street or the north gate adjacent to the Interislander ferry terminal).

As outlined in the introduction, the Aotea Quay corridor project has its genesis in two adjacent projects – TQHR and the Interislander terminal redevelopment.

TQHR seeks to deliver improvements to the Thorndon Quay/Hutt Road corridor, targeting public transport and active travel. It is an important component of the LGWM programme as it will help with reducing the demand for private motor vehicles from the northern suburbs and wider region (key locations for assumed growth). It will achieve this by improving the walking and cycling connections along the corridor and by providing peak direction bus lanes that will increase the relative attractiveness of PT services. One of the elements of the proposed scheme is a median barrier that limits right turn and U-turn movements along Hutt Road. While this delivers safety benefits, it means that turning facilities will have to be provided at either end to maintain property access. At the southern end, the TQHR project team has determined that the turnaround facility needs to be on Aotea Quay as this has the additional benefit of removing ferry traffic from Hutt Road by facilitating a direct connection to/from the motorway (State Highway 1).

The Interislander terminal upgrade is part of project iReX (the inter island resilience connection project) which is seeking to upgrade the current Kiwirail inter-island vessels to increase capacity for both road and rail and improve service reliability. This requires an upgrade to the existing ferry terminal in Kaiwharawhara as shown in Figure 2

Figure 3 - Interislander Terminal Redevelopment

Access to and from the ferry terminal will be provided from Aotea Quay (as it is at the moment). Increased capacity, coupled with scheduling changes, will result in changes in demand along Aotea Quay and the Kiwirail project team has identified a requirement to improve the intersections in close proximity to the terminal.

Therefore, the objectives for this study have been developed by combining the investment objectives agreed for TQHR with the requirements of the Interislander terminal project. These are summarised in the table below (Table 1) along with the other elements/effects to be assessed as part of the evaluation process:

Table 1 - Investment objectives and assessment criteria

Group	Thorndon Quay / Hutt Road criteria	Proposed Aotea Quay criteria
Investment objectives	Improved LOS for bus users including improved access, journey times and reliability. Provide sufficient capacity for growth in public transport	Changes on Aotea Quay do not reduce ability to deliver IO1 for TQHR and enhance it by reducing ferry related traffic on Hutt Road
	Improved LOS and reduced safety risk for people walking and cycling along and across Thorndon Quay/Hutt Road	Improved LOS and reduced safety risk for people walking and cycling along and across Aotea Quay, particularly to support active mode access to the ferry terminal and adjacent land use developments
	Reduce the frequency and severity of crashes on Hutt Road	Reduce the frequency and severity of crashes on Aotea Quay
	Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area	Not relevant[1] - Aotea Quay is sufficiently removed from Thorndon Quay to have minimal impact
	Maintain similar access for people and freight to the ferry terminal / Centreport	Maintain similar access for people and freight to the ferry terminal / Centreport[2]
Effects	Mana Whenua Values	High level assessment of overall cultural, social and environmental effects
	Social	
	Property access	Property access
	Fit with LGWM programme	Fit with LGWM programme
	Delivery	Delivery

[1] Although Aotea Quay is sufficiently removed from Thorndon Quay to make this particular investment objective irrelevant, amenity will be a consideration for the detailed design phase of this project, especially given the importance of Aotea Quay as a gateway corridor into Wellington.
[2] Maintaining a similar level of access will, in reality, necessitate improvements given the changes associated with the Interislander ferry terminal project.

Delivery, maintenance and operations	Operations and maintenance	Operations and maintenance
	Timeframe for delivery	Timeframe for delivery

It is important to acknowledge that LGWM has a number of programme objectives (pertaining to carbon emissions, mode shift, urban amenity and accessibility). These have been assessed under the “Fit with LGWM programme” effects criterion. In summary, the key over-riding objective for the improvements to the Aotea Quay corridor is to provide access to the ferry terminal and Hutt Road properties by facilitating U-turn movements and mitigating the effects of traffic growth. This has been the key influence in the development of options.

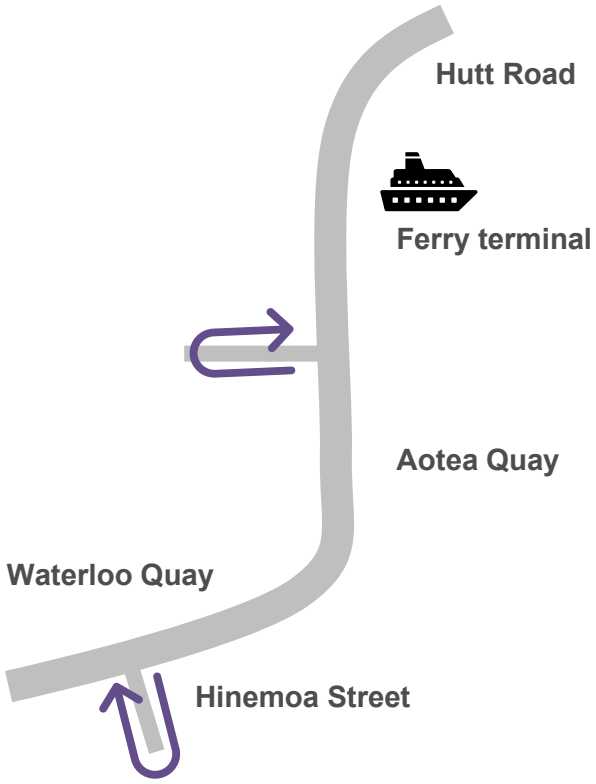
4 Option Development

The approach to the option development has been undertaken at two levels – first to consider functional connection options and then consider the specific form of improvements at different locations (the Ferry Terminal access and the CT Yard intersection).

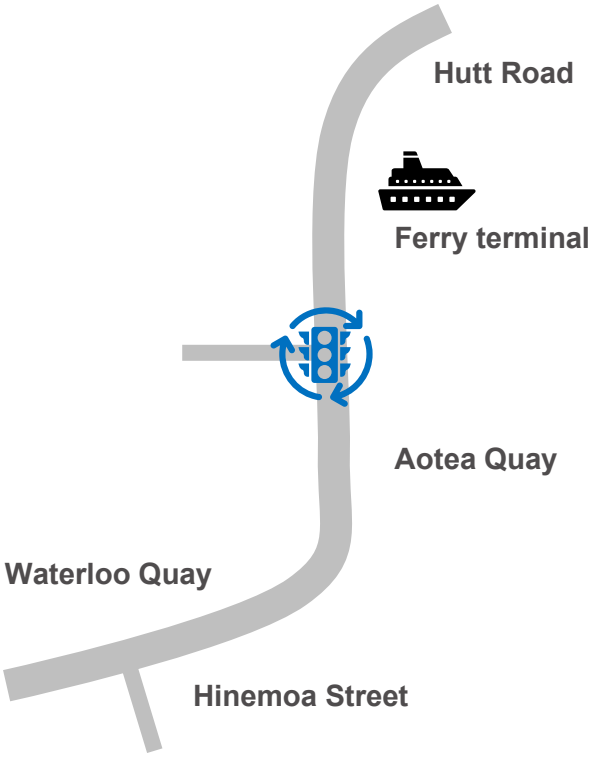
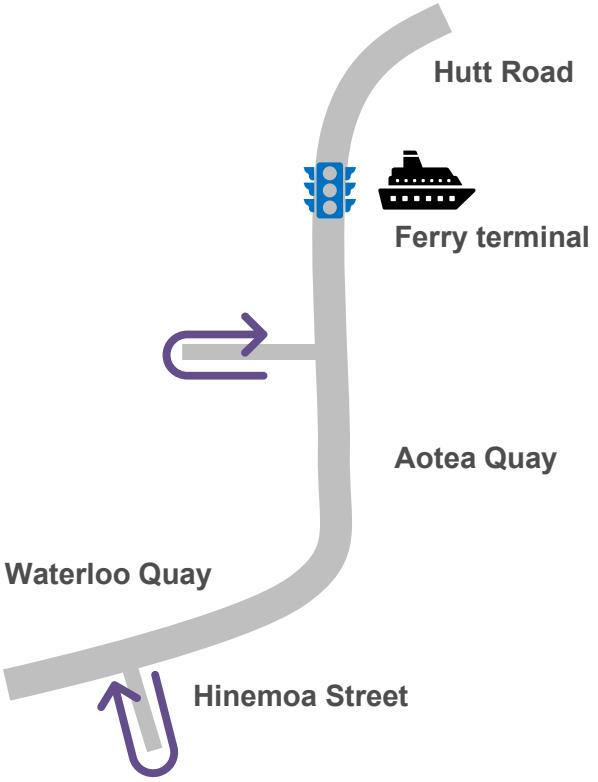
4.1 Functional connection options

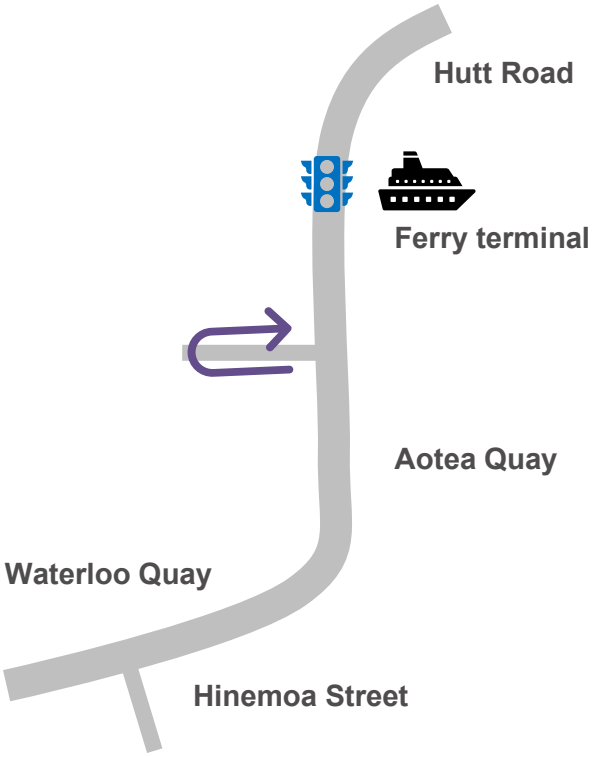
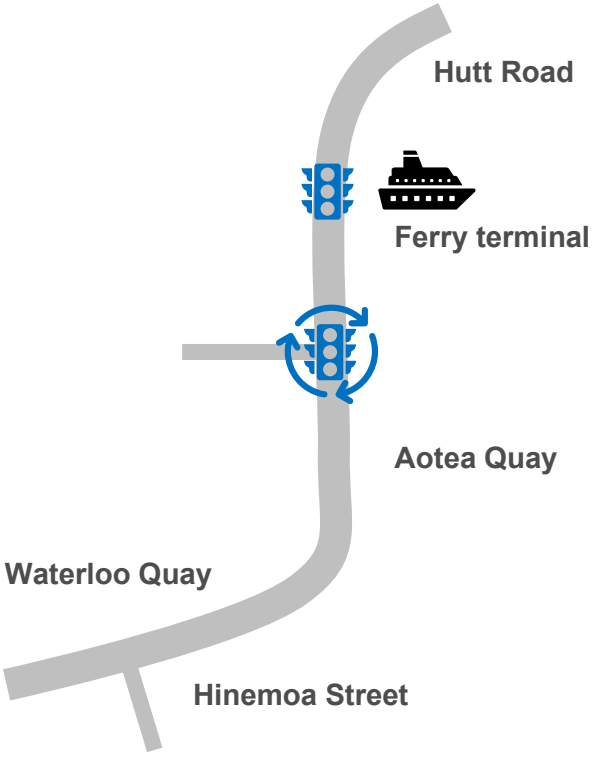
The functional connection options presented in Table 2 below have been developed by drawing on previous work undertaken by the LGWM TQHR and Kiwirail project teams[3].

Table 2: Functional connection options

Option	Layout
Option 1 - Do minimum • Current access arrangements and connectivity • Provides for limited informal U-turns from Hutt Road and associated with the ferry terminal at existing intersections – Hinemoa Street and CT yard	

[3] It should be noted that some larger scale options have been tabled as part of the longer term Multi User Ferry Precinct project (including significant grade separation options). Previous work undertaken for Kiwirail/LGWM has demonstrated that these options are only justified when a second ferry operator co-locates in Kaiwharawhara and have therefore not be considered further as part of this workstream.

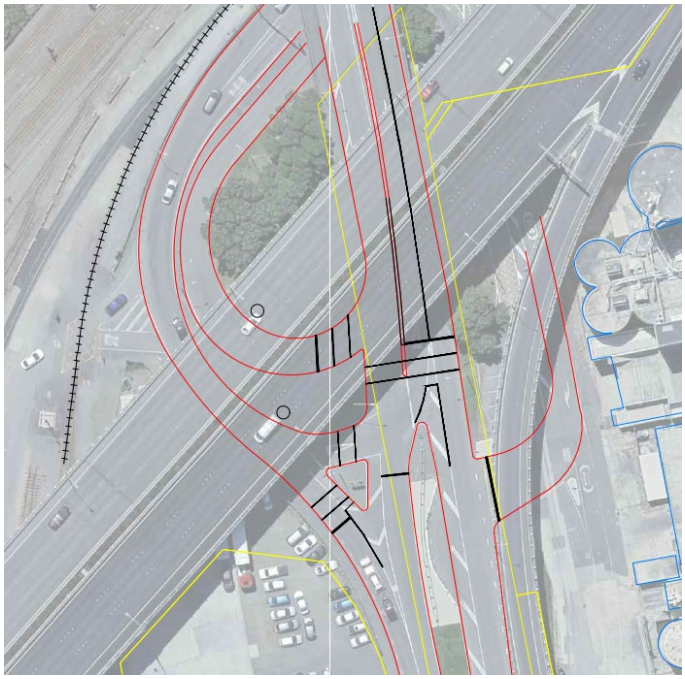
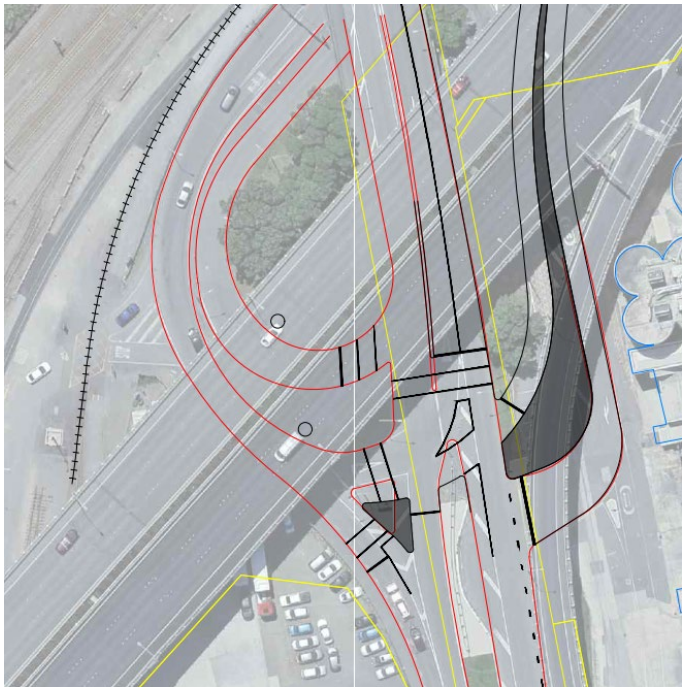
Option	Layout
Option 2 - Metered roundabout on Aotea Quay • As recommended by the LGWM TQ/HR project team • Provides for U-turns from Hutt Road • Removes ferry terminal trips from Hutt Road • Metering is required on northern approach to maintain the resource consent conditions of the adjacent stadium (the ability to stop traffic is required during emergency egress events) • Metering also provides improved control of the roundabout if U-turning movements block traffic leaving the CBD	
Option 3 - Signalised intersection at ferry terminal access (U-turns able to be undertaken at existing Hinemoa Street intersection) • As recommended by the Kiwirail ferry terminal project • Provides for limited informal U-turns from Hutt Road and associated with the ferry terminal at existing intersections – Hinemoa Street and CT yard • Improves access to / from Ferry Terminal • Removes northbound ferry terminal trips from Hutt Road (southbound traffic has to continue to use Hutt Road)	

Option	Layout
Option 4 - Signalised intersection at ferry terminal access + enhanced turn-around facility at CT yard • Formalises the turnback facility and provides for U-turns from Hutt Road and associated with the ferry terminal • Improves access to / from Ferry Terminal • Removes northbound ferry terminal trips from Hutt Road	
Option 5 - Signalised intersection at ferry terminal access + Metered roundabout on Aotea Quay • Provides for U-turns from Hutt Road • Improves access to / from Ferry Terminal • Removes ferry terminal trips from Hutt Road	

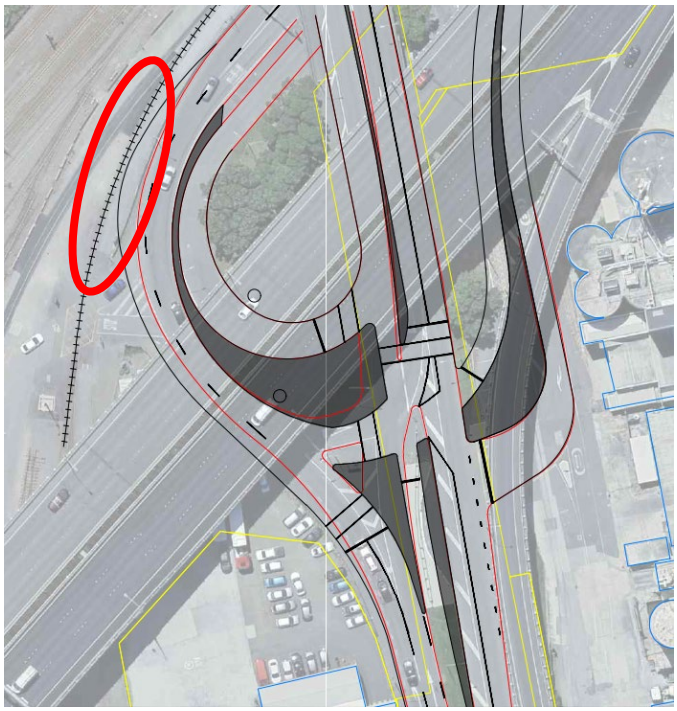
4.2 Ferry Terminal access intersection

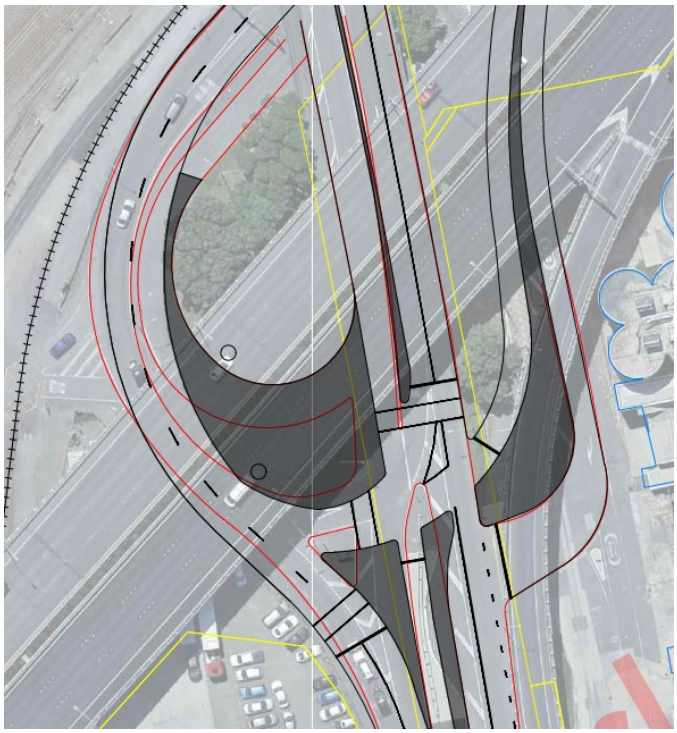
The functional connection options identify improvements at two intersections on Aotea Quay. Table 3 below describes the proposed options for the ferry terminal intersection (currently operating as a priority intersection). Following completion of this document, a fifth option was assessed that implemented a metering system at the exit gates from the ferry terminal.

Table 3: Ferry terminal – improvement options

Option	Layout
Option 1 - Fully signalised with no additional lanes • All movements retained • Pedestrian connectivity provided • No impacts on property / KiwiRail operations	
Option 2 - Fully signalised with connection to SH1 northbound • All movements retained + direct access from Ferry terminal to SH1 northbound provided • Pedestrian connectivity provided • Impacts on KiwiRail property / operations: ○ Additional approach lane on east approach utilises shunting line into ferry terminal	

Option	Layout

Option 3 - Fully signalised with additional lanes on east and west approaches
• All movements retained + direct access from Ferry terminal to SH1 northbound provided
• Pedestrian connectivity provided
• Impacts on KiwiRail property / operations:
  ○ Additional exit lane on west approach extends into KiwiRail land and potentially impacts shunting line
  ○ Additional approach lane on east approach utilises shunting line into ferry terminal
	

Option 4 - Fully signalised with additional lanes on east and west approaches – access from terminal to Hutt Road removed • Direct access from ferry terminal to Hutt Road northbound removed but direct access from ferry terminal to SH1 northbound provided • Pedestrian connectivity provided • Impacts on KiwiRail property / operations: ○ Additional approach lane on east approach utilises shunting line into ferry terminal	

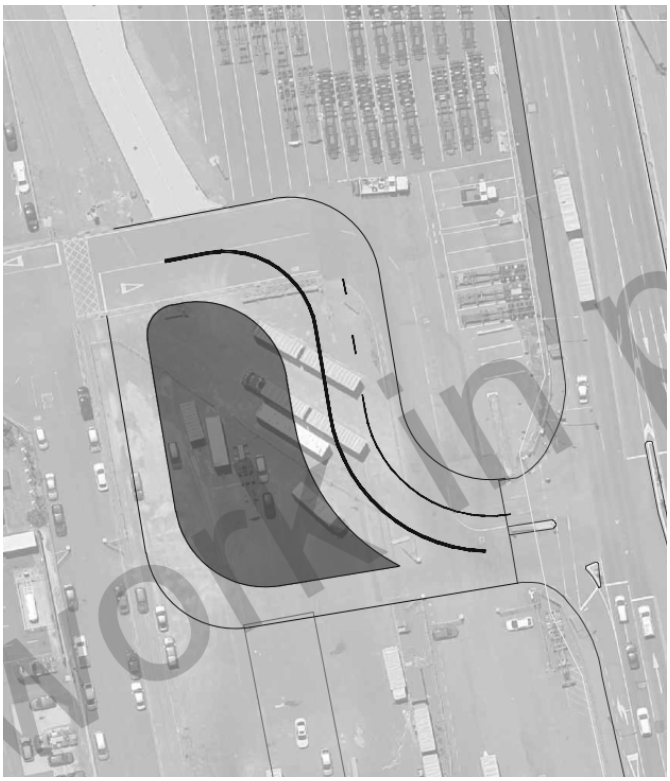
4.3 CT Yard intersection

The second intersection featuring improvement options is at the CT yard access point. This is currently a signalised intersection. Table 4 below describes the proposed options for the CT yard intersection.

Table 4: CT yard intersection – improvement options

Option	Layout
Roundabout option 1 - Large roundabout at existing CT yard intersection • 24m diameter island • Located at existing intersection • Reconfiguration of internal access roads required • North approach metered	
Roundabout option 2 - Large roundabout north of existing CT yard intersection • 24m diameter island • Optional offset on east side to improve deflection • Aligns with existing internal road • Large impact on trailer storage area • North approach metered	

Option	Layout
Roundabout option 3 - Small roundabout north of existing CT yard intersection • 16m diameter island, wider lanes • Aligns with existing internal road • Impact on trailer storage area • North approach metered	
Roundabout option 4 - Small roundabout north of existing CT yard intersection • 16m diameter island, wider lanes • Aligns with existing internal road • Impact on trailer storage area • North approach metered	

Option	Layout
Turnback Option • Aligns with existing internal road • Stacking room for approximately nine semi-trailer units	

5 Approach to Evaluation

The evaluation of options has been undertaken based on a simplified multi criteria analysis (MCA) approach using the investment objectives and criteria outlined in Table 1 above. Project team members have undertaken a scoring exercise in collaboration with LGWM team members and representatives from Kiwirail and Centreport using the scoring regimes set out in Table 5 and Table 6. Scores were then moderated in a workshop context.

Table 5 - Objectives and Design, Delivery and Operation Scoring Guide

Score	Scoring Description
5	Substantial benefits and a high degree of confidence of benefits being realised and/or long term / permanent benefits
4	High extent of benefits and confidence of benefit being realised and/or medium - long term benefits
3	Good benefits and/or medium term
2	Low or localised benefits and/or short term
1	Very low benefits and/or very short term
0	No change in benefits, impacts or difficulties from current situation
-1	Few difficulties, very low cost or low impact on some resources/values and/or very short term
-2	Minor difficulties, low cost or minor impacts on resources/values and/or short term
-3	Some difficulties, moderate cost or some impact on resources/values and/or medium term
-4	Clear difficulties, high cost or high impact on resources/values and/or medium - long term
-5	Substantial difficulties, very high cost or substantial impact on resources/values and/or long term / permanent

Table 6 - Effects Scoring Guide

Score	Scoring Description
5	Significantly positive
4	Moderate to significant positive
3	Moderately positive
2	Minor to moderately positive
1	Minor positive
0	Neutral or benign
-1	Minor negative
-2	Minor to moderately negative
-3	Moderately negative
-4	Moderately to significant adverse
-5	Significantly adverse

The following sub-sections describe the evaluation methodology adopted to derive the scores.

5.1 Traffic Modelling

A number of the evaluation metrics have drawn on output from traffic modelling. This section describes the modelling approach taken. A more detailed modelling report has been developed by the GWRC modelling team and is appended to this document (Appendix A).

5.1.1 Modelling approach

Modelling has been undertaken in partnership with the Wellington Transport Analytics Unit (Greater Wellington Regional Council). The modelling has used a relevant part (or subarea) of the Let's Get Wellington Moving N2A (Ngauranga to Airport) Aimsun model. The model is a wide area micro-simulation model, which allows for detailed consideration of vehicle dynamics and interactions, and impacts of queuing and congestion.

5.1.2 Modelled Transport Network

As agreed with KiwiRail and the LGWM project team, the modelling has assumed that the emerging preferred Thorndon Quay, Hutt Road (TQHR) improvements as well as the upgraded ferry terminal are delivered as a baseline for the options analysis. The existing layout (and traffic demand) has also been assessed for comparison purposes.

The TQHR improvements include peak direction Bus and HCV lanes between Jarden Mile and the Aotea Quay Ramps and peak direction bus only lanes on Thorndon Quay.

5.1.3 Modelled Years

Modelling has been undertaken for a base year of 2016 and a future year of 2026. This is consistent with the approach undertaken for other elements of the LGWM project - it accommodates a realistic level of future growth based on growth forecasts agreed between Greater Wellington Regional Council and all of the TLAs in the Wellington Region. Although modelling scenarios have been developed for later future years (2036 and 2046), the level of peak demand in the vicinity of the Aotea Quay corridor will remain relatively constant over time due to upstream and downstream network constraints (and assuming that Kiwirail vessel capacity remains unchanged beyond 2026).

5.1.4 Subarea of the N2A Transport Model

The modelling undertaken to support the assessment of Aotea Quay corridor options has used a sub area of the wider LGWM model. This extends from just north of the Jarden Mile intersection to south of Waring Taylor Street. This approach has meant that a number of model scenarios have been tested quickly and efficiently and has removed the risk of model "noise[4]" effecting the results of the assessment.

The network is shown in the diagram below (Figure 3). Background traffic has been loaded onto the network from the relevant base year scenario test of the LGWM model and has then been adjusted, where relevant, to match observed traffic count data as closely as possible.

[4] Where model noise refers to unforeseen or unexpected changes in model output in areas unrelated to those being investigated. It is common in models of large and complex networks and can take a while to debug. The subarea approach removes the risk of this.

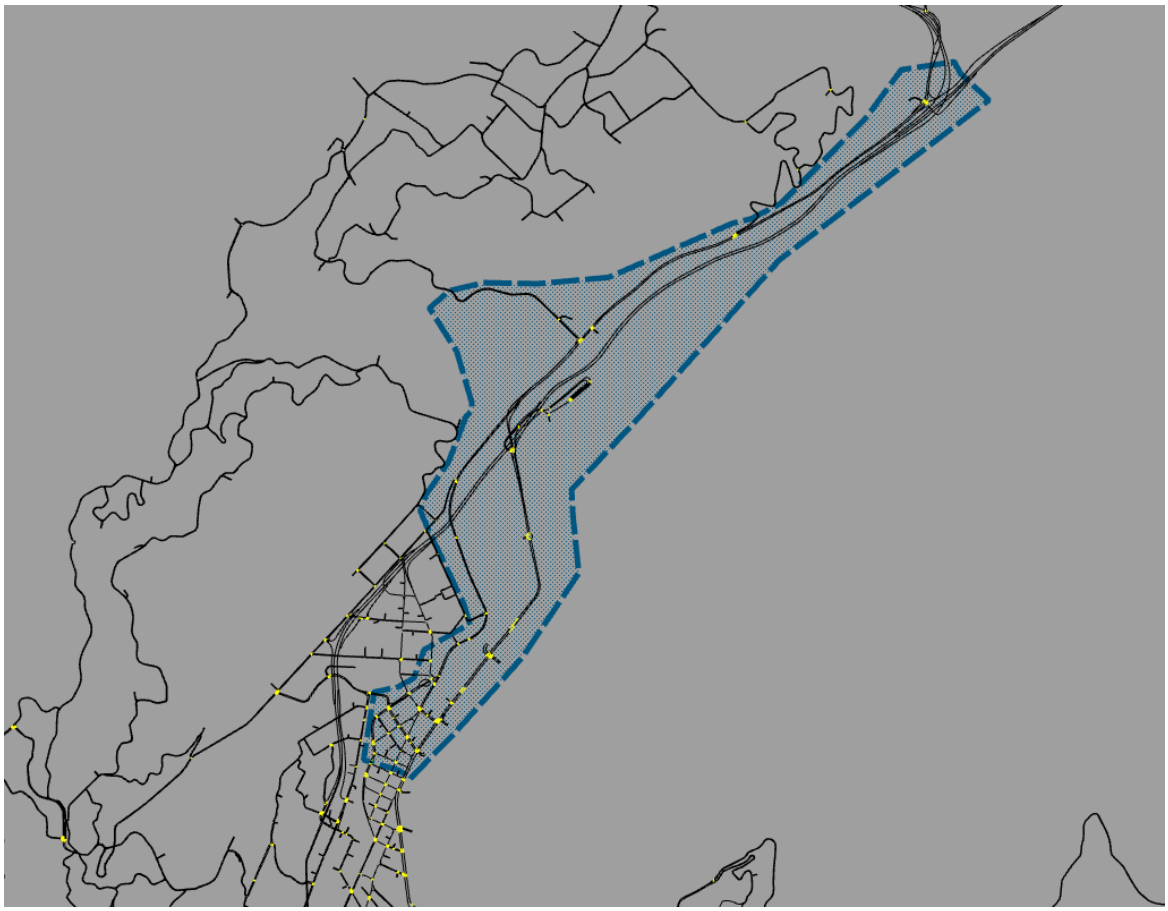


Figure 4 - Subarea of the N2A Transport Model

5.1.5 Ferry activity

As discussed above, activity associated with the Interislander ferry has a significant impact on the corridor. The current Interislander ferry timetable includes an arrival at 17:45 and a departure at 20:00. The future Interislander ferry timetable assumes an arrival at 17:30 and a departure at 18:30. Achieving this future 1 hour turnaround is critical for the scheduling of ferry service, however it does mean that both arriving and departing activities coincide with the PM peak on the road network.

Traffic demand associated with the ferry has been supplied by Kiwirail and is shown in the table (Table 7) below. There is significant day to day and seasonal variability associated with the demand for the ferries. The demand used is reflective of high (96th percentile) summer conditions so is likely to demonstrate worst case network performance. This is consistent with analysis undertaken for Kiwirail where it was determined that this is a realistic scenario that could occur alongside a busy weekday commuter peak. While this loading scenario is reflective of a 96th percentile day in 2026, with growth in ferry demand it is considered likely that these loadings will occur more frequently over time[5].

[5] It is worth noting that higher ferry demands are projected to occur during opening year, however these will coincide with holiday periods where demand on the network is lower and therefore they haven't been assessed as part of this analysis.

Table 7 - Ferry demand

Mode	Base	Future
PUDO	126 each direction	163 each direction
Cars	234	412
HCV	16	28

In order to understand the rate at which people arrive to check in for the Interislander ferry services, an observational survey was undertaken on behalf of Kiwirail for a busy morning Interislander ferry departing Wellington during the October (2021) school holiday period. The observed profile is shown in the graph below (Figure 4) and indicates that around 80% of arriving demand arrives in three 15-minute time slices around the recommended 60-minute check in time.

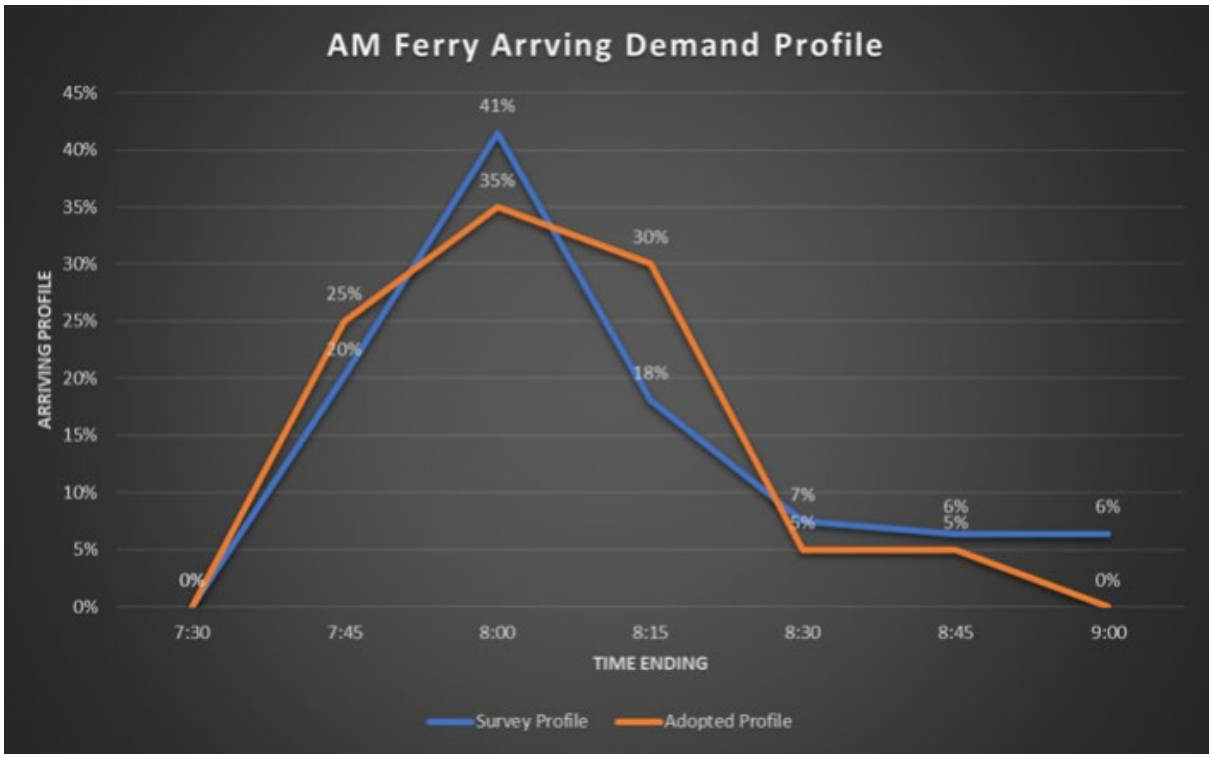


Figure 5 - Observed arrival profiles for the ferry

To ensure vehicles arrive in time for the ferry departure, these times have been shifted forward 15 minutes to account for transit time through the model network. The model releases vehicles onto the network in 15 minutes increments, this time shift enables vehicles to travel through the network and check in according to the observed profile.

Exiting ferry traffic is assumed to release within 15 minutes of the ferry arriving (i.e. in the same model time slice), queuing outside the network as needed (in other words, queuing on the ferry). 40% of the exiting Pick Up Drop Off (PUDO) traffic is assumed to be released onto the network in the ferry arrival time slice and 60% in the time slice after. This is to account for luggage collection, hailing taxis and rental arrangements.

The same profiles have been adopted for current and future ferry fleets.

The following diagram (Figure 5) shows how these profile assumptions have been applied in the traffic model:

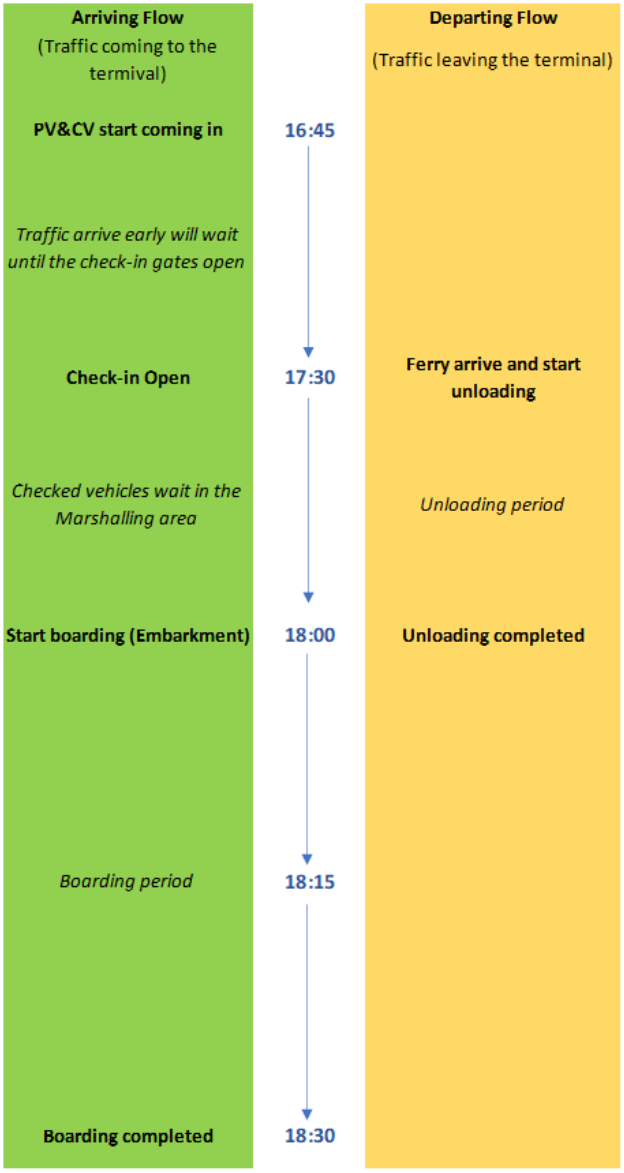


Figure 6 - Ferry trafic profiles as modelled

5.1.6 Ferry Terminal Layout and Assumptions

To model the operation of boarding and alighting movements in the Interislander ferry terminal, several assumptions have been used in the model as below:

- Check-in delays: the average delay of 30 (±15) seconds per passenger vehicle and 60 (±20) seconds per commercial vehicle.
- PUDO traffic delay: to understand the impact of the PUDO activities to the overall operation of the terminal, particularly the blocking-back effect, the average delay of 15 seconds was applied to each vehicle that access the pick-up or drop-off facilities.

The modelled layout of the current Interislander ferry terminal is shown in Figure 6 below:

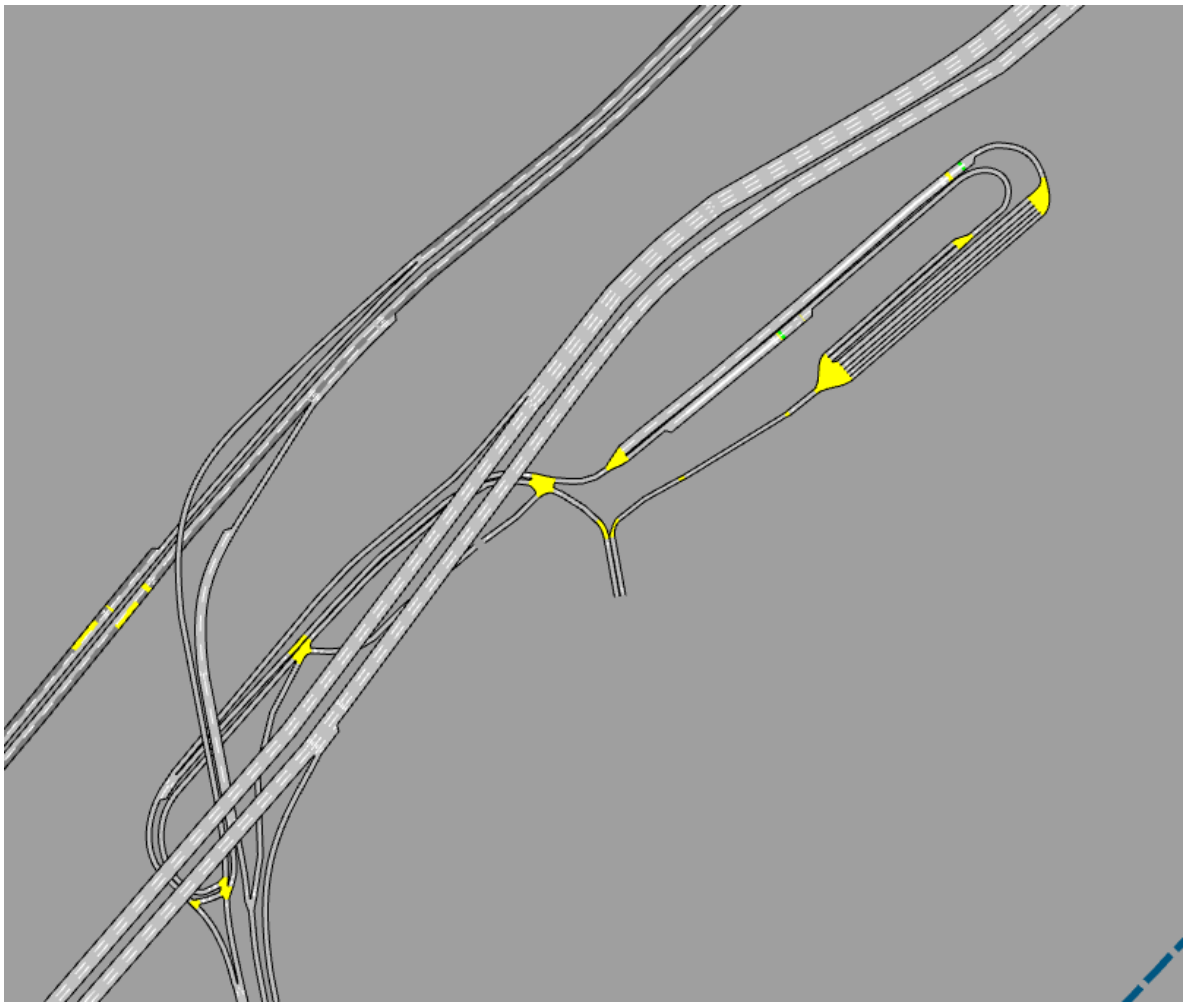


Figure 7 - Modelled layout of the existing ferry terminal

The modelled layout of the future ferry terminal has been developed as a simplified representation of the emerging preferred terminal layout and is shown in Figure 7 below:

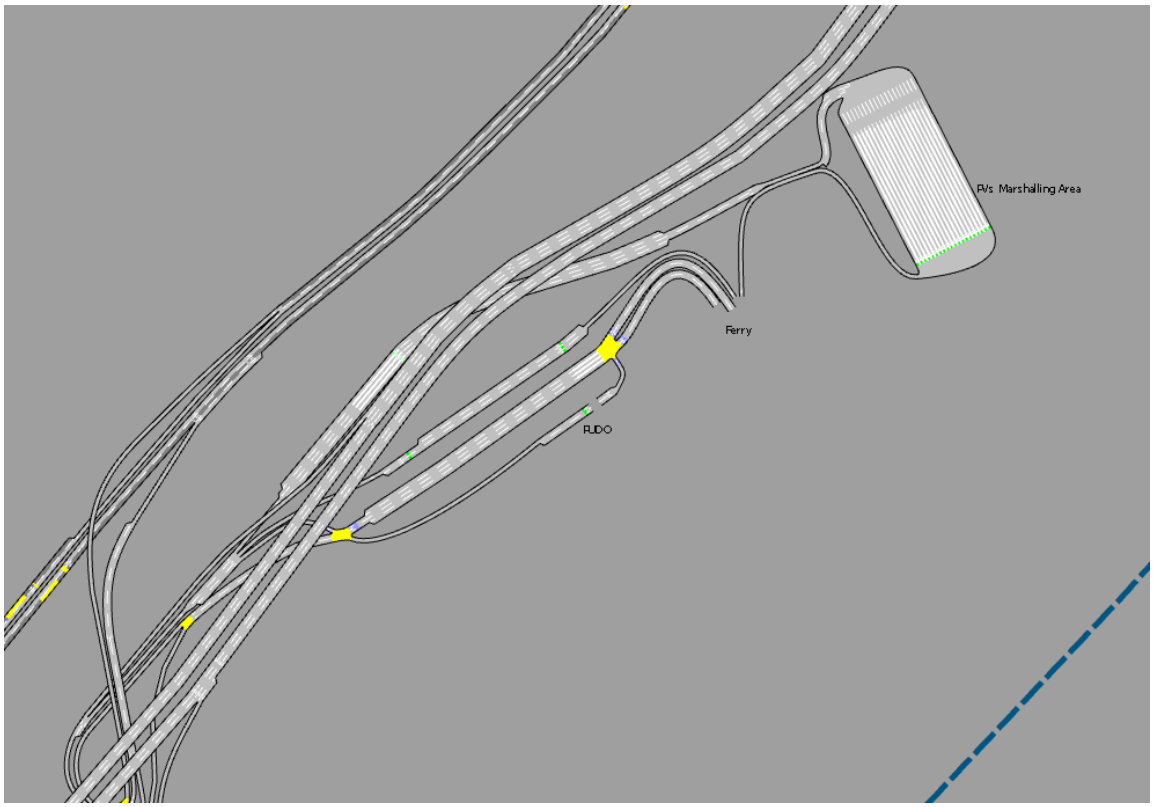


Figure 8 - Modelled layout of future terminal

5.1.7 Aotea Quay corridor options

As discussed above, the Aotea Quay corridor improvement options have been developed and tested with future Interislander ferry demands. The approach to modelling these options is described further as follows.

5.1.7.1 Metered Roundabout

As outlined above, the metering is only applied to the north approach of the roundabout to mitigate Interislander ferry release traffic from affecting the Aotea Quay outbound traffic, particularly in the PM peak. Previous investigations have demonstrated that metering of this roundabout is required to prevent right turning, or U-turning traffic from blocking the movement of commuter traffic out of the CBD. These investigations have also shown that the implementation of the metering needs to be carefully managed to prevent blocking back onto SH1 or into the Interislander ferry terminal. This has been reinvestigated as part of this Project and is discussed further below.

All metered roundabout options discussed in section 4 above are considered sufficiently similar from a modelling perspective. Therefore a single metered roundabout test has been undertaken as shown in Figure 8. Roundabout options have been assessed assuming a 50kph design speed (acknowledging that negotiation speeds through the roundabout will vary and typically be lower than this).

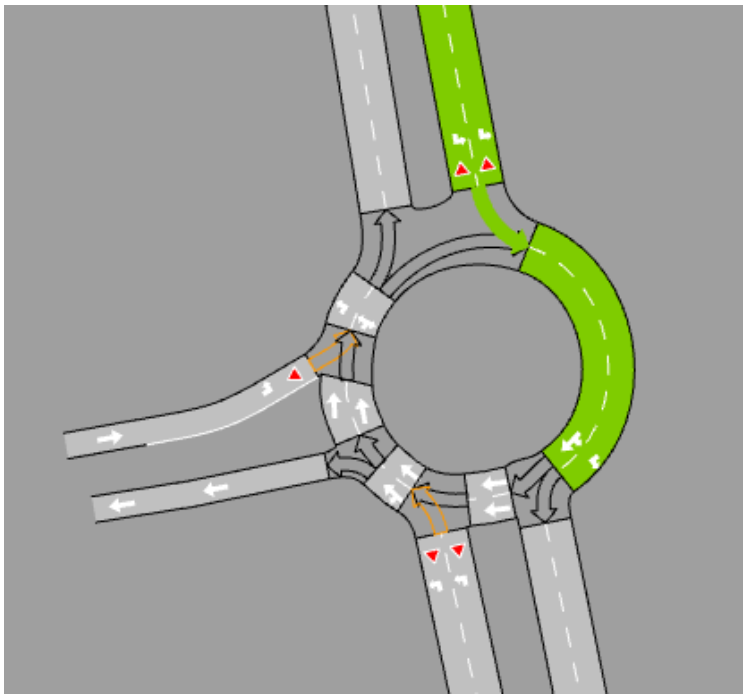


Figure 9 - Aotea Quay/CT yard metered roundabout

5.1.7.2 Ferry Terminal Signalised Intersection

A number of tests have been run that include a signalised intersection at the SH1 ramp/Aotea Ramps/Aotea Quay intersection. The core tests assume all movements are provided as shown in Figure 9 (and corresponds to option 3 described in section 4 above). Further tests of alternative configuration options have also been undertaken to understand the relative performance of the different options.

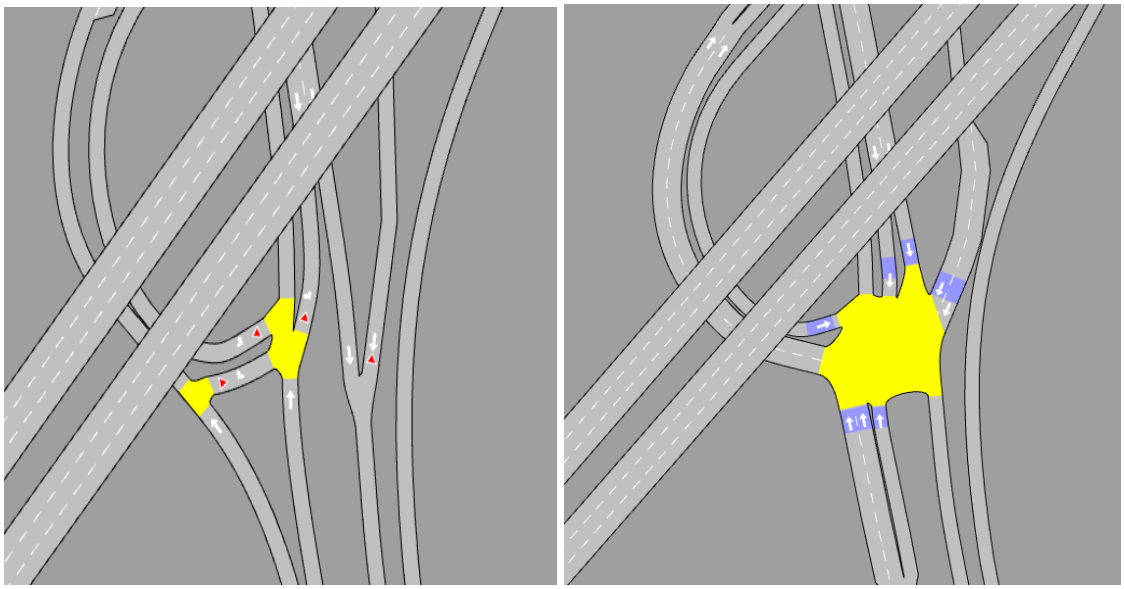


Figure 10 - Aotea Quay ferry terminal intersection (existing left and signalised option 3 right)

5.1.7.3 Alternative Turnaround Option

An alternative turnaround option has been tested that retains the existing signals but allows U-turning traffic to access the northbound carriageway of Aotea Quay by way of a dedicated slip lane as shown in Figure 10).

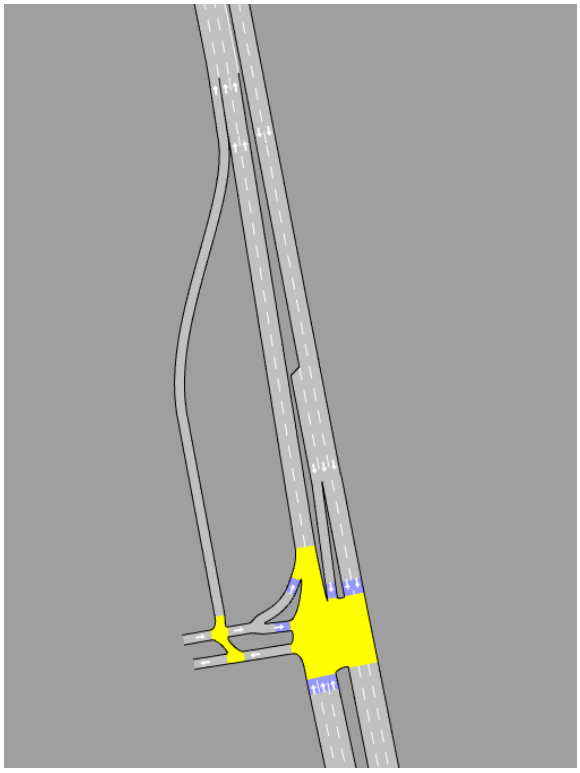


Figure 11 - Aotea Quay/CT yard turnback facility option

5.2 Evaluation methodology

5.2.1 IO1 – Bus level of service

The influence on Hutt Road has been determined through a quantitative assessment of travel times coupled with a more qualitative connectivity assessment. The quantitative analysis has been undertaken using the LGWM Aimsun traffic model (as described above) – travel times along Hutt Road have been extracted from the model to understand the extent to which the changes on Aotea Quay create (or reduce) congestion along Hutt Road. Hutt Road travel times have been used as a proxy for the impact on the PT corridor on the assumption that traffic congestion on Hutt Road would likely delay the movement of buses along the corridor. It is acknowledged that the Thorndon Quay/Hutt Road scheme will provide peak hour bus lanes, however high levels of traffic congestion may delay access to these bus lanes, particularly in the vicinity of the Aotea Quay/Hutt Road merge point.

In addition to this, a qualitative assessment has been undertaken to consider whether the options facilitate the removal of ferry related traffic from Hutt Road. The investment objective has been scored using an “on balance” assessment with input from key specialists from LGWM and project partner stakeholders.

5.2.2 IO2 - Active travel level of service and safety

Aotea Quay is not particularly well suited or well used by pedestrians and cyclists. One of the intentions of the LGWM TQHR programme is to enhance the provision for active travel along Hutt Road and Thorndon Quay (rather than Aotea Quay). Furthermore, pedestrian/cycling access to the ferry terminal is provided via a connection to Hutt Road, using the existing footpath on the overbridge. Notwithstanding this, where possible options should seek to enhance level of service and safety for the active modes.

This investment objective has been scored using an "on balance" assessment with input from key specialists from LGWM and project partner stakeholders.

5.2.3 IO3 - Reduce the frequency and severity of crashes on Aotea Quay

Analysis of crash risk and severity has been undertaken based on a qualitative assessment of improvements options drawing on the existing crash data. The investment objective has been scored in a workshop setting using input from key stakeholders and specialists.

5.2.4 IO4 - Maintain similar access for people and freight to the ferry terminal/centreport

The Interislander ferry terminal and Centreport are important destinations of national strategic significance in the Wellington transport network and both are accessed currently via Aotea Quay. The relative performance of the options has been assessed through a quantitative assessment of travel times from the traffic model and a qualitative assessment of connectivity.

The quantitative assessment considered the localised performance of the network in the immediate vicinity of the Aotea Quay corridor as well as slightly longer distance trips between the Ngauranga interchange and the ferry terminal (these two journeys, when combined, provide an indication as to the performance of trips to/from Centreport).

5.2.5 Environmental and social effects

The assessment of the social and environmental effects of the options was a high level qualitative evaluation of potential impacts, positive and negative, that took into account whether the option would have any material change on environmental characteristics or on those conditions that enable or affect people's social wellbeing. Such effects, in the context of Aotea Quay, include:

- Whether there are any effects on any significant environmental features or conditions in the vicinity
- Whether there may be any adverse environmental effects arising from the construction and use of transport improvements, and
- Whether the changes would contribute positively or negatively to improve the ability of people and communities to meet their social and economic wellbeing.

The entirety of Aotea Quay and the land either side of the road was formed by a large-scale reclamation that occurred between 1924-34, which also created the Thorndon Railyards and the Aotea Quay wharves. The land is all zoned under the operative District Plan as Central Area – Pipitea Precinct, which provides for the various transport and freight activities in the area, including the port. No special or highly valued features are identified.

At the northern end of Aotea Quay, around the entrance to the ferry terminal, the District Plan identifies the Wellington Faultline has a major natural hazard.

The State Highway 1 Wellington Urban Motorway is designated (by Waka Kotahi NZTA), while the local roads, including Aotea Quay, are not designated.

The land west of Aotea Quay is owned by KiwiRail is primarily designated for Rail purposes, including land leased out for freight activities. The premises used by NZ Couriers is not designated. The land to the east of Aotea Quay is owned and used by CentrePort as part of the principal port for Wellington. The Kaiwharawhara Ferry Terminal is at the northern end of Aotea Quay, with its main vehicle entrance part of the on and off-ramps to the Wellington Urban Motorway overbridge. The rail line into Aotea Quay crosses over the exit lanes from the ferry terminal onto Aotea Quay.

There is a likelihood that reclaimed land contained contaminated material.

5.2.6 Property and access

The high-level qualitative assessment of the potential positive or negative effects of the options on property focused on the immediate impacts on the adjoining properties that have direct access onto or from Aotea Quay, although potential impacts on the use of and access to other properties outside the immediate vicinity was also considered: for example, whether congestion could be detrimental to accessing other properties such as those off Waterloo Quay.

This assessment also took account of the potential effects of the options on the use of adjoining property, such as the loss of land required for transport improvements or the impact on the internal access and site arrangements that might be required from changes to access. It also considered the longer-term impacts of the loss of any property that would otherwise be available for future redevelopment.

5.2.7 Fit with Let's Get Wellington Moving programme

The "fit with LGWM programme" criterion has been scored on a qualitative basis depending on the extent to which the options facilitate the Thorndon Quay/Hutt Road project. It is acknowledged that LGWM has a range of broader objectives and a strong focus on mode shift and decarbonisation. Improvements to the Aotea Quay corridor will contribute to this by taking traffic off Hutt Road and allowing reprioritisation towards public transport and active modes.

5.2.8 Delivery, Operations and Maintenance

Table 8 below describes the approach to evaluating the delivery, operations and maintenance criteria.

Table 8: Approach to evaluating the delivery, operations and maintenance criteria

Criteria	Approach to evaluation
Delivery	Qualitative assessment focussed on the constructability of the options, in particular the disruption to the travelling public and commercial operators whilst the projects are being constructed.
Operations and maintenance	Qualitative assessment focussed on the change in operations and maintenance costs associated with the new infrastructure. This criteria has not considered the operational impacts on commercial operators etc from the changes in routes.
Timeframe for delivery	Has not been assessed as all options are assumed to be able to be delivered within the timeframe required by the programme.

6 Option Assessment

6.1 Functional Connection Options

This section outlines the performance of the functional connection options against the evaluation criteria.

6.1.1 IO1 – Bus level of service

Modelled future year (with anticipated future ferry operations) travel times along Hutt Road for the PM peak period for each option are summarised in Table 9.

Table 9 - IO1 Modelled Future Year Travel Times (seconds) for functional connection options

Journey	Option 1	Option 2	Option 3 / 4	Option 5
Hutt Road Southbound (Onslow Road to Sar St)	>500	492.1	393.4	185.2
Hutt Road Southbound (Hutt Road ramp to Ferry Terminal Access)	187.9	317.8	168.7	24.4
Hutt Road Northbound (Ferry Terminal Access to Hutt Road ramp)	55.2	30.8	69.2	36.0

As shown, Option 5 results in the shortest relative travel times along Hutt Road during this peak period in the future year, with a modelled time of around three minutes from Onslow Road to Sar Street (peak direction) – equivalent to existing travel times along this corridor.

The results of the evaluation for IO1 are shown in Table 10. This table demonstrates that the only option that doesn't result in queuing leading to a significant degradation of public transport network performance is option 5. Implementing a roundabout in isolation facilitates the removal of traffic, but creates congestion that blocks back to Hutt Road. Implementing a signalised intersection in isolation improves network control, but not enough to prevent queuing extending onto Hutt Road. Combining the two mitigates the negative aspects of each and achieves similar levels of network performance to those experienced currently.

Table 10 - IO1 assessment for functional connection options

Criteria	Option	Score	Comments
Changes on Aotea Quay do not reduce the ability to deliver IO1 for TQHR	1 – do minimum	-3	Increased traffic volumes results in increased congestion leading to higher travel times on Hutt Road, creating delays for public transport vehicles.
	2 – metered roundabout	-3	The implementation of a roundabout in isolation does little to improve conditions on Hutt Road. Although ferry traffic is removed from Hutt Road, the congestion caused by the roundabout blocks back

		onto the corridor creating delays for public transport vehicles.
3 – ferry signals	-3	Although the signals at the ferry terminal provide some control of vehicles leaving the terminal, queuing to access the terminal is forecast to block back onto Hutt Road and create delays for public transport vehicles.
4 – ferry signals + CT yard turnaround	-2	The implementation of an enhanced turnaround facility does alleviate some of the congestion seen in option 3, however it has insufficient capacity to completely remove it.
5 – metered roundabout + ferry signals	+3	The combination of a signalised intersection and a metered roundabout removes most of the ferry related traffic from Hutt Road and delivers a similar level of network performance to the current network (despite the increase in demand).

6.1.2 IO2 - Active travel level of service and safety

The scores given to the four functional connection improvement options in terms of their potential for improved LOS and reduced safety risk for people walking and cycling along and across Aotea Quay, and the reasoning for those scores, are provided in Table 11 below. Overall, the options that provide improved signalised pedestrian crossings scored well. Options that provide a roundabout scored slightly less well – pedestrians will have to walk further to cross the western arm of the roundabout and safety for cyclists is less good on multi lane roundabouts.

Table 11 - IO2 assessment for functional connection options

Criteria	Option	Score	Comments
Improved LOS and reduced safety risk for people walking and cycling along and across Aotea Quay	1 – do minimum	-1	Slight reduction in safety and LOS due to increased traffic
	2 – metered roundabout	-3	Roundabout delivers poor outcomes for active travel. Fully signalised roundabout could be significantly better for pedestrians however it is still not considered to be ideal for cyclists
	3 – ferry signals	2	Signals improves safety and LOS for peds and cyclists. Slightly offset by a potentially

		increased traffic towards the southern end of Waterloo quay and Hinemoa Street
4 – ferry signals + CT yard turnaround	3	Signals improves safety and LOS for peds and cyclists. Turnaround facility reduces traffic towards the southern end of Waterloo quay and Hinemoa Street
5 – metered roundabout + ferry signals	1	Signals improve safety and LOS for active travel, but roundabout offsets this

6.1.3 IO3 - Reduce the frequency and severity of crashes on Aotea Quay

Aotea Quay is a key corridor accessing the Wellington CBD and carries around 32,000 vehicles per day (vpd), 9% of which are heavy commercial vehicles. While the route is a primary access to the city, it also services the port and the interisland ferry terminal as well as numerous freight yards.

From the end of the motorway ramps to immediately south of Seven Lane there have been some 36 crashes in the five-year period 2016 to 2020 inclusive. Of these, 12 resulted in minor injuries and 2 serious injuries. Without going into the crashes in detail, Figure 11 below suggest the dominant crash types are rear end crashes, U Turn crashes, lane changing crashes and loss of control crashes.

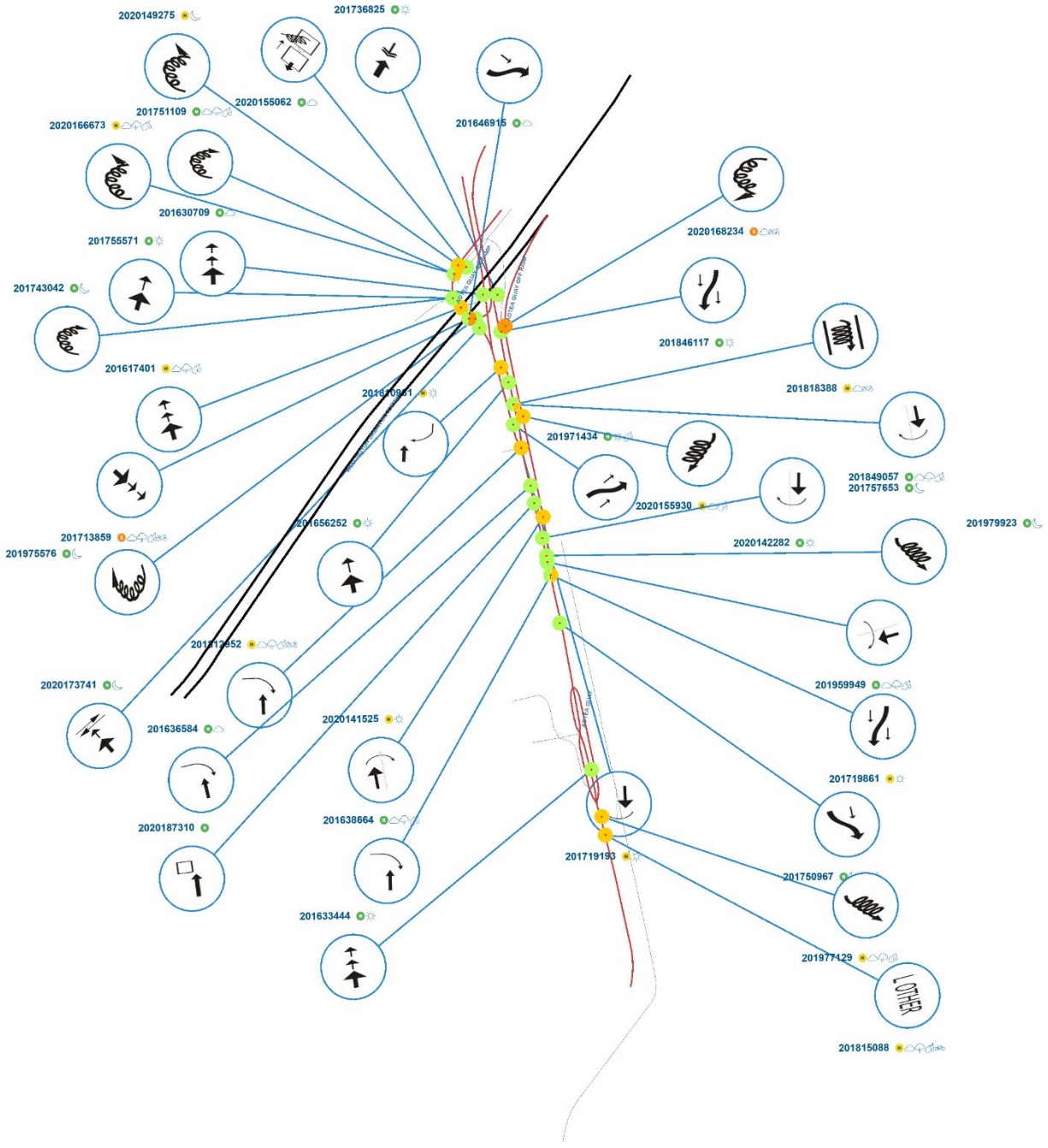


Figure 12 Reported Crashes 2016 to 2020 inclusive

The Waka Kotahi MegaMAPs system divides the route into two with the northern section, which includes access to the Ferry Terminal and Motorway as being Medium Personal and Medium Collective risk while the southern is described as Medium-Low Personal Risk and Medium Collective Risk.

As noted elsewhere, traffic seeking to access the Ferry Terminal must currently use the Old Hutt Road. The volume and composition of this traffic is unlikely to support the objectives of Let's Get Welly Moving and the intention is to encourage this traffic to remain on the motorway, exit onto Aotea Quay and turn back to the Ferry Terminal using an appropriate turning facility. The second issue is ensuring traffic exiting the Ferry Terminal can access the motorway to travel via SH 1 and 2.

These objectives raise three questions related to the most appropriate:

- form of turning facility
- access to the Ferry Terminal
- location and size of the turning facility

When looking at the form of the turning facilities the key safety issue is associated with capacity and the possibility of southbound traffic on Aotea Quay backing up the Aotea Off Ramp onto the motorway (this is indicated in the traffic modelling). It is understood that in order to ensure this does not happen in the peak periods, a signal metered roundabout on Aotea Quay is the preferred option paired with signalisation of the Ferry Terminal access. It is interesting to note that there are a number of U Turn crashes on Aotea Quay as seen in the previous figure.

The scores given to the four functional connection improvement options in terms of their potential to reduce the frequency and severity of crashes on Aotea Quay, and the reasoning for those scores, are provided in Table 12 below.

Safety will be a key consideration as the design progresses for the corridor. As part of a separate workstream, the speed limits along Aotea Quay are being reviewed.

Table 12 - IO3 assessment for functional connection options

Criteria	Option	Score	Comments
Reduce the frequency and severity of crashed on Aotea Quay	1 – do minimum	-1	Increased traffic results in increased exposure/risk of accidents
	2 – metered roundabout	-2	Roundabout alone may result in increased weaving movements and may result in traffic queuing back to the motorway off-ramp
	3 – ferry signals	2	Signals alone improve the safety of the ferry terminal intersection. It is worth noting that visibility on the northern approach to the signals is poor and this will have to be considered further in the development of the design.
	4 – ferry signals + CT yard turnaround	2	Signals plus the turnback facility improve the safety of the ferry terminal intersection
	5 – metered roundabout + ferry signals	1	Signals result in improved safety outcomes, slightly offset by weaving associated with roundabout. The metering created by the signals at the Ferry Terminal creates gaps for weaving manoeuvres by SH1 off-ramp traffic.

6.1.4 IO4 - Maintain similar access for people and freight to the ferry terminal/centreport

Modelled future year (with anticipated future ferry operations) travel times between Ngauranga Gorge and the ferry terminal, and on Aotea Quay, for the PM peak period for each option are summarised in Table 13.

Table 13: IO4 Modelled Future Year Travel Times (s) for functional connection options

Journey	Option 1	Option 2	Option 3 / 4	Option 5
Ngauranga to Ferry Terminal Southbound	>500	306.5	>500	321.3
Ferry Terminal to Ngauranga Northbound	>500	333.9	299.5	317.4
Aotea Quay Southbound (Ferry Terminal Access to roundabout)	198.0	62.9	32.8	44.7
Aotea Quay Southbound (Roundabout to Station)	>500	371.5	205.6	219.6
Aotea Quay Northbound (Stadium to roundabout)	102.6	121.1	106.6	108.4
Aotea Quay Northbound (Roundabout to Ferry Terminal Access)	49.8	87.5	29.8	48.4

As shown, Options 2 and 5 result in shorter relative travel times from Ngauranga to the ferry terminal access (southbound) during this peak period in the future year, with a modelled time of around five to five and a half minutes. Modelled travel times for these two options benefit from the roundabout along Aotea Quay, which allows ferry traffic to use the SH1 corridor instead of Hutt Road to reach the terminal.

When considering the wider route travel time between Ngauranga and the ferry terminal for Options 2 and 5, it can be seen that these modelled times are relatively similar. However, from a corridor level of detail, travel times along Aotea Quay are significantly shorter with Option 5. This reflects the benefit in providing the signalised ferry terminal intersection in conjunction with a metered roundabout on Aotea Quay, as ferry traffic has a more direct connection out of the terminal and onto the SH1 corridor taking pressure off the roundabout.

The assessment against IO4 is presented in Table 14. This shows that, although all of the options deliver a degree of connectivity improvement, only option 5 scores positively due to overall network performance. During peak periods, all other options experience congestion and delay.

Table 14 - IO4 assessment for functional connection options

Criteria	Option	Score	Comments
Maintain similar access for people and freight to the	1 – do minimum	-4	No improvement to access to ferry terminal or Centreport. Reduced network performance due to increased traffic creates delays and congestion

ferry terminal/ centreport	2 – metered roundabout	-2	The roundabout provides improved access to the ferry terminal (similar access to Centreport) – during peak periods, however, the network performs poorly
	3 – ferry signals	-3	Signals introduce improvements for ferry traffic leaving the terminal (due to a direct connection to the SH1 on-ramp), however no improvements for arriving traffic and significant traffic congestion forecast during peak periods
	4 – ferry signals + CT yard turnaround	-3	Signals introduce improvements for ferry traffic leaving the terminal (due to a direct connection to the SH1 on-ramp), however no improvements for arriving traffic and significant traffic congestion forecast during peak periods – turnback has limited capacity and therefore has minimal effect
	5 – metered roundabout + ferry signals	+2	Improved access to and from the ferry terminal. Network interventions deliver good performance resulting in improved access for ferry customers and to Centreport

6.1.5 Environmental and social effects

The scores given to the four functional connection improvement options in terms of their potential social and environmental effects, and the reasoning for those scores, are provided in Table 15 below.

Table 15 - Environmental and Social Assessment Scores and Commentary for Functional Connection Options

Criteria	Option	Score	Comments
Environmental and Social Effects	1 – do minimum	-1	No material effect on social or environmental conditions in short-term, but increasing congestion, including the contribution from new ferries, will increasingly create delays and consequential effects
	2 – metered roundabout	0	Some benefit from improved access to/from ferry terminal, but not sufficiently material for a +1. Roundabout construction likely to disturb contaminated land

3 – ferry signals	0	Minor benefit from improved access to/from ferry terminal: not sufficiently material for a +1.
4 – ferry signals + CT yard turnaround	0	Moderate disruption to travelling public and KiwiRail access during signalisation of the intersection. Improved benefits for ferry traffic. Broader social and environmental effects not substantive enough for +1. Roundabout construction likely to disturb contaminated land
5 – metered roundabout + ferry signals	1	Best benefit of options for improved access to/from ferry terminal. Roundabout construction likely to disturb contaminated land

6.1.6 Property and access

The scores given to the four functional connection improvement options in terms of their implications for property use and access, and the reasoning for those scores, are provided in Table 16 below.

Table 16 - Property and Access Assessment Scores and Commentary for Functional Connection Options

Criteria	Option	Score	Comments
Property and Access Effects	1 – do minimum	-1	Greater interaction with traffic into /out of these busy access points. Small benefit for ferry traffic and subsequent benefits
	2 – metered roundabout	0	No material change to property access, small benefit for ferry traffic. Loss of land in CT yard, depending on type and location of roundabout
	3 – ferry signals	0	Improved access to / from ferry terminal: not sufficiently material for a +1. Greater interaction with traffic into /out of the main Port access.
	4 – ferry signals + CT yard turnaround	0	Improved access to / from ferry terminal: not sufficiently material for a +1. Greater interaction with traffic into /out of the main CT yard access.
	5 – metered roundabout + ferry signals	1	Best improvement for access to / from ferry terminal, and maintaining access to

			CT yard. Loss of land in CT yard, depending on type and location of roundabout.

6.1.7 Fit with LGWM programme

With the exception of the do minimum (which doesn't help with the delivery of the LGWM objectives and results in deteriorating network performance), all options align to an extent with the wider LGWM programme. They all provide improved access to key destinations (port and ferry terminal) and facilitate multi modal access by removing traffic from Hutt Road (to a greater or lesser extent), thereby having an indirect positive effect on carbon emissions. The combination of the signalised intersection and the roundabout performs best against this criterion as it provides for all movements and doesn't result in increased queuing or delay.

Criteria	Option	Score	Comments
Fit with LGWM programme	1 – do minimum	-4	Doesn't facilitate U turns and limits the ability to deliver on LGWM goals due to increased congestion
	2 – metered roundabout	+2	Fits with LGWM's objectives to provide a turnback facility on Aotea Quay. Increased congestion will limit effectiveness
	3 – ferry signals	+1	Partial ability to remove traffic from Hutt Road, however compromised by additional traffic congestion
	4 – ferry signals + CT yard turnaround	+2	Improved turnback will facilitate U-turning traffic
	5 – metered roundabout + ferry signals	+4	All movements provided for. Can operate without significantly increasing delays or congestion relative to now

6.1.8 Delivery, operations and Maintenance

Table 17 below presents the assessment of the delivery, operations and maintenance criteria for the functional connection options. The timeframe for delivery criteria was not assessed and is not presented below.

Table 17: Assessment of the delivery, operations and maintenance criteria for the functional connection options

Criteria	Option	Score	Comments
Delivery	1 – do minimum	-1	Relatively simple to implement, minimal disruption to travelling public or KiwiRail / CentrePort operations
	2 – metered roundabout	-4	Disruption associated with construction of the roundabout for travelling public on Aotea Quay and CT yard access
	3 – ferry signals	-2	Moderate disruption to travelling public and KiwiRail access during signalisation of the intersection
	4 – ferry signals + CT yard turnaround	-2	Moderate disruption to travelling public and KiwiRail access during signalisation of the intersection
	5 – metered roundabout + ferry signals	-4	Disruption associated with construction of the roundabout for travelling public on Aotea Quay and CT yard access + disruption associated with the signalisation of the intersection
Operations and maintenance	1 – do minimum	-1	Increased maintenance required for turn-around areas
	2 – metered roundabout	-3	Significant increased maintenance & operational costs associated with roundabout
	3 – ferry signals	-2	Increased maintenance & operational costs associated with signalised intersection
	4 – ferry signals + CT yard turnaround	-3	Increased maintenance & operational costs associated with signalised intersection and turn around facility
	5 – metered roundabout + ferry signals	-4	Significant increased maintenance & operational costs associated with roundabout + increased maintenance & operational costs associated with signalised intersection

6.1.9 Recommended Option

A summary of the MCA is shown in Table 18.

Table 18 - Functional Connections MCA summary

Criterion	Option 1	Option 2	Option 3	Option 4	Option 5
Bus level of service	-3	-3	-3	-2	+3
Active travel level of service and safety	-1	-3	2	2	1
Reduce the frequency and severity of crashes on Aotea Quay	-1	-2	2	2	1
Maintain similar access for people and freight to the ferry terminal/centreport	-4	-2	-3	-3	2
High level assessment of overall social and environmental effects	-1	0	0	0	1
Property Access	-1	0	0	0	1
Fit with LGWM Programme	-4	2	1	2	4
Constructability	-1	-4	-2	-2	-4
Operations and maintenance	-1	-3	-2	-3	-4

The only option that delivers positive scores against all investment objectives is option 5, the combined signalised intersection and metered roundabout. All other options result in degraded network performance during peak periods. This finding is consistent with the recommendation made in the transport assessment for the Kiwirail ferry terminal project. This option does, however, have the greatest negative scores for delivery, operations and maintenance (as it is the most onerous option). The following sections therefore investigate the intersection form options in greater detail.

6.2 Ferry Terminal Access Intersection

A number of more detailed options have been identified to improve the operation of the ferry terminal access intersection (as outlined in section 4.2). This section describes how each of the options perform against the evaluation criteria. In all cases, the evaluation has assumed that a roundabout is also provided at the CT yard intersection to facilitate turning movements. Although the evaluation has not been revisited to consider the metered option, subsequent modelling has shown that it is able to deliver similar levels of control to intersection option 3[6].

6.2.1 IO1 – Bus level of service

All intersections provide the same level of connectivity and priority into the ferry terminal from Hutt Road. On the assumption that a roundabout is also provided, all options perform well and do not block the movement of public transport vehicles.

Table 19 - IO2 assessment for ferry terminal intersection

Criteria	Option	Score	Comments
Changes on Aotea Quay do not reduce the ability to deliver IO1 for TQHR	1 – existing layout with signals	+3	Assuming the roundabout is delivered, the signals reduce the risk of queuing back onto Hutt Road
	2 – signals with improved east approach	+3	Assuming the roundabout is delivered, the signals reduce the risk of queuing back onto Hutt Road
	3 – signals with improved east and west approaches	+3	Assuming the roundabout is delivered, the signals reduce the risk of queuing back onto Hutt Road
	4 – signals with improved east and west approaches and removal of Hutt Road link	+3	Assuming the roundabout is delivered, the signals reduce the risk of queuing back onto Hutt Road

6.2.2 IO2 - Active travel level of service and safety

The scores given to the four improvement form options in terms of the improved LOS and reduced safety risk for people and cycling along and across Aotea Quay, and the reasoning for those scores, are provided in Table 20 below.

[6] It is worth noting that the metered option results in deteriorating levels of performance within the ferry terminal. This will be an issue for Kiwirail's operations, but won't result in reduced network performance.

Table 20 - IO2 assessment for ferry terminal intersection

Criteria	Option	Score	Comments
Improved LOS and reduced safety risk for people walking and cycling along and across Aotea Quay	1 – existing layout with signals	4	Improvements for active travel users at the intersection through the use of controlled crossings.
	2 – signals with improved east approach	4	Improvements for active travel users at the intersection through the use of controlled crossings.
	3 – signals with improved east and west approaches	4	Improvements for active travel users at the intersection through the use of controlled crossings.
	4 – signals with improved east and west approaches and removal of Hutt Road link	4	Improvements for active travel users at the intersection through the use of controlled crossings.

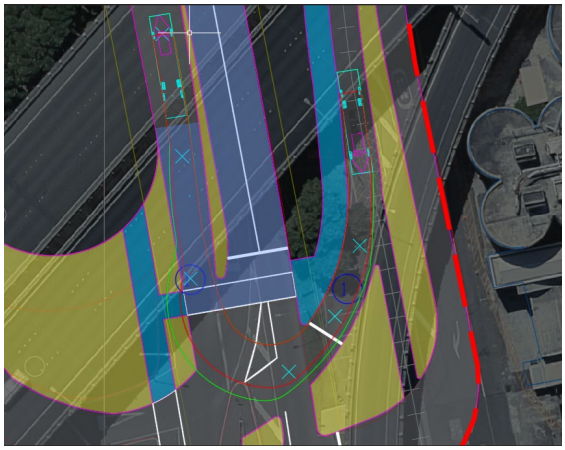
6.2.3 IO3 - Reduce the frequency and severity of crashes on Aotea Quay

There are a number of options for the signalisation of the Ferry Terminal access. The key safety issue is again associated with capacity and the potential for queues to develop which in turn will generate undesirable behaviour such as queue jumping and drivers trying to force their way into their desired lane. Overall option 4, but with the potential for a right turn out to the Old Hutt Road is favoured.

The scores given to the four improvement options in terms of their potential to reduce the frequency and severity of crashes on Aotea Quay, and the reasoning for those scores, are provided in Table 21 below.

Table 21 - IO3 assessment for ferry terminal intersection

Criteria	Option	Score	Comments
Reduce the frequency and severity of crashes on Aotea Quay	1 – existing layout with signals	2	Signals improve safety of ferry terminal intersection
	2 – signals with improved east approach	2	Signals improve safety of ferry terminal intersection. Improved access to State Highway north through provision of right turn out from Ferry Terminal.
	3 – signals with improved east and west approaches	4	Signals improve safety of ferry terminal intersection. Improved access to State Highway north through provision of right

		turn out from Ferry Terminal. Dual lanes northbound on Aotea Quay approach allows separation of SH1 northbound traffic from Ferry Terminal traffic.
4 – signals with improved east and west approaches and removal of Hutt Road link	3	Signals improve safety of ferry terminal intersection. Improved access to State Highway north through provision of a straight ahead movement at the intersection. Dual lanes northbound on Aotea Quay approach allows separation of SH1 northbound traffic from Ferry Terminal traffic. The loss of the direct access to Hutt Road northbound from the Ferry Terminal will need to be addressed by removing the island for the right turn out movement from the Ferry Terminal to allow for right turn access to Hutt Road northbound at the signals. The western island extent will need to be shifted back to allow for the right turn out tracking through to Hutt Road.  There are also internal KiwiRail site impacts potentially affecting the cement haulage vehicles and other port traffic.

6.2.4 IO4 - Maintain similar access for people and freight to the ferry terminal/centreport

Modelled future year (with anticipated future ferry operations) travel times along Aotea Quay for the PM peak period for each ferry terminal intersection layout are summarised in Table 22. These intersection layouts have been tested on the functional connection Option 5 model.

Table 22: IO4 Modelled Future Year Travel Times (s) for ferry terminal intersection

Journey	Option 1	Option 2	Option 3	Option 4
Aotea Quay Northbound (Waring Taylor St to Hutt Road ramp)	566.0	*[7]	402.7	472.7
Aotea Quay Southbound (Hutt Road ramp to Waring Taylor St)	342.0	*	288.7	312.6

As shown, Option 3 results in the shortest relative travel times along Aotea Quay between Waring Taylor Street and the Hutt Road ramps during this peak period in the future year.

Modelled travel times for this option benefits from the additional capacity provided by the two northbound left-turn lanes on Aotea Quay and subsequent two exit lanes, which provides access on to SH1 and the ferry terminal. This increased capacity, alongside the improvements to the east approach (dual lane exit out of the terminal) result in reduced intersection delay and is reflected in the shorter travel time.

Removal of the Hutt Road link in Option 4 results in a marginal difference in travel times relative to Option 3, and hence indicates that the key improvement to intersection performance is provided by the additional capacity to accommodate the left-turning movement from Aotea Quay on to SH1 or the ferry terminal.

Table 23 - IO4 assessment for ferry terminal intersection

Criteria	Option	Score	Comments
Maintain similar access for people and freight to the ferry terminal/ centreport	1 – existing layout with signals	+1	Improved access to the ferry terminal with a signal-controlled intersection. Minor delays to Aotea Quay approaches as green time will now be shared with the ferry terminal approach.
	2 – signals with improved east approach	+2	Improved access to the ferry terminal with a signal-controlled intersection. A dual lane exit out of the ferry terminal allows for a greater rate of traffic discharge and reduces queuing and delays within the terminal. Minor delays to Aotea Quay approaches as green time will now be shared with the ferry terminal approach.
	3 – signals with improved east and west approaches	+4	Improved access to the ferry terminal with a signal-controlled intersection. A dual lane exit out of the ferry terminal allows for a greater rate of traffic discharge and

[7] Initial modelled simulations for Option 2 indicated significant queueing along Aotea Quay without the second northbound left-turn lane on Aotea Quay, and hence, detailed outputs were not extracted

		reduces queuing and delays within the terminal. Second northbound left-turn lane on Aotea Quay and exit lane leading to the SH1 ramps provide additional capacity, reducing congestion and delays.
4 – signals with improved east and west approaches and removal of Hutt Road link	+3	Improved access to the ferry terminal with a signal-controlled intersection. A dual lane exit out of the ferry terminal allows for a greater rate of traffic discharge and reduces queuing and delays within the terminal. Second northbound left-turn lane on Aotea Quay and exit lane leading to the SH1 ramps provide additional capacity, reducing congestion and delays. Removal of Hutt Road link means exiting ferry traffic headed in this direction will need to U-turn at the Aotea Quay roundabout instead.

6.2.5 Environmental and social effects

The scores given to the four improvement form options in terms of their potential social and environmental effects, and the reasoning for those scores, are provided in Table 24 below.

Table 24 - Environmental and Social Assessment Scores and Commentary for Improvement Form Options

Criteria	Option	Score	Comments
Environmental and Social Effects	1 – existing layout with signals	1	Minor improved access from ferry terminal a small benefit
	2 – signals with improved east approach	2	Improved access from ferry terminal direct to SH1 a small benefit, avoid time and costs of Hutt Road; improved pedestrian access a benefit
	3 – signals with improved east and west approaches	1	Improved access from ferry terminal direct to SH1 a small benefit, access to Hutt a very minor benefit; impact on KR rail yard ops; improved pedestrian access a benefit
	4 – signals with improved east and west approaches and removal of Hutt Road link	2	Improved access from ferry terminal direct to SH1 a small benefit, access to Hutt a very minor benefit; property costs to KR; improved pedestrian access a benefit

6.2.6 Property and access

The scores given to the four improvement form options in terms of their implications for property use and access, and the reasoning for those scores, are provided in Table 25 below.

Table 25 - Property and Access Assessment Scores and Commentary for Improvement Form Options

Criteria	Option	Score	Comments
Property and Access Effects	1 – existing layout with signals	1	Minor improved access from ferry terminal a small benefit
	2 – signals with improved east approach	1	Minor improved access from ferry terminal a small benefit
	3 – signals with improved east and west approaches	-3	Improved access to ferry terminal but potentially fatal impact on KR access to rail yard; realignment of rail line into ferry terminal may not be feasible
	4 – signals with improved east and west approaches and removal of Hutt Road link	1	Minor improved access from ferry terminal a small benefit

6.2.7 Fit with LGWM programme

The assessment for the fit with LGWM programme criterion is presented in Table 26. This shows that options 2, 3 and 4 all deliver improvements due to the direct access provided to SH1. Option 1 does not provide this and therefore results in an increase in U-turning movements at the roundabout. Options 3 and 4 were awarded a higher score than option 2 due to increased capacity, removing traffic from Hutt Road and improving network performance.

Table 26 - Fit with LGWM programme assessment scores and commentary for signalised intersection options

Criteria	Option	Score	Comments
Fit with LGWM programme	1 – existing layout with signals	0	Roundabout will provide turning facility, this signal configuration will have minimal influence on this
	2 – signals with improved east approach	+2	Improves operation of roundabout through provision of direct connection to SH1
	3 – signals with improved east and west approaches	+3	Intersection performs better than option 2 and reduces risk of congestion extending to Hutt Road

	4 – signals with improved east and west approaches and removal of Hutt Road link	+3	Direct connection to Hutt Road removed resulting in reduced traffic on Hutt Road (will be lightly used if direct SH1 connection is provided). Intersection performs well

6.2.8 Delivery, operations and Maintenance

Table 27 below presents the assessment of the delivery, operations and maintenance criteria for the ferry terminal access intersection options. The timeframe for delivery criteria was not assessed and is not presented below.

Table 27: Assessment of the delivery, operations and maintenance criteria for the ferry terminal access intersection options

Criteria	Option	Score	Comments
Delivery	1 – existing layout with signals	-1	Minor disruption to travelling public and KiwiRail access during signalisation of the intersection
	2 – signals with improved east approach	-2	Moderate disruption to travelling public and KiwiRail access during signalisation of the intersection
	3 – signals with improved east and west approaches	-3	Moderate disruption to travelling public and significant disruption to KiwiRail access during signalisation of the intersection
	4 – signals with improved east and west approaches and removal of Hutt Road link	-2	Moderate disruption to travelling public and KiwiRail access during signalisation of the intersection
Operations and maintenance	1 – existing layout with signals	-2	Increased maintenance & operational costs associated with signalised intersection
	2 – signals with improved east approach	-2	Increased maintenance & operational costs associated with signalised intersection
	3 – signals with improved east and west approaches	-2	Increased maintenance & operational costs associated with signalised intersection

Criteria	Option	Score	Comments
	4 – signals with improved east and west approaches and removal of Hutt Road link	-2	Increased maintenance & operational costs associated with signalised intersection

6.2.9 Recommended Option

A summary of the MCA is shown in Table 28.

Table 28 – Ferry terminal access intersection MCA summary

Criterion	Option 1	Option 2	Option 3	Option 4
Bus level of service	3	3	3	3
Active travel level of service and safety	4	4	4	4
Reduce the frequency and severity of crashes on Aotea Quay	2	2	4	3
Maintain similar access for people and freight to the ferry terminal/centreport	1	2	4	3
High level assessment of overall social and environmental effects	1	2	1	2
Property Access	1	1	-3	1
Fit with LGWM Programme	0	2	3	3
Constructability	-1	-2	-3	-2
Operations and maintenance	-2	-2	-2	-2

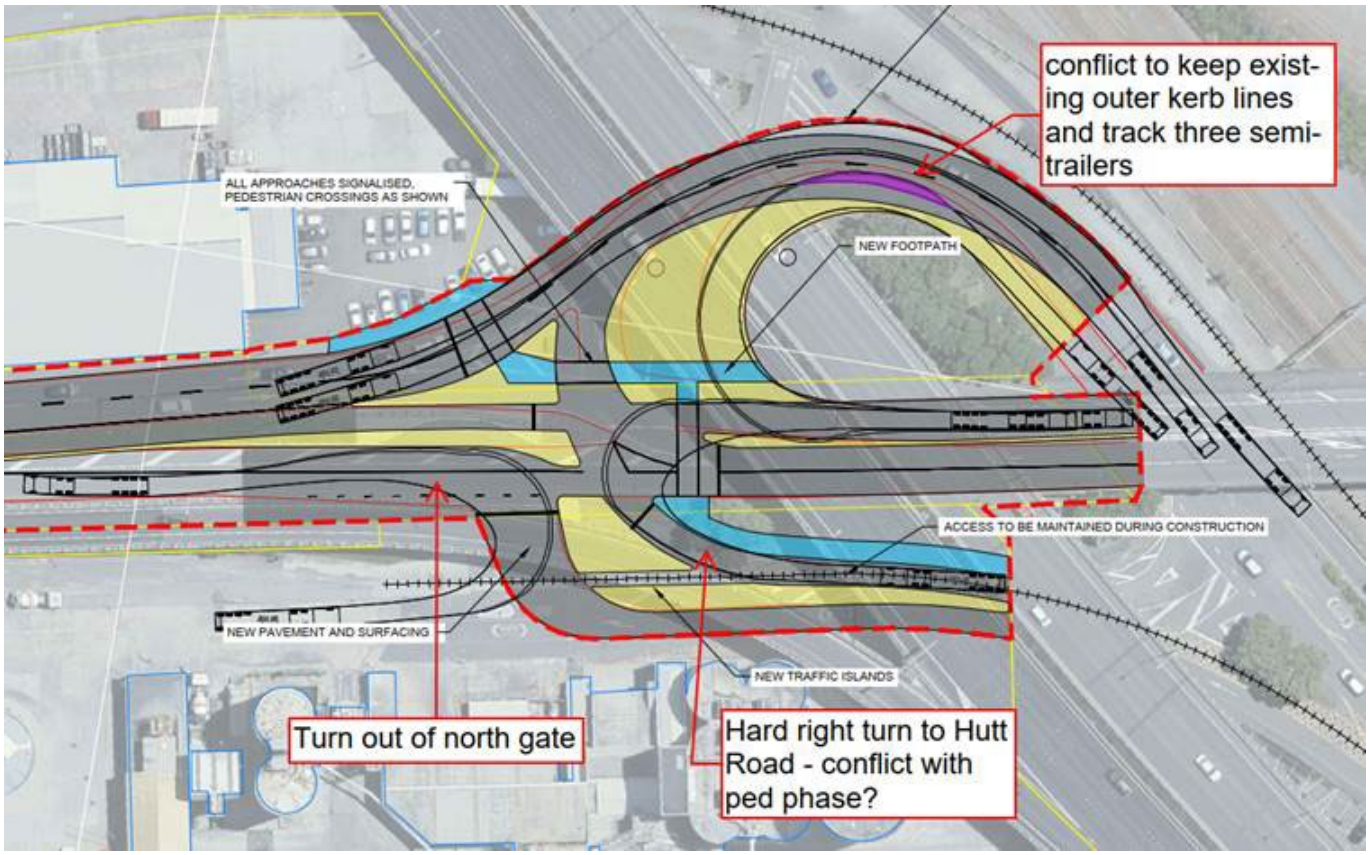
Four signalised intersection options have been identified and assessed. Option 1 fits within the existing footprint and provides improved control of traffic leaving the ferry terminal, however it doesn't provide direct access to SH1 for ferry traffic and is forecast to increase delay for NB traffic on Aotea Quay. Option 2 does provide direct access to SH1 from the ferry terminal but is also forecast to increase delay for NB traffic on Aotea Quay. Option 3 provides more capacity and performs better than options 1 or 2 but has a larger footprint that is likely to require rail realignment. Option 4 removes the risk of rail realignment by removing the road connection between the ferry terminal and Hutt Road.

During the MCA workshop it was agreed that, while option 3 retains all movements, the connection to Hutt Road is likely to be relatively lightly used. It was therefore agreed that option 4 is the preferred option. Traffic travelling between the ferry terminal and Hutt Road would have to undertake at U-turn at the roundabout at the CT yard. The impact on traffic movements into and out of Centreport's north gate was also discussed (as this traffic currently uses Hutt Road). Further analysis of vehicle tracking (using a semitrailer) was subsequently undertaken to understand the routes available for vehicles leaving north gate (see Figure 12). This shows two feasible alternatives – vehicles will either have to navigate through

the ferry terminal and then make a hard right towards Hutt Road (this would conflict with the proposed pedestrian crossing in this location). Alternatively, vehicles will need to turn left and make a U-turn at the roundabout. This will need to be considered further at the detailed design phase. In addition to this, it was noted during the workshop that the proposed intersection improvements would have an impact on access to/from the NZ couriers depot just south of the intersection. This access way will likely have to become left in, left out, and this will need further consideration as the design is developed.

As noted above, a metered exit from the ferry terminal will deliver similar levels of network performance to the full signalised intersection (albeit with reduced levels of service and increased delay for vehicles leaving the Kiwirail terminal).

Figure 13 - Vehicle tracking for option 4



All signalised intersection options will create queuing on all approached. Advanced warning signage may be warranted, particularly on the northern approach where visibility is poor (Figure 14).

Subsequent discussions between LGWM and Kiwirail have confirmed that Kiwirail will deliver the changes to the ferry terminal intersection, with Kiwirail to determine whether a full signalised intersection or a metered exit will be provided. LGWM will deliver the roundabout.

Figure 14 - Northern approach visibility challenge

6.3 CT Yard Intersection

The roundabout options feature two variables – size and location. Two size options have been assessed (16m and a 24m diameter roundabouts) and two location options have been assessed (a northern location and a southern location). All options have been scored on the assumption that the signalised intersection has been provided at the ferry terminal intersection.

6.3.1 IO1 – Bus level of service

The performance of Hutt Road is not influenced by the size or location of the roundabout, therefore all options have been awarded the same score in Table 29.

Table 29 - IO1 assessment for roundabout options

Criteria	Option	Score	Comments
Changes on Aotea Quay do not reduce the ability to deliver IO1 for TQHR	1 – large roundabout to south	+2	Roundabout removes ferry related traffic from Hutt Road and improves network performance for PT vehicles
	2 – large roundabout to north	+2	Roundabout removes ferry related traffic from Hutt Road and improves network performance for PT vehicles
	3 – small roundabout to south	+2	Roundabout removes ferry related traffic from Hutt Road and improves network performance for PT vehicles
	4 – small roundabout to north	+2	Roundabout removes ferry related traffic from Hutt Road and improves network performance for PT vehicles

6.3.2 IO2 - Active travel level of service and safety

The scores given to the four roundabout options in terms of their potential to improve LOS and reduced safety risk for people walking and cycling along and across Aotea Quay, and the reasoning for those scores, are provided in Table 30 below.

Table 30 – IO2 assessment for roundabout options

Criteria	Option	Score	Comments
Improved LOS and reduced safety risk for people walking and cycling along and across Aotea Quay	1 – large roundabout to south	-3	Pedestrian facilities provided on western side only. Noting there is no desire to cross to the north due to lack of footpath on the northern side. Pedestrians and required to check behind them for approaching vehicles when crossing north. Crossing location only benefits from the signal metering during the peak periods.

			The lack of shoulders for cycling would result in cyclists utilising the footpath instead. Cyclists are not encouraged to use Aotea Quay due to the availability of cycle lanes on Thorndon Quay.
	2 – large roundabout to north	-3	Pedestrian facilities provided on western side only. Noting there is no desire to cross to the north due to lack of footpath on the northern side. Pedestrians and required to check behind them for approaching vehicles when crossing north. Crossing location only benefits from the signal metering during the peak periods. The lack of shoulders for cycling would result in cyclists utilising the footpath instead. Cyclists are not encouraged to use Aotea Quay due to the availability of cycle lanes on Thorndon Quay.
	3 – small roundabout to south	-4	Pedestrian facilities provided on western side only. Noting there is no desire to cross to the north due to lack of footpath on the northern side. Pedestrians and required to check behind them for approaching vehicles when crossing north. Crossing location only benefits from the signal metering during the peak periods. The lack of shoulders for cycling would result in cyclists utilising the footpath instead. Cyclists are not encouraged to use Aotea Quay due to the availability of cycle lanes on Thorndon Quay. The use of a small diameter roundabout with a large circulating lane area is likely to make travel through the roundabout riskier for any cyclist using Aotea Quay.
	4 – small roundabout to north	-4	Pedestrian facilities provided on western side only. Noting there is no desire to cross to the north due to lack of footpath on the northern side. Pedestrians are required to check behind them for approaching vehicles when crossing north. Crossing location only benefits from the signal metering during the peak periods.

			The lack of shoulders for cycling would result in cyclists utilising the footpath instead. Cyclists are not encouraged to use Aotea Quay due to the availability of cycle lanes on Thorndon Quay. The use of a small diameter roundabout with a large circulating lane area is likely to make travel through the roundabout riskier for any cyclist using Aotea Quay.

6.3.3 IO3 - Reduce the frequency and severity of crashes on Aotea Quay

In terms of the size and location of the turning facilities there are two issues:

- The location of the roundabout and
- The size of the roundabout.

Ferry Terminal traffic exiting the motorway onto Aotea Quay will need to weave across to the right lane to U Turn at the proposed roundabout. In the absence of a specific weaving analysis/modelling, locating the roundabout as far to the south as possible will provide the maximum weaving space.

There are two proposals in terms of roundabout size. A smaller 16m diameter roundabout with wide circulating lanes or a 24m diameter roundabout. The larger 24m diameter roundabout is preferred as it will contain the turning HCVs in their own lane with less likelihood of lane departures, while ensuring more appropriate deflection for light vehicles which have the potential to flat line the smaller diameter roundabout with the wide circulating lanes.

Thus, the preference is for the larger 24m diameter roundabout located as far south as possible to maximise the weaving distance for vehicles entering Aotea Quay from the SH1 southbound off-ramp.

The scores given to the four roundabout options in terms of their potential to reduce the frequency and severity of crashes on Aotea Quay, and the reasoning for those scores, are provided in Table 30 below.

Table 31 - IO3 assessment for roundabout options

Criteria	Option	Score	Comments
Reduce the frequency and severity of crashes on Aotea Quay	1 – large roundabout to south	-1	Slightly reduced safety due to weaving associated with U turn movement.
	2 – large roundabout to north	-3	Northern location of roundabout is less safe due to reduced weave distance from SH1 southbound off ramp.
	3 – small roundabout to south	-2	Smaller roundabout is slightly less safe than larger roundabout as there is the risk of HCV lane departures. There is also the risk of minimal deflection for light vehicles

			which results in them 'flat-lining' the smaller roundabout.
	4 – small roundabout to north	-4	Smaller roundabout is slightly less safe than larger roundabout and combined with northern location makes this worst option.

6.3.4 IO4 - Maintain similar access for people and freight to the ferry terminal/centreport

Access to the ferry terminal and Centreport is not influenced in any meaningful way by the size or location of the roundabout. Therefore all options have been awarded the same score in Table 31.

Table 32 - IO4 assessment for roundabout options

Criteria	Option	Score	Comments
Maintain similar access for people and freight to the ferry terminal/ Centreport	1 – large roundabout to south	+2	Roundabout improves access to the ferry terminal, particularly from the state highway. Minimal change for Centreport
	2 – large roundabout to north	+2	Roundabout improves access to the ferry terminal, particularly from the state highway. Minimal change for Centreport
	3 – small roundabout to south	+2	Roundabout improves access to the ferry terminal, particularly from the state highway. Minimal change for Centreport
	4 – small roundabout to north	+2	Roundabout improves access to the ferry terminal, particularly from the state highway. Minimal change for Centreport

6.3.5 Environmental and social effects

The scores given to the four roundabout options in terms of their potential social and environmental effects, and the reasoning for those scores, are provided in Table 32 below.

Table 33 - Environmental and Social Assessment Scores and Commentary for Roundabout Options

Criteria	Option	Score	Comments
Environmental and Social Effects	1 – large roundabout to south	-1	Very minor benefit from removal of signals, but counteracted by increase in traffic volumes at peak; minor loss of economic use of land. Little differentiation from other options in environmental effects

2 – large roundabout to north	-1	Larger loss of economic use of CT site; otherwise only small benefits. Little differentiation from other options in environmental effects
3 – small roundabout to south	-1	Very minor benefit from removal of signals, but counteracted by increase in traffic volumes at peak; minor loss of economic use of land. Little differentiation from other options in environmental effects
4 – small roundabout to north	-1	Larger loss of economic use of CT site; otherwise only small benefits. Little differentiation from other options in environmental effects

6.3.6 Property and access

The scores given to the four improvement form options in terms of their implications for property use and access, and the reasoning for those scores, are provided in Table 33 below.

Table 34 - Property and Access Assessment Scores and Commentary for Roundabout Options

Criteria	Option	Score	Comments
Property and Access Effects	1 – large roundabout to south	-1	Would require re-arrangement of property access to and within CT site; some loss and impact on current use of land; minor loss of land available for future redevelopment
	2 – large roundabout to north	-2	Better access to CT with direct alignment with internal roading, although some internal access re-arrangement required; greater loss of land and therefore impact on current use of property, particularly KiwiRail operations
	3 – small roundabout to south	-1	Would require re-arrangement of property access to and within CT site; some loss and impact on current use of land; minor loss of land available for future redevelopment
	4 – small roundabout to north	-2	Better access to CT with direct alignment with internal roading, although some internal access re-arrangement required;

			greater loss of land and therefore impact on current use of property, particularly KiwiRail operations

6.3.7 Fit with LGWM programme

All roundabout options provide the desired turning facility for traffic on Hutt Road.

Table 35 - Fit with LGWM programme assessment for roundabout options

Criteria	Option	Score	Comments
Fit with LGWM programme	1 – large roundabout to south	+2	Provides turning facility for Hutt Road property access
	2 – large roundabout to north	+2	Provides turning facility for Hutt Road property access
	3 – small roundabout to south	+2	Provides turning facility for Hutt Road property access
	4 – small roundabout to north	+2	Provides turning facility for Hutt Road property access

6.3.8 Delivery, operations and Maintenance

Table 35 below presents the assessment of the delivery, operations and maintenance criteria for the CT yard intersection options. The timeframe for delivery criteria was not assessed and is not presented below.

Table 36: Assessment of the delivery, operations and maintenance criteria for the CT yard intersection options

Criteria	Option	Score	Comments
Delivery	1 – large roundabout to south	-4	Disruption associated with construction of the roundabout for travelling public on Aotea Quay and CT yard access
	2 – large roundabout to north	-4	Disruption associated with construction of the roundabout for travelling public on Aotea Quay and CT yard access
	3 – small roundabout to south	-4	Disruption associated with construction of the roundabout for travelling public on Aotea Quay and CT yard access

Criteria	Option	Score	Comments
	4 – small roundabout to north	-4	Disruption associated with construction of the roundabout for travelling public on Aotea Quay and CT yard access
Operations and maintenance	1 – large roundabout to south	-3	Significant increased maintenance & operational costs associated with roundabout
	2 – large roundabout to north	-3	Significant increased maintenance & operational costs associated with roundabout
	3 – small roundabout to south	-3	Significant increased maintenance & operational costs associated with roundabout
	4 – small roundabout to north	-3	Significant increased maintenance & operational costs associated with roundabout

6.3.9 Recommended Option

A summary of the MCA is shown in Table 37.

Table 37 – CT Yard access intersection MCA summary

Criterion	Option A	Option B	Option C	Option D
Bus level of service	2	2	2	2
Active travel level of service and safety	-3	-3	-4	-4
Reduce the frequency and severity of crashes on Aotea Quay	-1	-3	-2	-4
Maintain similar access for people and freight to the ferry terminal/centreport	2	2	2	2
High level assessment of overall social and environmental effects	-1	-1	-1	-1
Property Access	-1	-2	-1	-2
Fit with LGWM Programme	2	2	2	2
Constructability	-4	-4	-4	-4
Operations and maintenance	-3	-3	-3	-3

All roundabout options deliver a similar level of performance against the assessment criteria. They all provide the required turnaround facility improving access to Centreport and the properties along Hutt Road.

The key areas of differentiation relate to safety and property. Although all roundabout options create an increased risk of weaving related crashes, the northern location is considered less safe due to the closer proximity to the Aotea Quay off ramp. The larger roundabout design is considered slightly safer due to the reduced risk of larger vehicles departing from their lane.

Although the larger roundabout footprint has a slightly larger impact on property, this was not considered sufficiently different to warrant a change in score. The positioning of the roundabout along the corridor does have an impact, however – the southern location will require reconfiguration of the road network within the CT yard, however the northern location will have a greater impact on overall property area. Following discussion with Kiwirail a compromise location between the two locations assessed in this evaluation may balance out the property impact. This will be investigated during the detailed design phase of this project.

Overall, it was agreed at the workshop that a larger roundabout in a more southerly location was the preferred option (principally driven by the safety argument).

7 Conclusion and Next Steps

This evaluation has concluded that a combination of a signalised intersection and metered roundabout will deliver the desired access and safety improvements for the Aotea Quay corridor.

A number of alternative intersection layouts were assessed for each location – at the ferry terminal intersection, a signalised intersection layout that minimises additional land take, but maximises capacity for key movements has been identified. The compromise with this preferred layout is that it removes direct connectivity to Hutt Road, however this connection will be lightly used in the future. At the CT yard intersection, a 24m diameter metered roundabout located close to the existing signals has been identified as the preferred option. Further engagement between Kiwirail and LGWM has confirmed that LGWM will deliver the roundabout and Kiwirail will provide the signalised intersection (either as a metered exit, or a full signalised intersection).

The next stage will be the development of detailed designs for the corridor based on the preferred options. This will need to include the following tasks:

- Although active travel users will not be directly encouraged to use this corridor, the detailed design phase will need to demonstrate how they can be accommodated safely. This will include specific consideration of crossing the western arm of the proposed roundabout.
- Placemaking and wayfinding will need to be included in the design as it develops – the ferry terminal represents an important gateway to Wellington and this will need to be reflected.
- Due consideration will need to be given to access arrangements for businesses along Aotea Quay (including the stadium) and how intersection arrangements will account for this.
- Further safety assessment of the roundabout layout – impacts on crash frequency and crash severity will need to be accounted for, as well as the impact of weaving traffic either side of the roundabout.
- Signal design that takes into account coordination of signals at the two intersections to deliver a safe system. This will need to include engagement with the TOC (at this stage it is assumed that the TOC will operate the system).

Appendix A – GWRC Modelling Report

Aotea Quay / Hutt Road Ferry Integration

Modelling Report

John Pell, Wellington Transport Analytics Unit
Vinh Pham, Stantec

For more information, contact the Greater Wellington Regional Council:

Wellington
PO Box 11646

T 04 384 5708
F 04 385 6960
www.gw.govt.nz

Masterton
PO Box 41

T 06 378 2484
F 06 378 2146
www.gw.govt.nz

Upper Hutt
PO Box 40847

T 04 526 4133
F 04 526 4171
www.gw.govt.nz

[Report Number]

[Date]

www.gw.govt.nz
info@gw.govt.nz

Contents

1. Intro

This memo summarises modelling undertaken by the Wellington Transport Analytics Unit (WTAU) and Stantec to support integration between the Thorndon Quay / Hutt Rd and Kiwirail's Single User Terminal (SUT) projects.

This round of modelling draws and expands on the previous work carried out to evaluate different ferry terminal locations and proposed layouts and combines this with the Thorndon Quay/Hutt Road (TQHR) project's currently preferred option. A key part of this work is understanding how these two projects will interact and how this might influence the required network interventions.

The modelling uses the Ngauranga to Airport Aimsun model (N2AM) which covers the Wellington CBD and surrounding suburbs to the south of the Ngauranga Interchange. N2AM was developed as part of the Let's Get Wellington Moving (LGWM) programme.

2. Previous Modelling

Three phases of modelling potential future ferry terminal locations and layouts have been undertaken to date. These phases can be summarised as follows:

- Phase 1 was focused around determining the location of the new multi-user ferry terminal and level of intervention required at each location to manage and mitigate impacts. This was effectively comparing the suitability of co-locating the Bluebridge and Interislander ferry operator at either of the two sites (Kings Wharf or Kaiwharawhara). Both a low and a high-level intervention access option was tested for each location. This work determined that some network intervention would be required regardless of where the ferry terminal might be located.

- Phase 2 expanded on the investigations in Phase 1, looking at additional potential ferry colocation sites.

- Following phase 2, the existing Interislander site at Kaiwharawhara was determined as the preferred location for the Wellington ferry terminals. To further understand the access implications Stantec was commissioned by Centreport to test various layout configurations. This included more detail around sailing times and arrival/ departure profiles. This work confirmed the challenges of a southern access to the terminal and recommended a northern access via ramps onto the motorway and Hutt Road, similar to the findings from Phase 1. This option however would have a significant cost.

The most recent modelling on TQHR, as part of the single stage business, has looked at reallocating the kerbside general traffic lanes to alternative modes such as high occupancy vehicles, buses and trucks in various combinations. This modelling has generally assumed fixed traffic demands, with some sensitivity

testing, however in reality this option would be expected to generate modal shift that reduces the number of car trips down the corridor. The currently preferred TQHR option includes peak direction bus lanes on Thorndon Quay and peak direction bus and truck lanes on Hutt Road.

3. Options & Tests

Building on the previous modelling, this round of modelling assumes the Interislander site with a southern terminal access. As this work is looking at the short term, only Interislander ferry operations are assumed with a current and future ferry traffic variation of each. Bus lanes are assumed on Thorndon Quay and Hutt Road, with the Hutt Road bus lanes also allowing HCVs.

All tests have been run through the 2026 forecast year model and have two core ferry demand scenarios, designed to represent a 90th percentile[1] load that coincides with normal traffic conditions, and a sensitivity test:

- Current ferry at 90th percentile load
- Future larger ferry (50% greater capacity) at 90th percentile load
- High HCV future ferry sensitivity Test

Details around these ferry loadings are expanded upon in the Modelling Assumptions section. Table 1 below outlines the tests which have been run through the model.

Table 1: Test Descriptions

Test	Intervention	Demand	Time period
Test 1a	Signalised roundabout	Current ferry	PM Peak
Test 1b	Signalised roundabout	Future ferry	PM Peak
Test 2a	Signalised roundabout and signalised intersection	Current ferry	PM Peak
Test 2b	Signalised roundabout and signalised intersection	Future ferry	PM Peak
Test 3a	Signalised roundabout and signalised intersection	Current ferry	AM Peak
Test 3b	Signalised roundabout and signalised intersection	Future ferry	AM Peak
Test 4	Signalised roundabout and signalised intersection, force port trucks to use SH1 and roundabout	Future ferry	PM Peak
Test 4 S1	Signalised roundabout and signalised intersection, force port trucks to use SH1 and roundabout	High HCV Ferry	PM Peak
Test 5	Turn back loop, signalised roundabout and signalised intersection, force port trucks to use SH1 and roundabout	Future ferry	PM Peak
Test 6	Turn back loop and signalised intersection, force port trucks to use SH1 and roundabout	Future ferry	PM Peak

[1] Note 100th percentile load (busiest ferries) occurs over the Christmas period when traffic volumes on the wider local road and state highway network are lower, and thus ferry operational do not result in significant impacts on the wider network

3.1 Signalised Roundabout

The Signalised roundabout, shown in Figure 1 replaces the CT Yard entrance signalised intersection. The signalisation is in the form metering which is only applied to the northern approach to mitigate the impact that vehicles released from the ferry have on the Aotea Quay outbound traffic, particularly in the PM peak. This layout features in all scenarios except for Test 6.

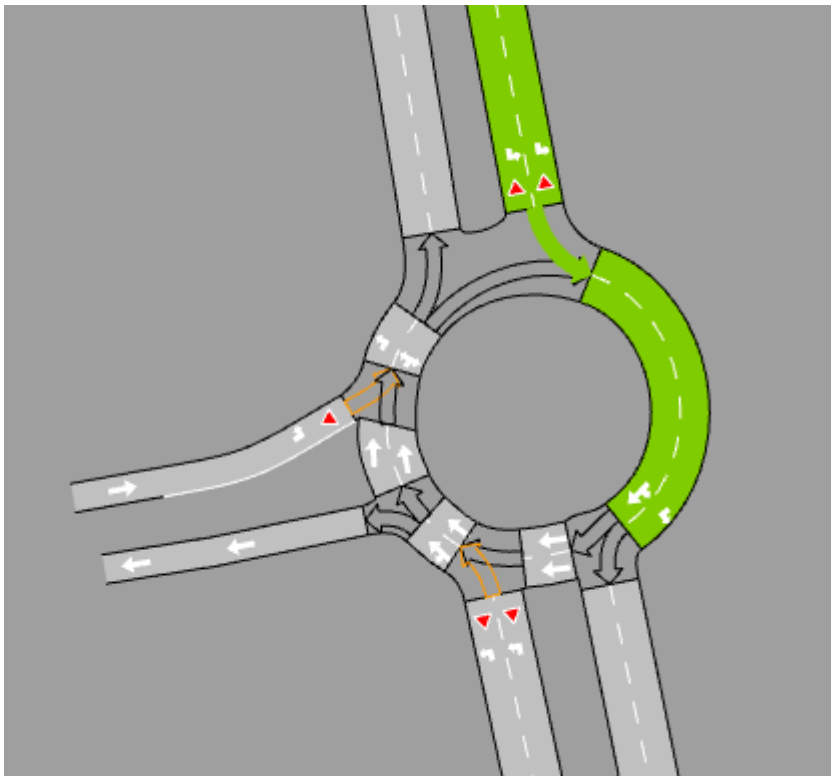


Figure 1: Metered Roundabout Layout

3.2 Signalised Aotea Quay/Ferry Access intersection

Figure 2 shows the existing and signalised layout options for the Aotea Quay/ Ferry Access intersection. The signalised layout provides a direct connection from the ferry terminal onto SH1, removing exiting ferry traffic from Aotea Quay. A variation of this intersection forcing trucks exiting the ferry terminal to head south has also been tested in some options.

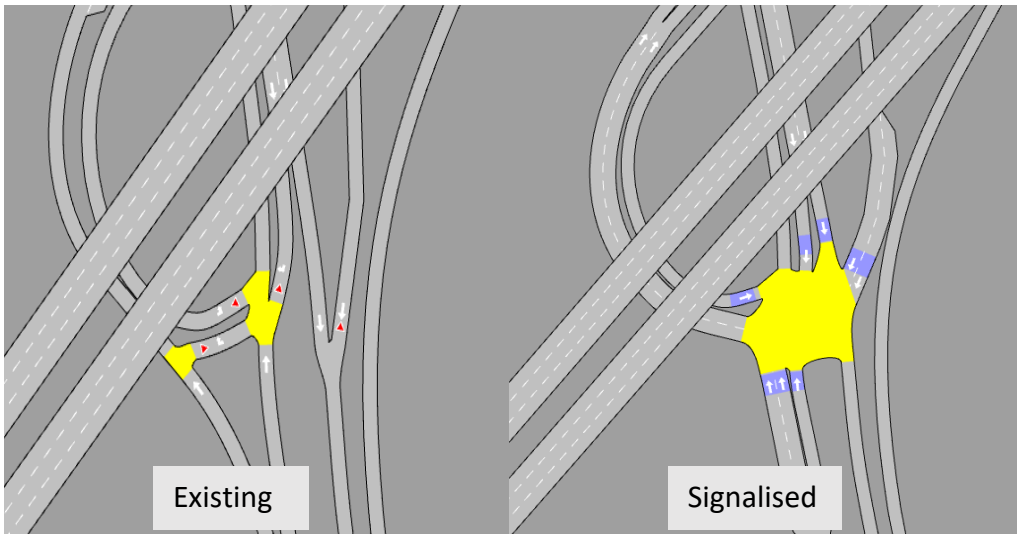


Figure 2: Aotea Quay/Ferry Access Layout

3.3 Truck Turnaround Area

To mitigate the impact of ferry trucks using the roundabout to turnaround and head north, a turnaround area in the CT Yard has been identified. As shown in Figure 3 there are two variations, one with the roundabout included and a second without.

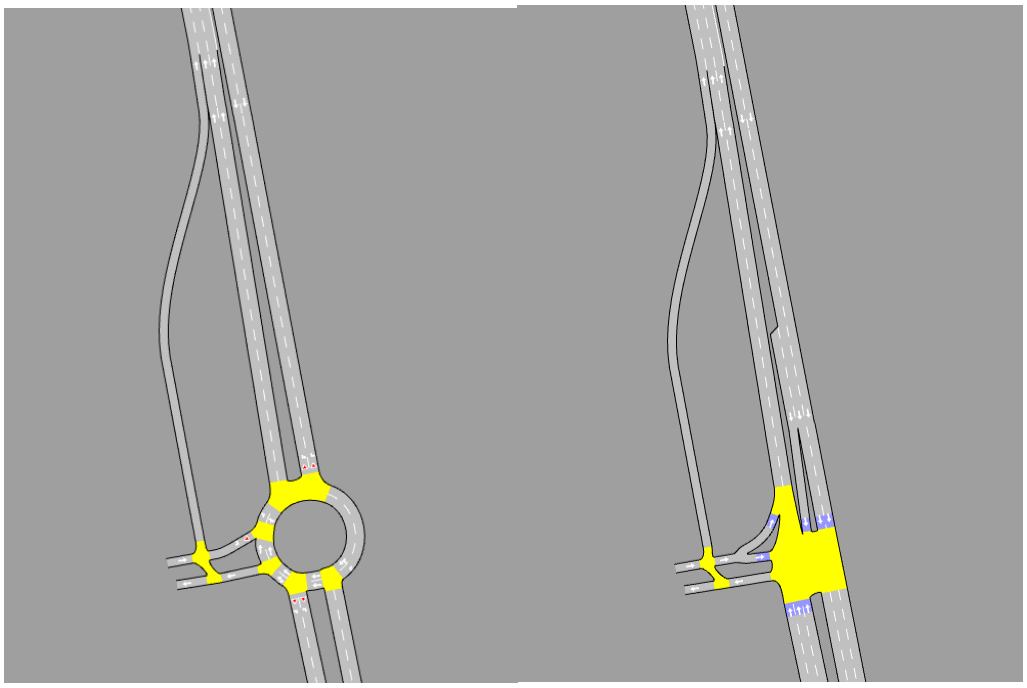


Figure 3: CT Yard Intersection Turnaround Area

4. Modelling Assumptions

This section outlines the modelling assumptions that have gone into the model.

4.1 Background traffic

The modelling has been based on the TQHR HCV and Bus lane option developed for LGWM. This includes peak direction Bus and HCV lanes between Jarden Mile and the Aotea Ramps and peak direction bus only lanes on Thorndon Quay. This option assumes fixed demands from the do min[2], however in reality this option would be expected to generate modal shift that reduces the number of car trips down the corridor. In this respect the scenario that has been modelled and reported in this note represents a 'worst case' scenario in terms of traffic impacts as it assumes no modal shift.

Note the Thorndon Quay and Hutt Road interventions are not yet committed projects, but are considered the most likely outcome for the TQHR project at the time of writing.

4.2 Model setup

Modelling for the current phase has been undertaken in a sub network of the wider model as shown in Figure 4. This extends from just North of the Jarden Mile intersection to south of Waring Taylor Street.

The Sub network approach was adopted for these model runs to decrease turnaround times of testing. The full Aimsun model can be sensitive to small changes in flow requiring signal tweaks in areas of the model away from the study area which the sub network model removes. This approach also allows more direct sensitivity testing in scenarios where, say, traffic is shifted from Hutt Road onto the Thorndon Overbridge as the adjusted trips can be directly loaded rather than trying to influence route choice. The use of sub networks is also in line with previous ferry terminal layout option testing.

[2] Do min scenario: the future Wellington roading network without having the TQHR HCV and Bus lanes

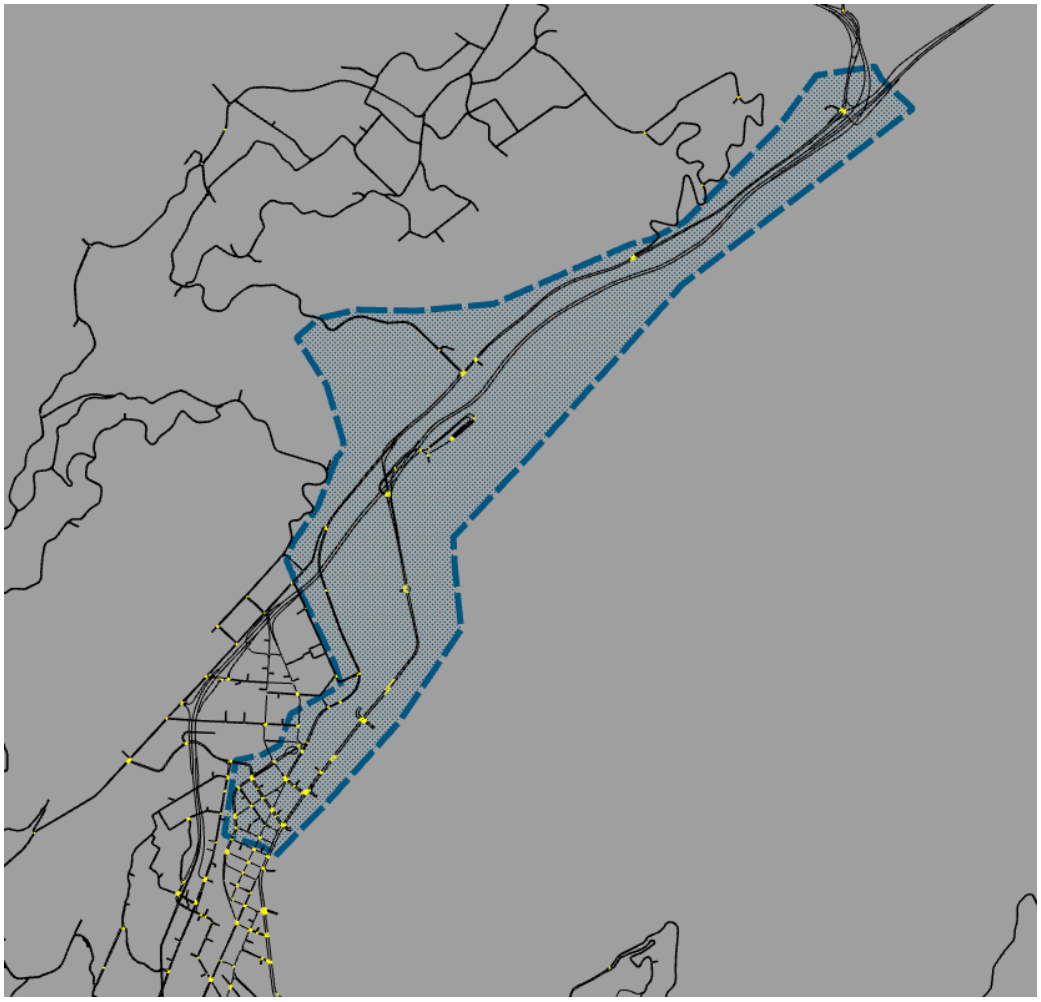


Figure 4: Sub Network Extents

4.3 Ferry Movements

Under the current Interislander timetable the busiest departing ferry departs from Wellington at 9am in the AM peak and the busiest arriving ferry arrives in Wellington at 5:45pm in the PM peak as shown in Figure 5.

Future ferry operations assume both peaks will include both a ferry arrival and a departure as shown in Figure 6. To achieve the desired future ferry operation, a 1 hour turnaround is required between arriving and departing ferries.

Figure 5: Current Ferry Crossing Timetable

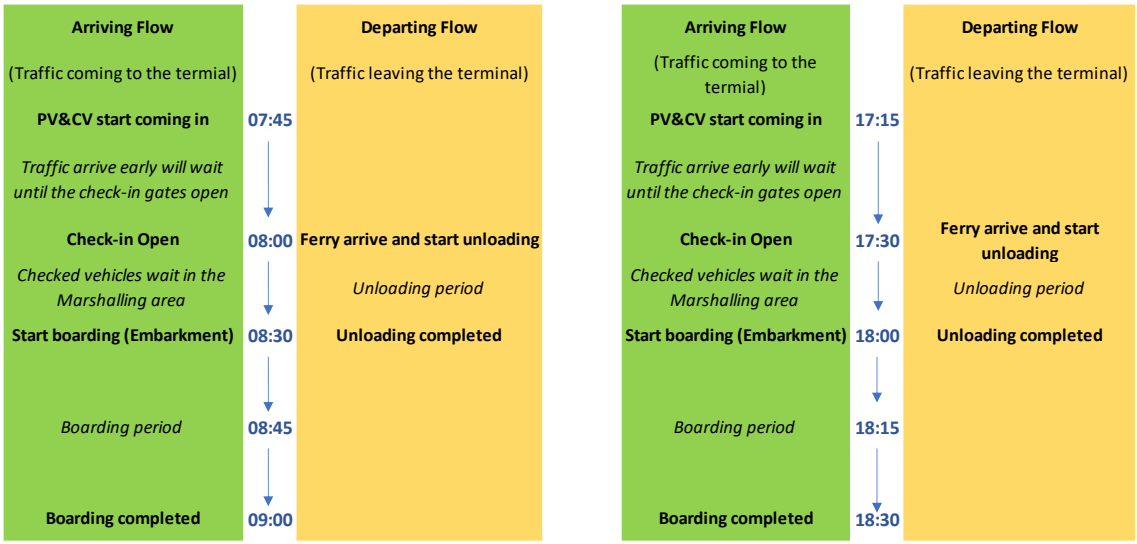


Figure 6: Future Ferry Crossing Timetable

4.4 Vehicle Demands and Profiles

Analysis of ferry crossing data found that the 90th percentile had 250 vehicles crossing. The crossing data also included a count of walk on boardings, though this didn't include any indication of how these trips might be arriving to the terminal. In this modelling exercise, the total PUDO vehicle demand are estimated by diving the total of foot passenger by 2.5 (assumed occupancy factor of ferry's foot passengers). The future crossing has the 90th crossing increase to 440 vehicles due to the larger ferries.

Table 2: Ferry Crossing Trips assumptions

Mode	Base	Future	High HCV (Future)
PUDO[3]	126	193	193
Cars	234	412	390
HCV	16	28	50

Table 3 shows the PUDO split assumptions used to derive the PUDO vehicles numbers. Private cars have an arrival and departure trips, whereas rental and some uber/taxis only create one trips. The rental figure is an assumption.

Table 3: Surveyed Drop off Splits

Mode	Percentage
Car - Rental	25%
Car - Private	38%
Uber / Taxi	37%

[3] Pick up drop off (Uber, kiss and ride, rentals)

Ferry arrival profiles have been based on survey data collected by Stantec for AM peak arrivals as shown in Figure 7. The arrival flow survey indicate arrival to the ferry terminal, i.e. the destination, whereas the model uses release profiles as vehicles enter the network i.e. from the origin. To account for the surveyed arrival profiles have been time shifted 15 minutes earlier. The model releases vehicles onto the network in 15 minutes increments, this time shift enables time for vehicles to travel through the network.

Exiting ferry traffic is assumed to release within 15 minutes of the ferry arrival (i.e. in the same model time slice), queuing outside the network (i.e. on the vessel) as needed. Exiting PUDO traffic is assumed to release 40% in the ferry arrival time slice and 60% in the time slice after. This is to account for luggage collection, hailing taxis and rental arrangements.

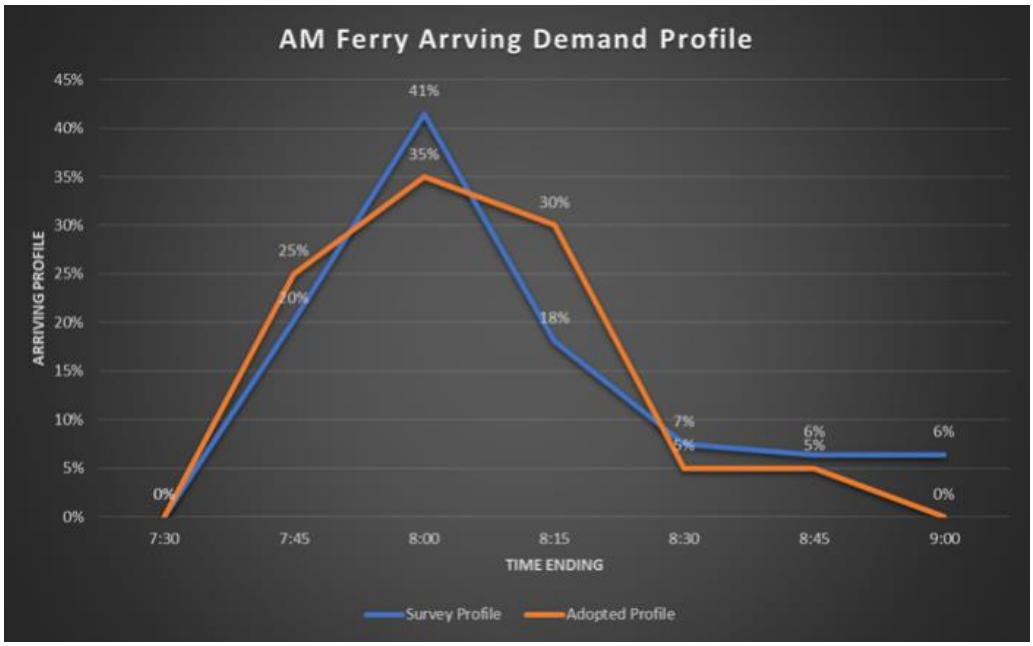


Figure 7: AM Peak Ferry Arrival Surveyed Profile

4.5 Ferry Layout

The current ferry layout is shown in Figure 8 and the future layout is shown in Figure 9. The future layout features increased marshalling area for both cars and trucks prior to entering the ferry. The capacity of the pick up and drop off (PUDO) is also increased. The two PUDO/Ferry outbound intersections have been assumed to be signal controlled to ensure vehicles are able to enter and exit the terminal – initial testing shows queues forming outside the ferry terminal without the signals included.

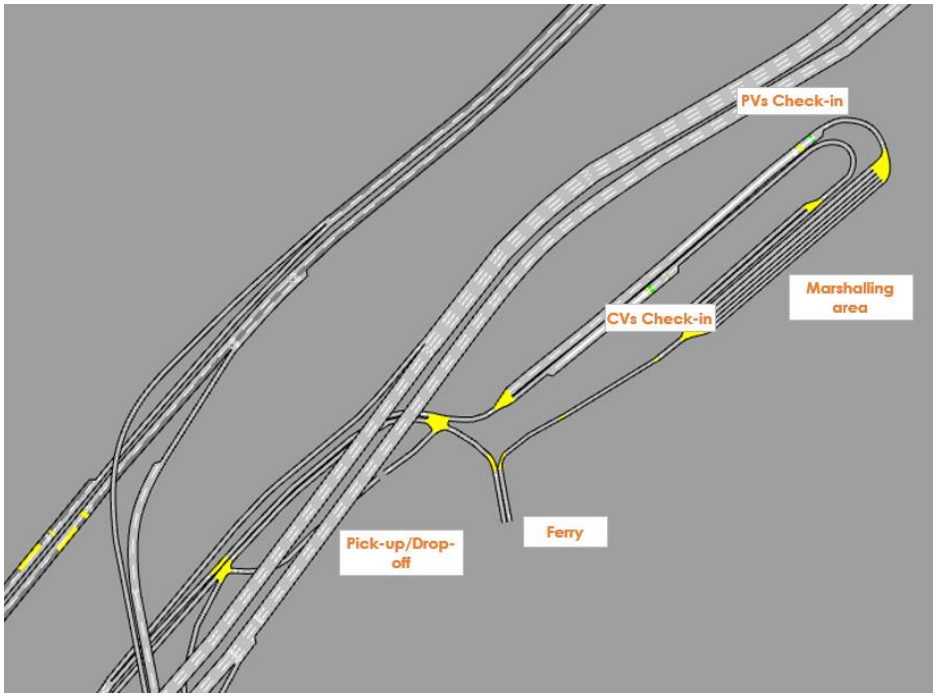


Figure 8: Current Ferry Terminal Layout

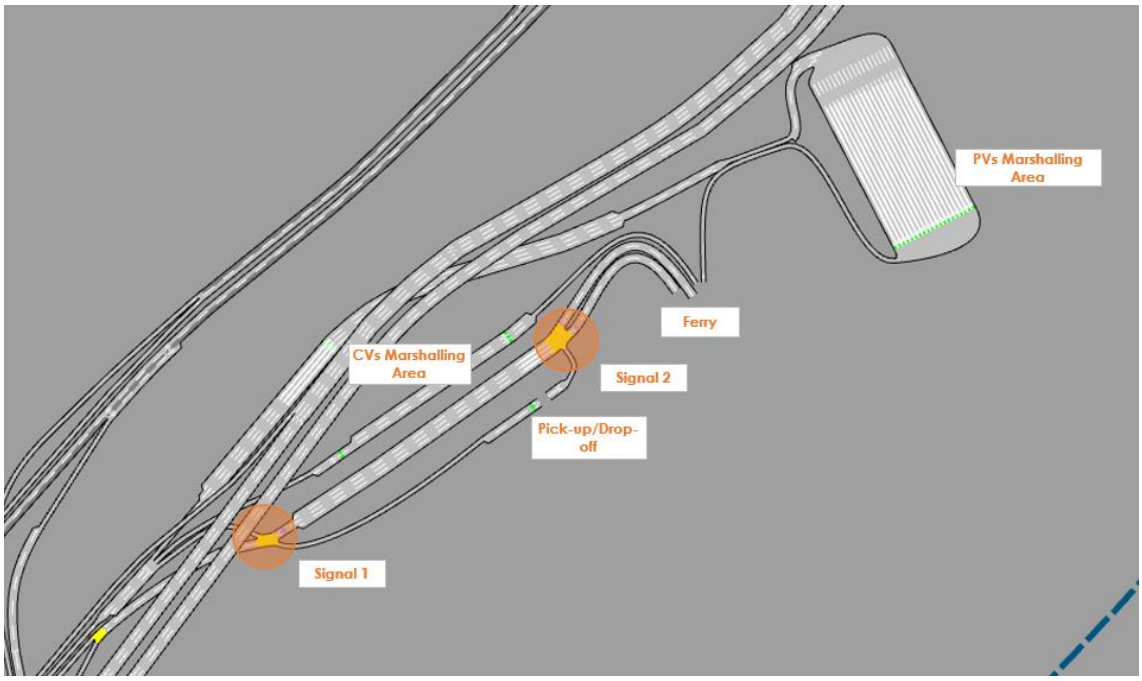


Figure 9: Future Ferry Terminal Layout

4.6 Other Assumptions

4.6.1 Thorndon Quay – Hutt Road HOV lanes

Hutt Road in the AM Peak is underrepresented in the base year model meaning delays and congestion along this corridor is also likely underrepresented in the 2026 forecast. Figure 10 shows the AM peak GEH validation, sections in blue represent low modelled volumes. To account for this, additional trips have been added along the Thorndon Quay and Hutt Road corridor, scaling up the forecast trips by the ratio of underrepresented trips to be more reflective of future traffic volumes.

Figure 10: Base Year AM GEH Validation

The high HCV sensitivity test also includes an assumption for larger trucks. The standard truck in N2AM is on average 9m in length, varying between 6m and 11m. The larger ferry truck sensitivity test assumes these would be articulated trucks and so include a 9m trailer increasing total length to 20m.

4.6.2 Ferry Terminal – Check-in gates opening time and delays

The delay caused by check-in procedures are different by vehicle types and by model scenarios. Generally, in the base model, the check-in gates are assumed to open one hour prior to the departing time. However, in the future cases, the check-in gates are assumed to open earlier (75 – 90 minutes) prior to the departing time, and the check-in process is more efficient to cope with the higher sailing demand.

Table 4: Check-in Delay Assumptions

		Delay per vehicle (seconds)		
		Low	Average	High
Base Case	Passenger Vehicle	25	40	55
	Heavy Vehicle	40	60	80
Future Cases	Passenger Vehicle	30	30	30
	Heavy Vehicle	40	60	80

5. Results

This section presents the modelling results for each of the options.

5.1 Test 1a – Existing ferry demand, signalised roundabout

Test 1a includes the existing ferry demands with the signalised roundabout. Overall this test shows a medium network impact from the release of ferry traffic onto the network. Figure 11 shows queues building up on both the north and south roundabout approach 10 minutes after the release of vehicles from the ferry. Queues from the southern approach form despite the inclusion of ramp metering on the southbound traffic – whilst there is some scope to tweak these signals, some delays would be expected and there is a fine balance between ferry traffic (wanting to u-turn at the roundabout) and commuter outflows

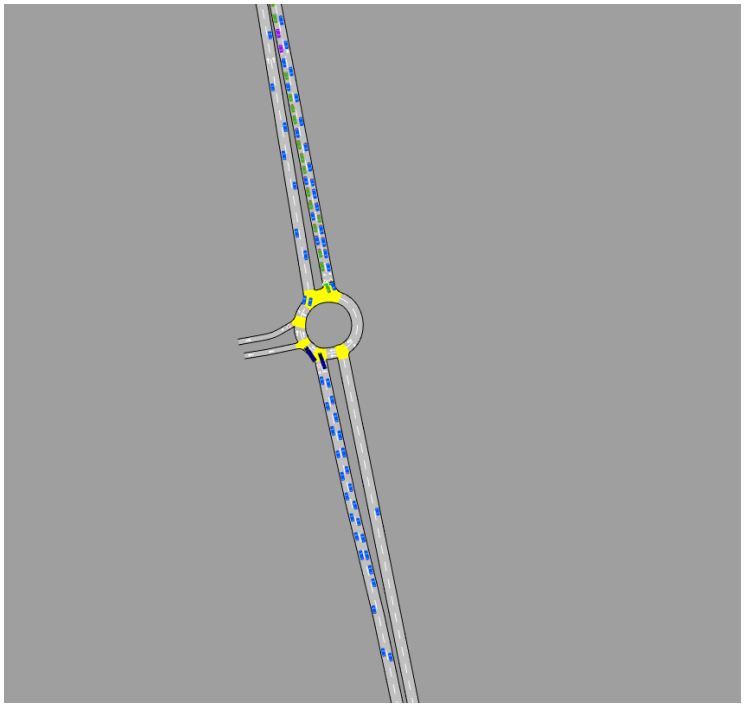


Figure 11: Roundabout Queues 10 minutes post Ferry Arrival

Queues form on the metered roundabout approach (with the caveat we are replicating meter signal delays with fixed signals) and extend back onto the Aotea off-ramp as shown in Figure 12 resulting in delays on SH1. With this level of queuing, the model is quite sensitive to minor changes/demand fluctuations and this highlights a safety risk if static queuing extends onto SH1.

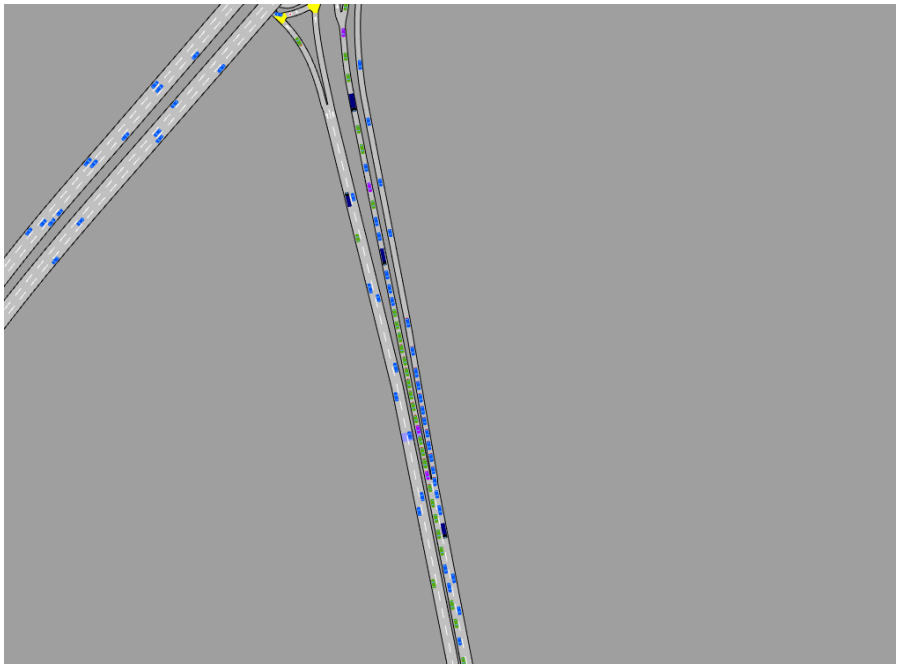


Figure 12: Queues Forming on Aotea Off-Ramp

5.2 Test 1b – Signalised roundabout, future ferry demand

Test 1b includes the signalised roundabout with the future ferry demands and terminal configuration. The increased ferry demand results in a reduced level network performance in comparison to test 1a with the current ferry demands. Figure 13 shows network queues extending onto SH1 and Hutt Road. Figure 14 shows the density plot at the CT Yard roundabout, showing the northbound queues extending further than in Test 1a.

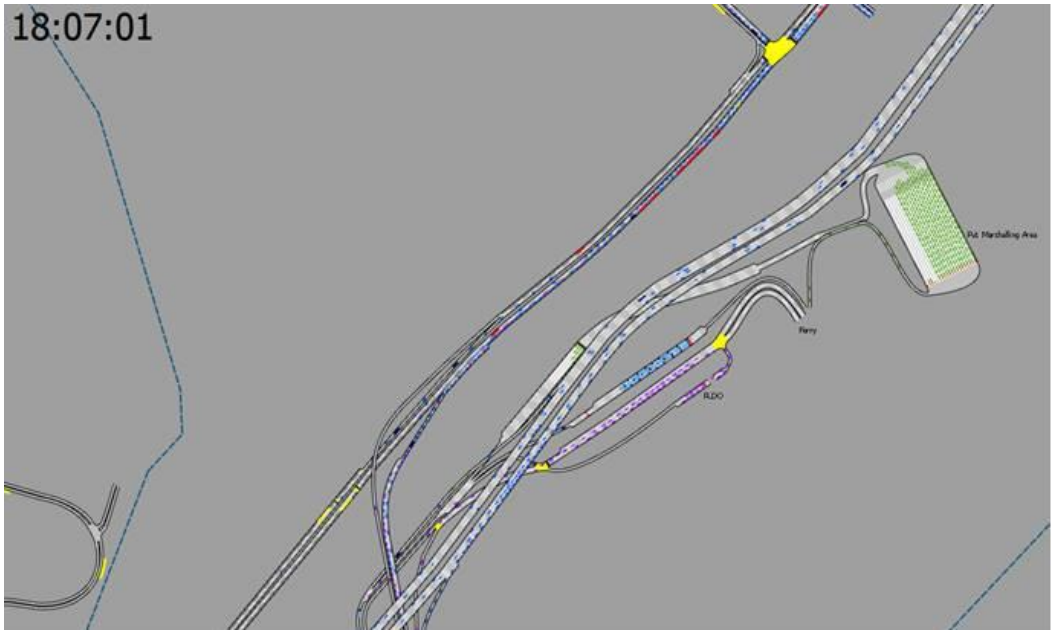


Figure 13: Test 1b Network Queuing

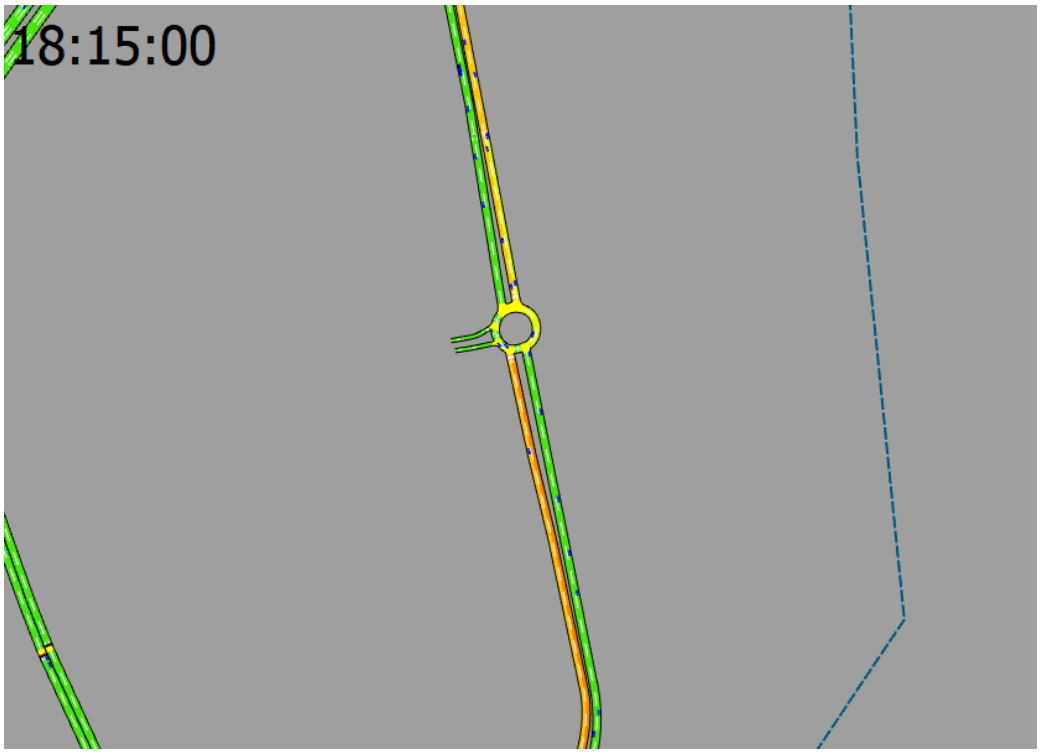


Figure 14: CT Yard Roundabout Density Plot

5.3 Test 2a – Current ferry demand, signalised roundabout, signalised intersection (PM Peak)

Test 2a features the current ferry demand and includes the signalised roundabout and signalised intersection. The signalised intersection provides a direct connection from the ferry terminal onto SH1 and thus results in significantly shorter queues occurring at the signalised roundabout as shown in Figure 15. Queues instead form within the ferry terminal and outside the model. Figure 16 shows the virtual queue forming outside the model, peaking at 75 vehicles queuing within the arrived ferry. This still achieves a 1 hour turnaround, though this is not required under the current ferry crossing schedule.

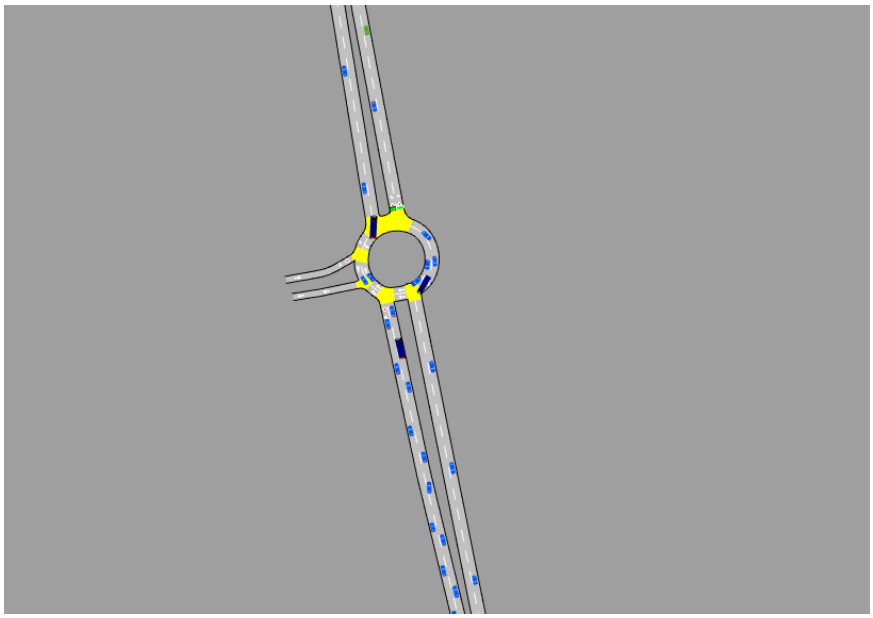


Figure 15: Test 2a Reduced Roundabout Queues

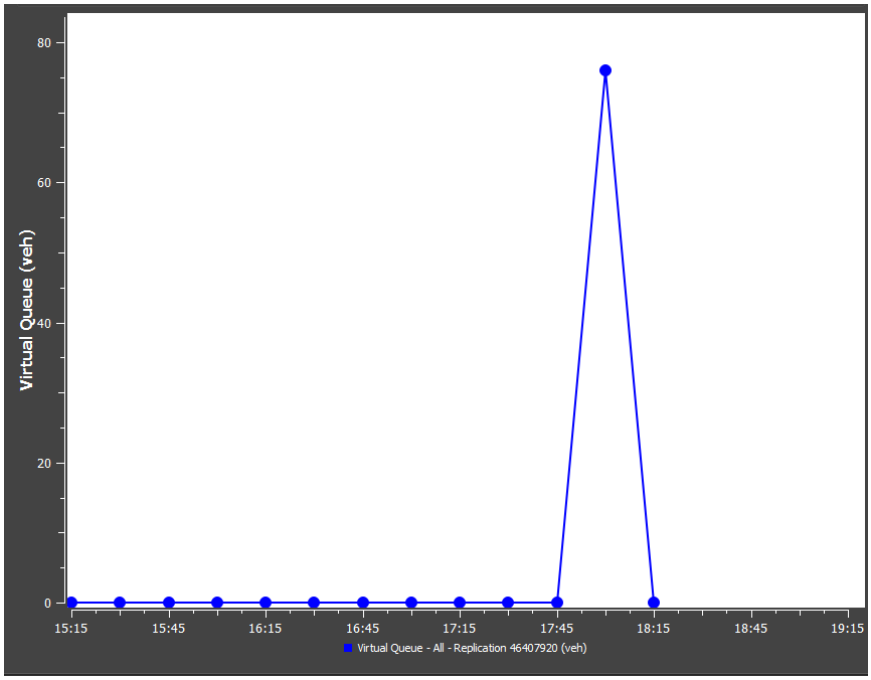


Figure 16: Test 2a Virtual Queues within Arriving Ferry

5.4 Test 2b – Future ferry demand, signalised roundabout, signalised intersection (PM Peak)

Test 2b shows minor impacts to the network similar performance to Test 2a. No significant queues are seen on Aotea Quay, Hutt Road or the SH1 off Ramp. The ferry terminal is able to achieve the required 1 hour turnaround time.

5.5 Test 3a – Current ferry demand, signalised roundabout, signalised intersection (AM Peak)

Test 3a looks at the AM peak ferry demand under a scenario that includes the proposed roundabout and signalised terminal intersection with the current ferry demands. Note for this test the roundabout signals are not activated (as it is not required due to the timing of vehicles arriving for the ferry and low number of arrivals on the overnight ferry from Picton), though they would be available as a mitigation measure, if required.

The Aotea Quay/ Ferry Terminal signals work well in this scenario, regulating traffic such that queues don't extend to adjacent intersections. Figure 17 shows queues forming on the Aotea Northbound approach, however these don't extend to the Roundabout and clear within 15 minutes.

Figure 17: Test 3a Signalised Intersection Queues

Significant delays and queuing are observed on the Hutt Road, though this is to be expected given the capacity drop for the bus/HCV lane in the AM peak and are not caused by ferry activity. The performance of the Onslow Road intersection deteriorates due to the shared through and right turn movement from Hutt Road in the southbound direction. The Hutt Road queues are rolling queues so traffic is constantly moving and thus the density plot at Kaiwharawhara/Hutt Road shown in Figure 18 doesn't show significantly degraded performance.

Figure 18: Test 3a Kaiwahrawhara Density Plots

5.6 Test 3b – Future ferry demand, signalised roundabout, signalised intersection (AM Peak)

Test 3b performs similar to Test 3a where the ferry terminal itself shows no notable adverse impact on the wider network but Hutt Road does indicate rolling queues and congestion due to the reduced lane capacity for general traffic. It is likely vehicles would reroute to SH1 under these conditions, which they are not able to do in the sub-network model. The Hutt Road and SH1 volumes are based on meso level modelling, whereas the sub-network is micro-simulation which typically shows more delays as is seen here.

5.7 Test 4 – Future ferry demand, signalised intersection, signalised roundabout, trucks 'forced' to use SH1 and roundabout

Test 4 generally runs through without notable impact on general traffic as most queuing is confined to the ferry terminal. Following the arrival of the 17:30 ferry, arriving trips show minor queues back onto Aotea Quay through the signalised intersection as shown in Figure 19 and Figure 20. However this may be understated in the model as the virtual queues (i.e. queues outside the model) for PUDO exiting traffic reach up to 200 vehicles as shown in Figure 21.

PUDO traffic is modelled as two trips in the demand matrix, the Dropoff/enter and Pickup/exit legs. Following the 17:30 ferry arrival, the pick up entering trips queue back into the signalised intersection. The pick up exiting trips are also held back by the ferry exiting trips, however these are also showing virtual queues of up to 200 vehicles, some of which may be added to the queues showing in the model. Not all of these virtual queues would be directly added, as pick up cars will park in the short term area waiting for their ferry passenger to arrive, but it does show a potential issue with the proposed layout under higher ferry passenger loadings that should be considered in future work.

Figure 19: Test 4 Ferry Terminal Queues

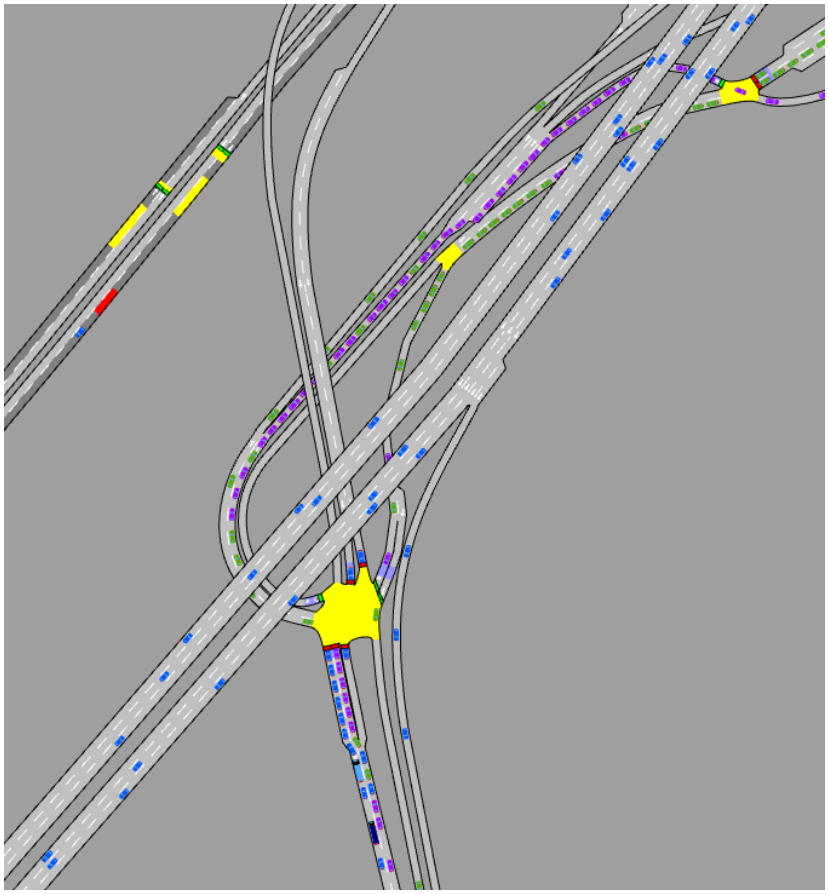


Figure 20: Test 4 Ferry Arrival Queues

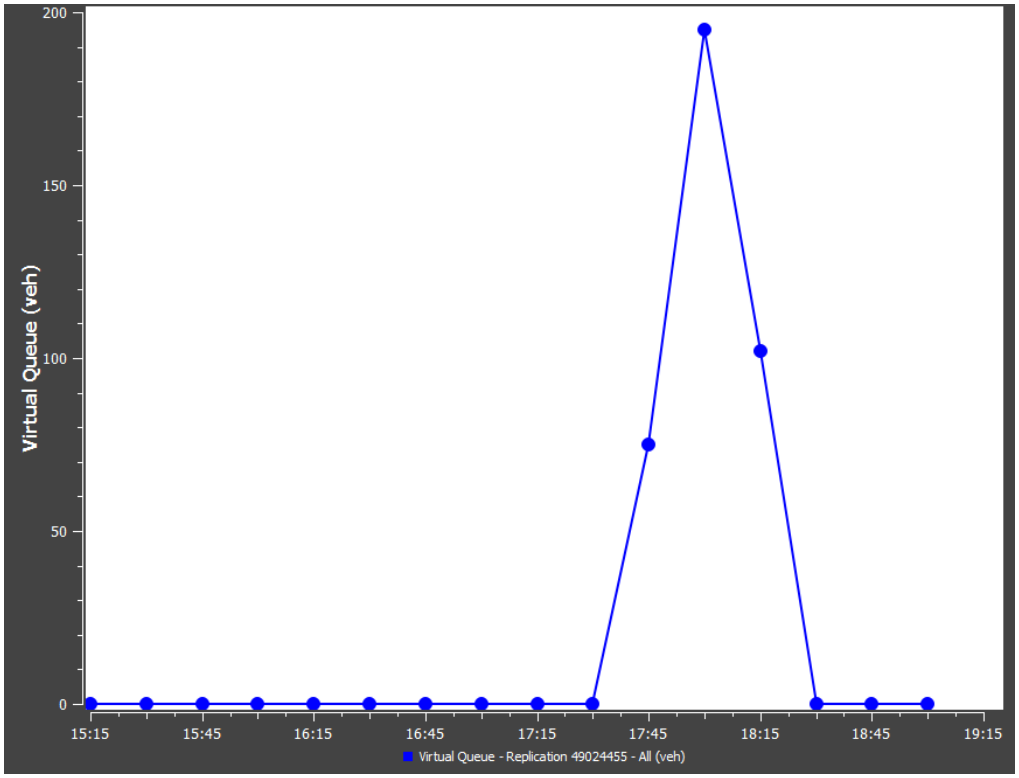


Figure 21: Test 4 PUDO Virtual Queues

5.8 Test 4 Sensitivity – as test 4 but higher HCV demand (and lower resultant car demand)

Initial runs of this test showed significant queuing throughout the network due to insufficient stacking space for the larger trucks in the check in area. Figure 22 shows the truck check-in area used in the other tests which does not pose an issue for the standard truck assumption. Figure 23 however shows that this model assumption is insufficient for High Truck crossing volumes with the larger vehicles as queues extend outside the terminal.

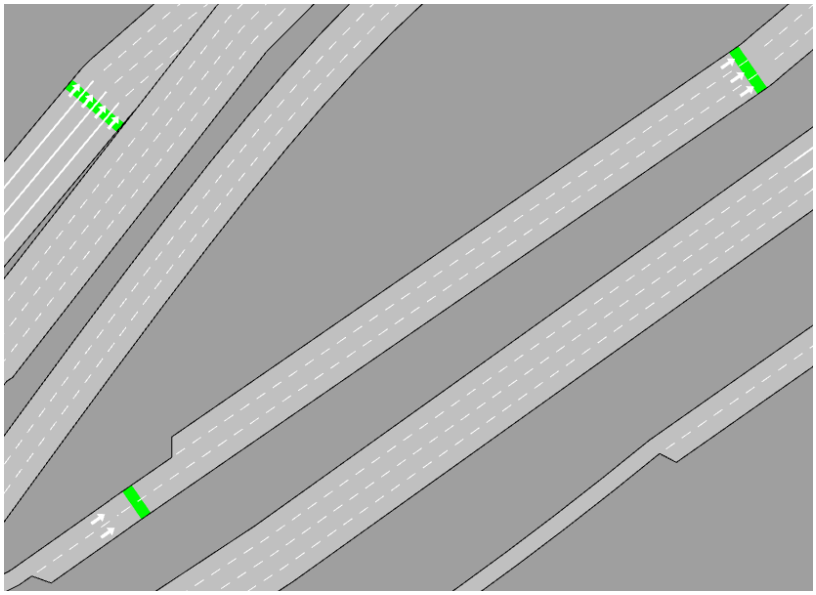


Figure 22: Model Truck Stacking Area

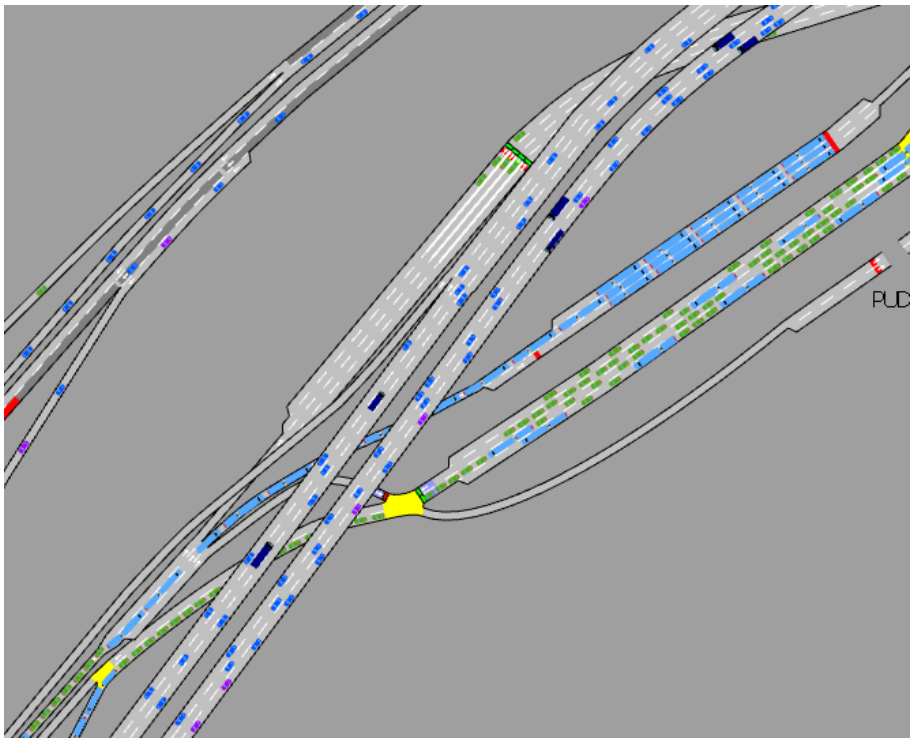


Figure 23: Modelled Insufficient Stacking Space

Figure 24 and Figure 25 show the wider impact of the insufficient stacking space where general traffic queues extend both onto SH1 and along Aotea Quay back to Bunny Street.

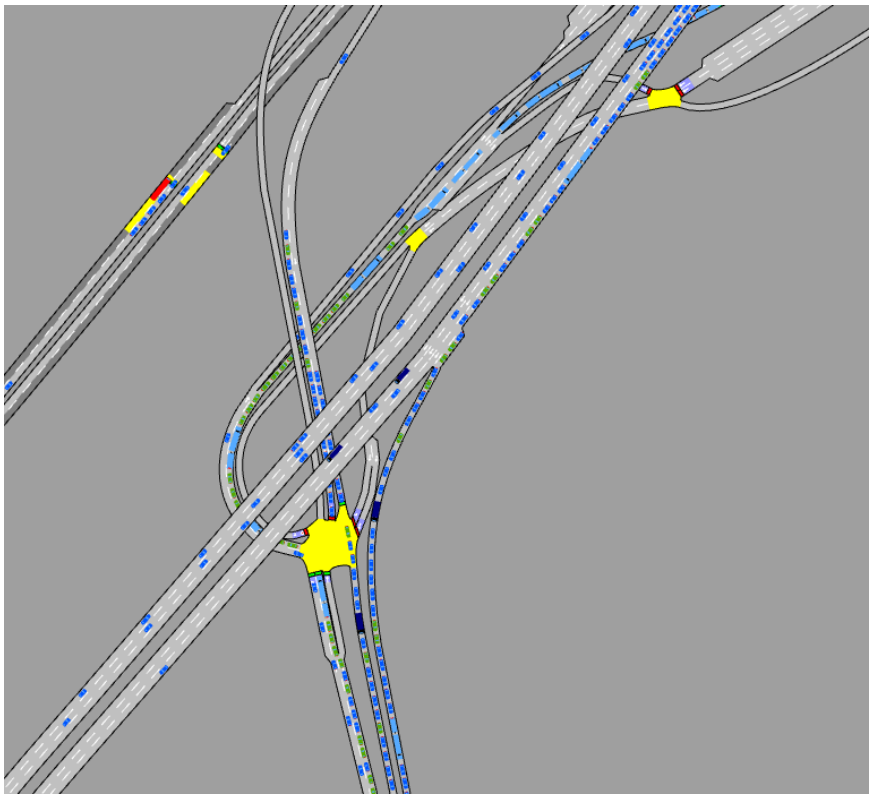


Figure 24: Queues Outside Terminal Onto SH1

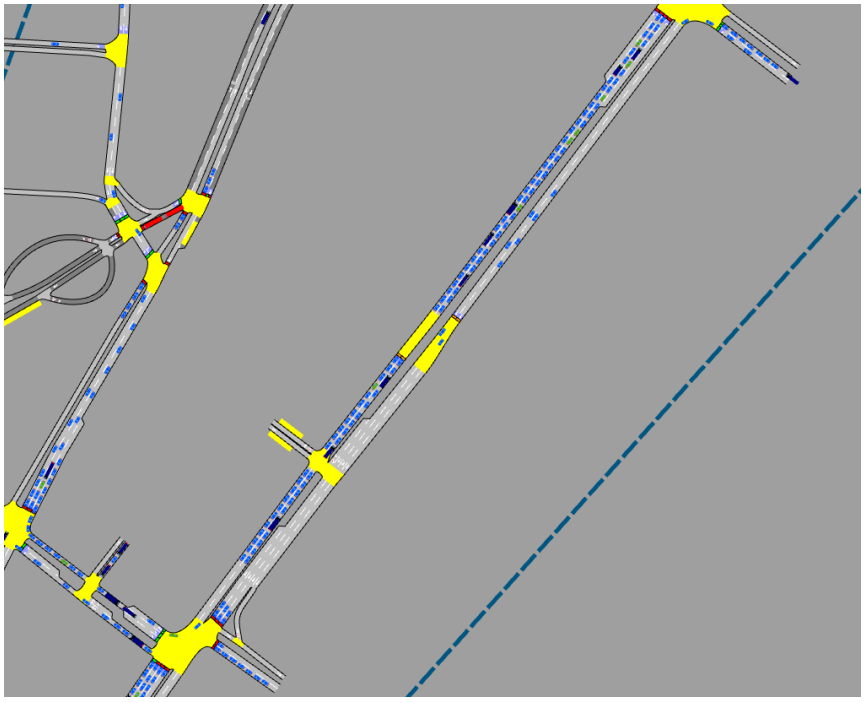


Figure 25: Queues Extend To Bunny Street

Figure 26 shows the future ferry terminal plan where 850m for truck stacking is provided for in 34 diagonal parks. The model assumed layout has around 400m of stacking space (3 lanes of 137m). This test assumes 50 vehicles so there will always be some overflow as the total queue would be up to 1,000m with the 20m vehicle length assumption. Aimsun is also not able to represent the diagonal parking so instead the number of lanes in the stacking area has been doubled to closer match the plans in terms of stacking length as shown in Figure 27.

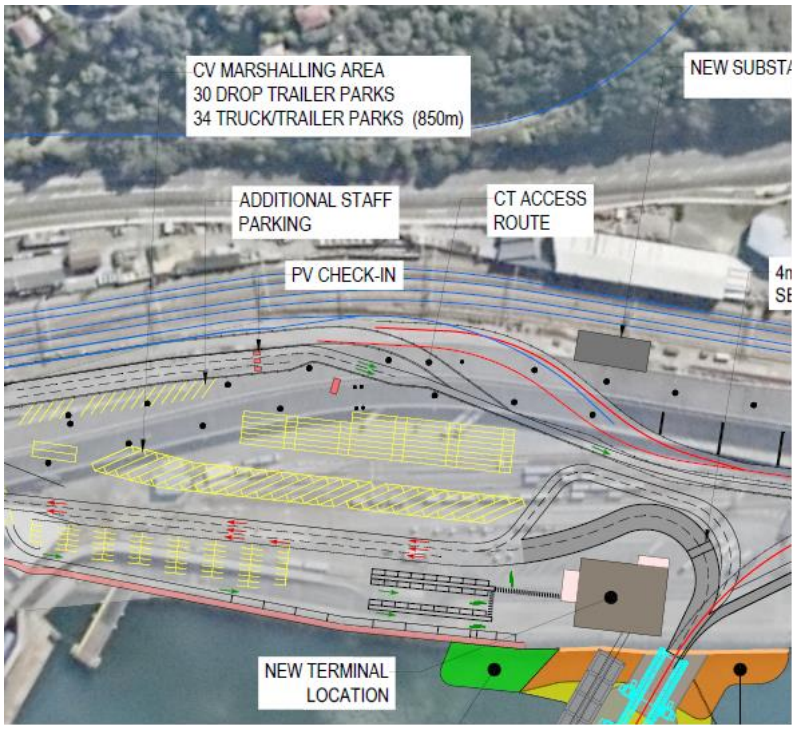


Figure 26: Future Ferry Terminal Truck Stacking Area

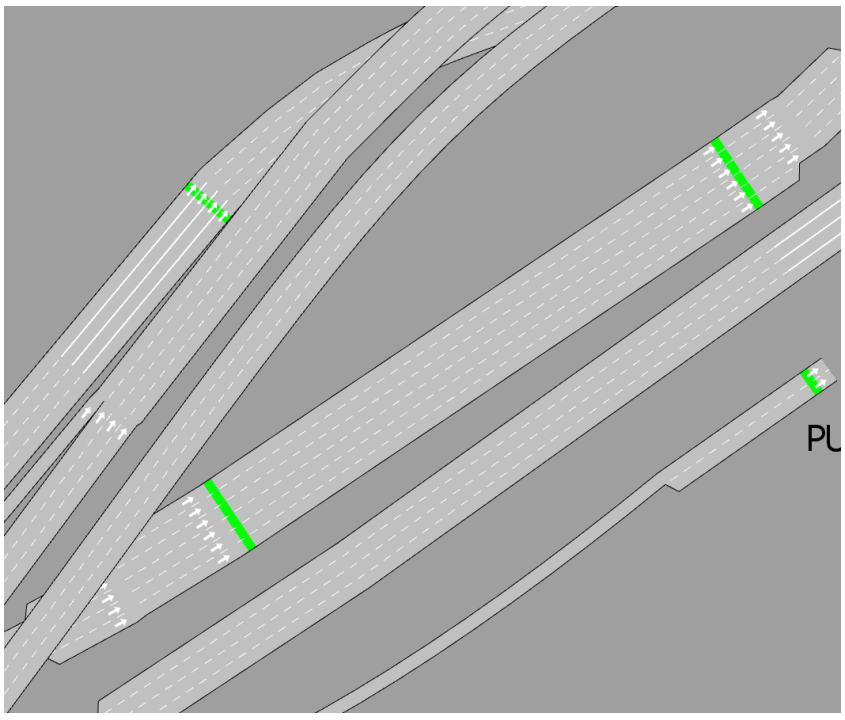


Figure 27: Revised Stacking Area

With the increased stacking area, network impacts are greatly reduced. The roundabout southbound approach performs similarly to Test 4 with only minor approach queues forming which don't reach the SH1 off ramps. Queues on Aotea Quay are also reduced, extending to the stadium at the longest point, as shown in Figure 28, rather than back to Bunny Street.

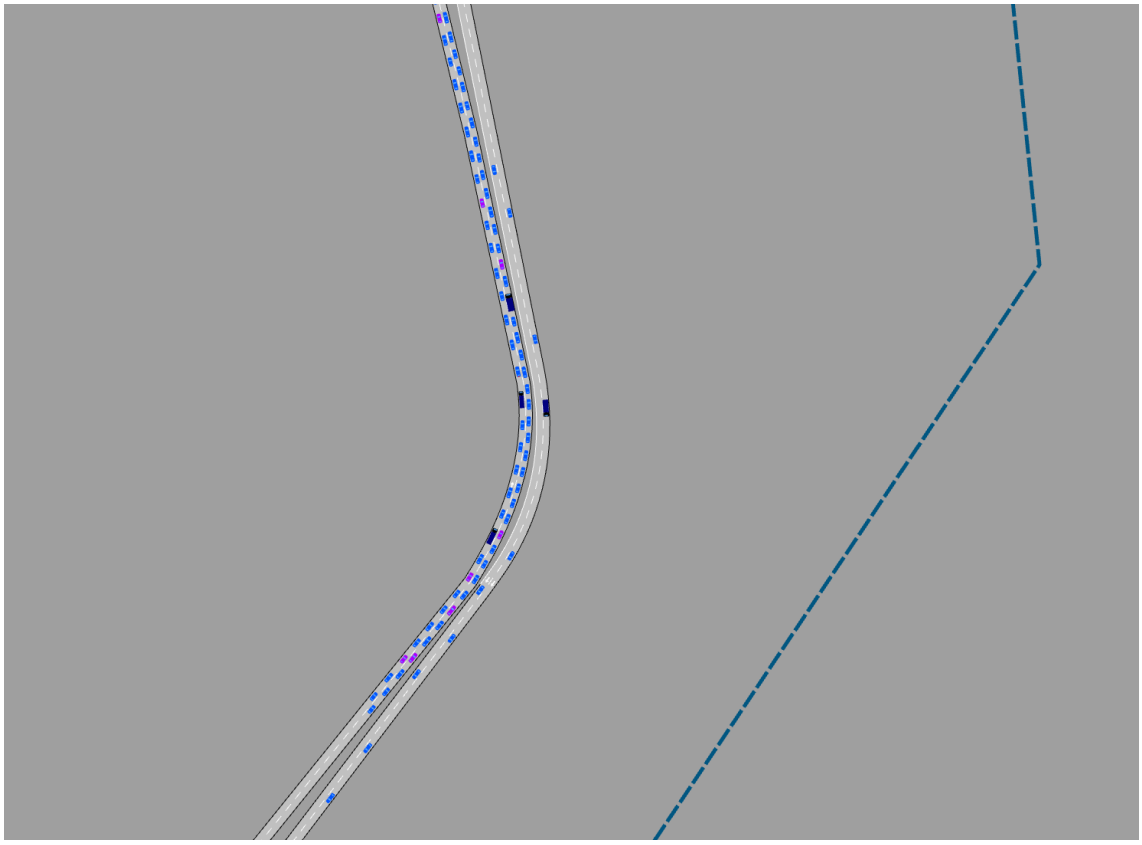


Figure 28: Aotea Queues Under Revised Layout

The key finding from this sensitivity test is that vehicle check-in and stacking will need to be carefully managed to ensure queues don't extend outside the terminal. This could be managed by allowing earlier check in or more stacking space onsite. The assumption of 50 long trucks arriving in the PM peak may or may not be realistic but does show the potential limits of the current terminal design.

5.9 Test 5 and Test 6 – Truck Turnaround Facility on Aotea Quay

Tests 5 and 6 include a turnaround facility at the CT Yard/Aotea Quay intersection instead of a signalised roundabout, allowing for ferry trucks to exit the terminal to the south, turnaround at the intersection and head to SH1/Hutt Road to the north. For the purposes of modelling, the Terminal/Aotea signals only allow trucks to turn left out of the terminal forcing the use of the turnaround facility for northbound truck journeys (the majority of truck movements).

Test 5 shows similar performance to Test 4 in terms of network impacts or internal ferry terminal effects. Test 6 however shows queues forming on the Aotea Bridge as, without the roundabout, ferry cars are effectively forced to use Hutt Road to access the terminal. This leads to the signalised intersection right turn into the terminal being put under pressure as shown in Figure 29

If the sensitivity demands and vehicles were run through either test 5 or test 6, we would expect to see an impact on network performance.

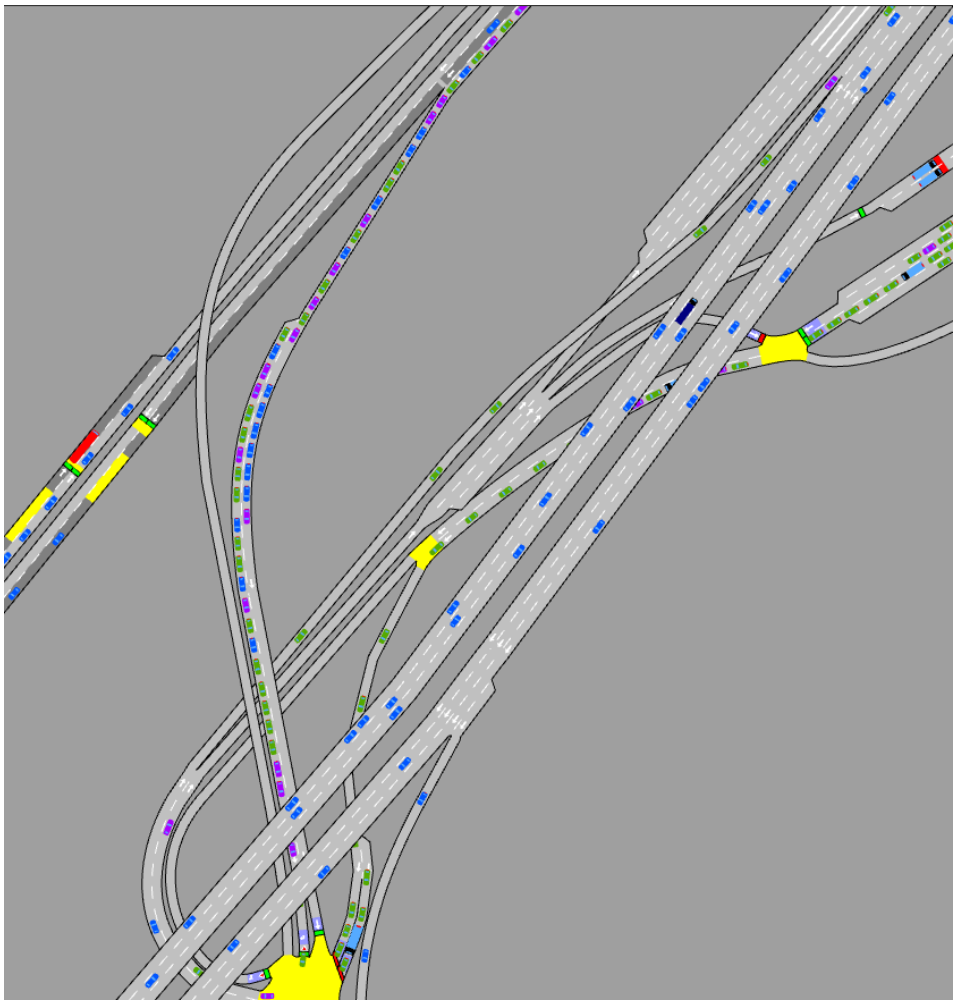


Figure 29: Test 6 Right Turn Queues

5.10 Performance Comparison

5.10.1 Network Statistics

Figure 30 shows delay times for the AM peak tests over the modelled 4 hours and Figure 31 shows this for the PM peak. In the AM, test 3b shows higher delays in the post peak, reflecting the increased Hutt Road congestion with the future ferries. The PM peak shows Tests 1b and 6 having the highest delays; the other future test scenarios showing similar delays.

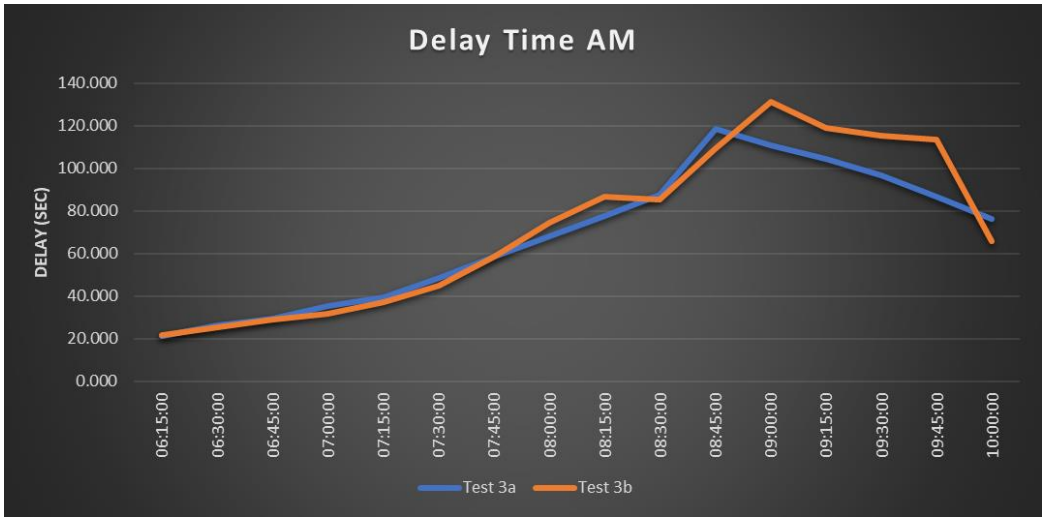


Figure 30: Network Stats AM Delay Time Comparison

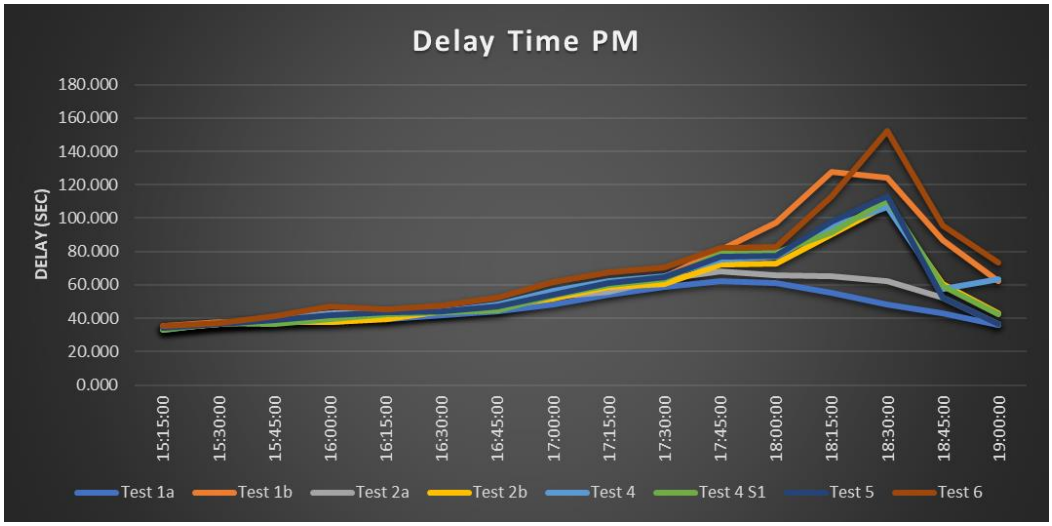


Figure 31: Network Stats PM Delay Time Comparison

Density plots for the AM and PM modelled peaks are shown in Figure 32 and Figure 33 respectively. Density within the model is measured in vehicles per kilometre and is an indication of congestion. The AM peak shows similar performance between the two scenarios. This contrasts with the delay time plots which indicates that while the delays increase in Test 3b, vehicles are still able to move through the network. The PM peak again shows tests 1b and 6 with the worst performance.

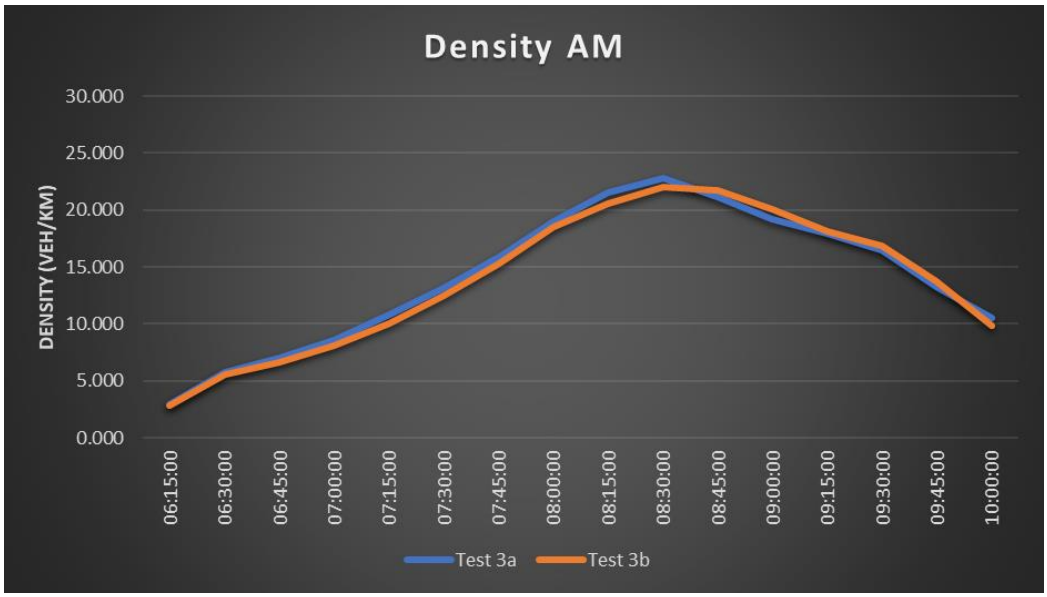


Figure 32: Network Stats AM Density Comparison

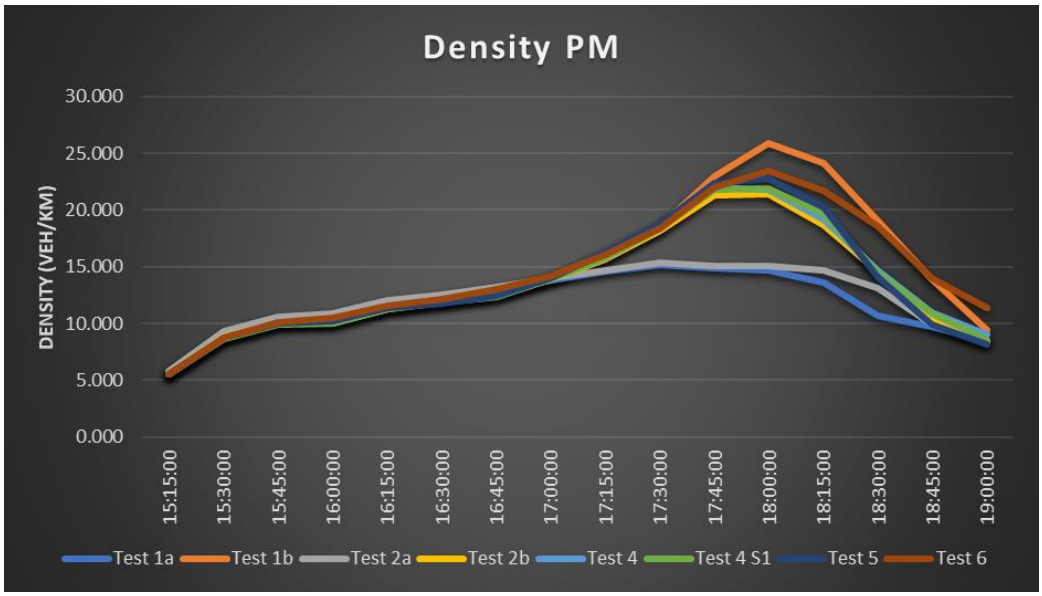


Figure 33: Network Stats PM Peak Density Comparison

Mean network queues are shown in Figure 34 for the AM peak and Figure 35 for the PM peak. The AM peak shows slightly larger mean queues forming in test 3b after 8:30 compared to test 3a. Similar to the previous network plots, tests 1b and 6 both show the worst performance in the PM peak.

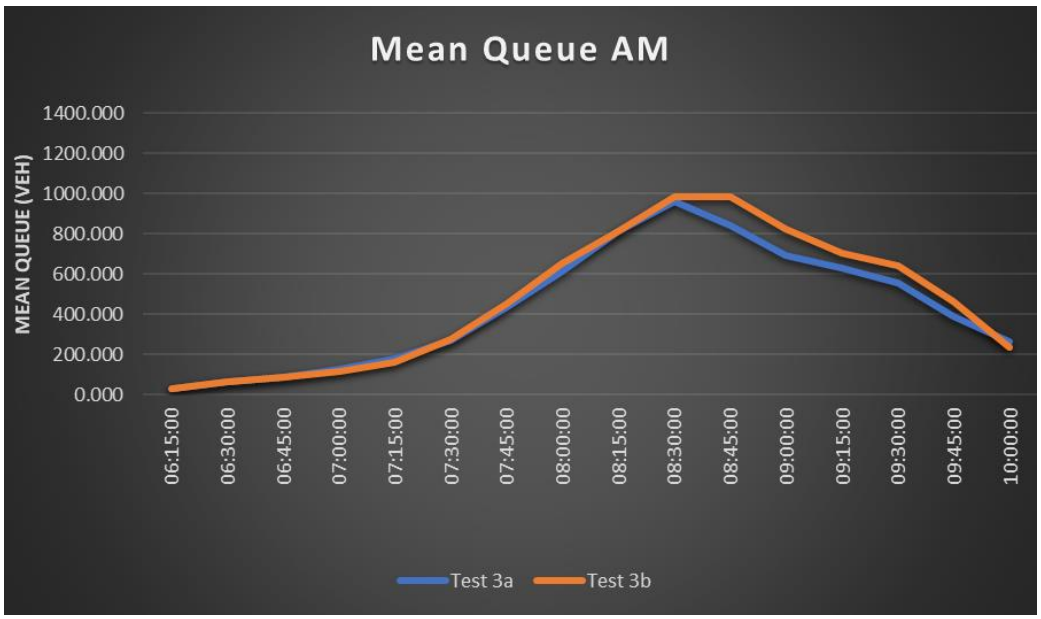


Figure 34: Network Stats AM Peak Mean Queue Comparison

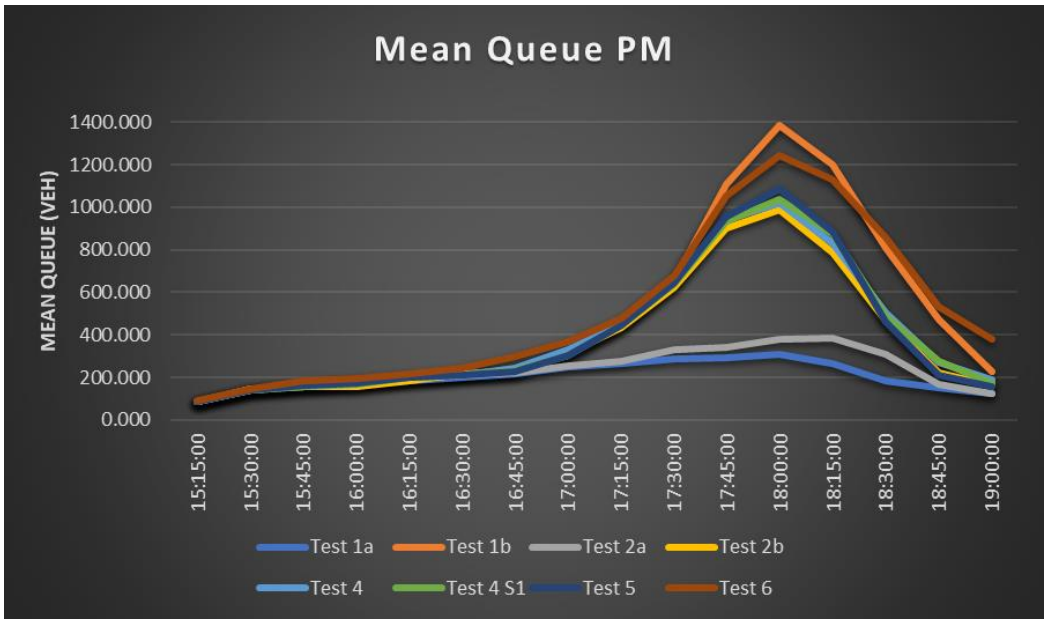


Figure 35: Network Stats PM Peak Mean Queue Comparison

5.10.2 Flow Profiles

Figure 36 and Figure 37 show flow profiles on Hutt Road between the Aotea Ramps and School Road in the AM SB direction and PM NB direction respectively. The AM peak shows similar performance between the two scenarios. The PM peak shows Test 6 with the least throughput at this location, indicative of the vehicles queuing back from the signalised ferry terminal intersection through the Aotea Ramp.

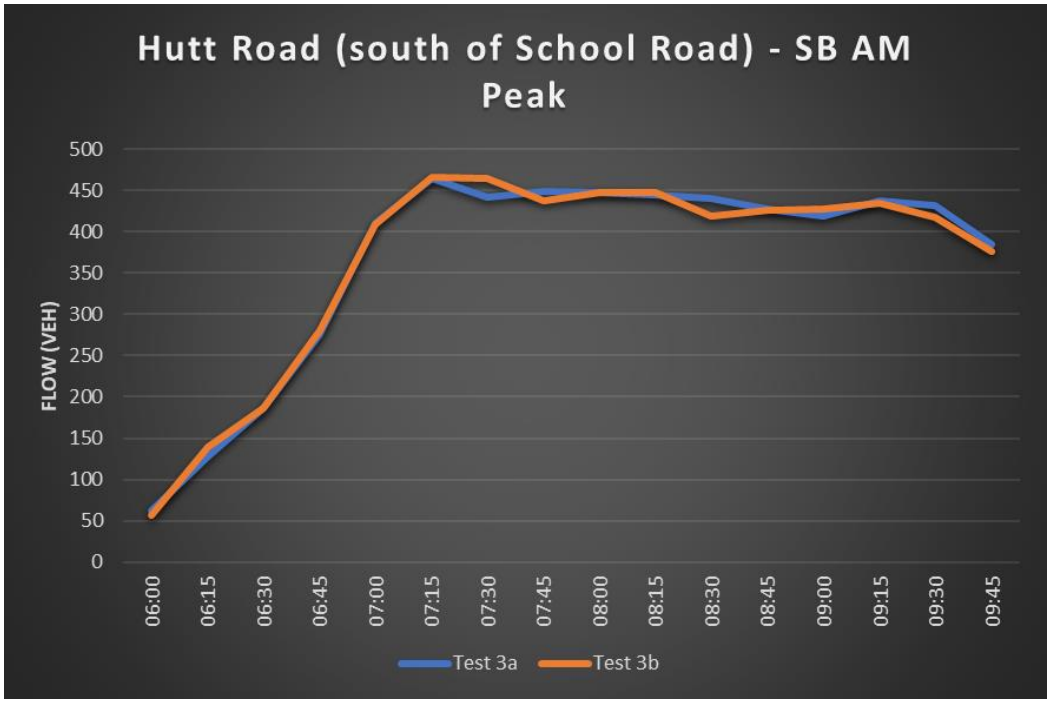


Figure 36: Flow Profile Hutt Road (south of School Road) SB AM

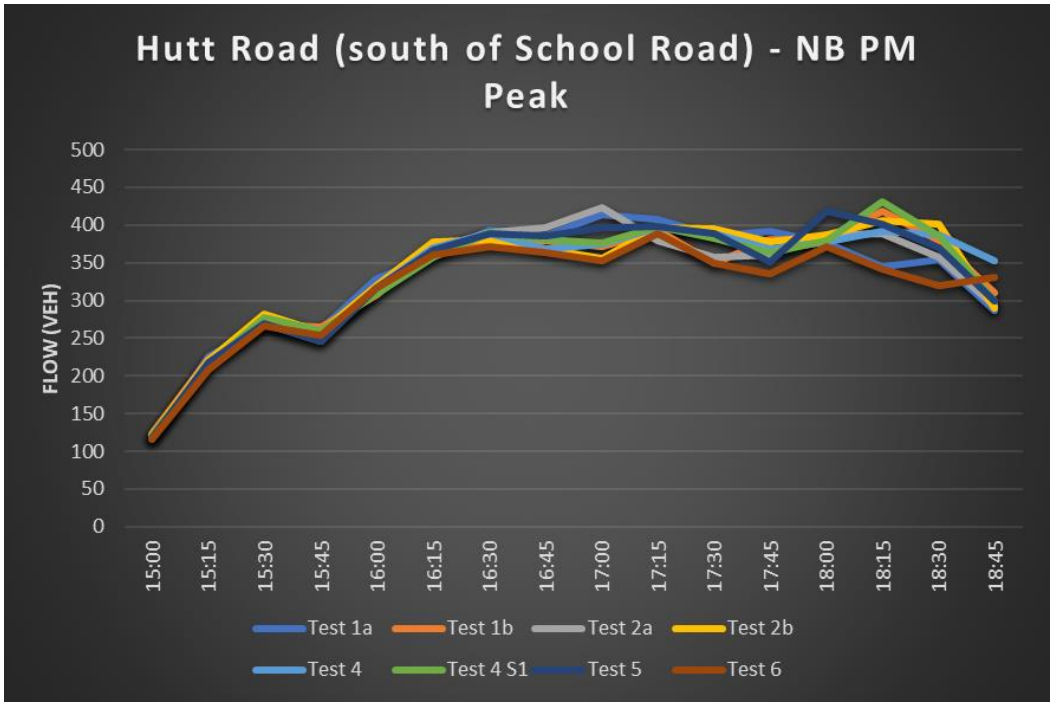


Figure 37: Flow Profile Hutt Road (south of School Road) NB PM

The flow profile further downstream on Hutt Road between Tinakori Road and Sar Street is shown in Figure 38 for the AM peak and Figure 39 for the PM peak. The AM peak shows greater throughput in Test 3b in the later half of the peak period. The PM peak shows similar flows at this location in each of the options.

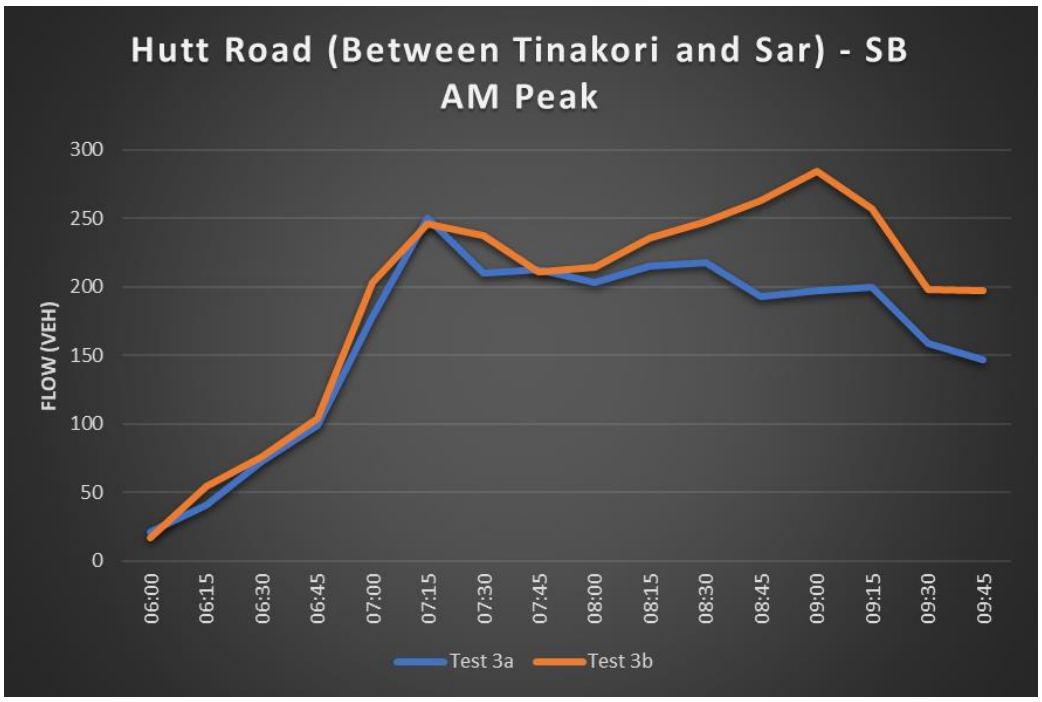


Figure 38: Flow Profile Hutt Road (between Tinakori and Sar) SB AM

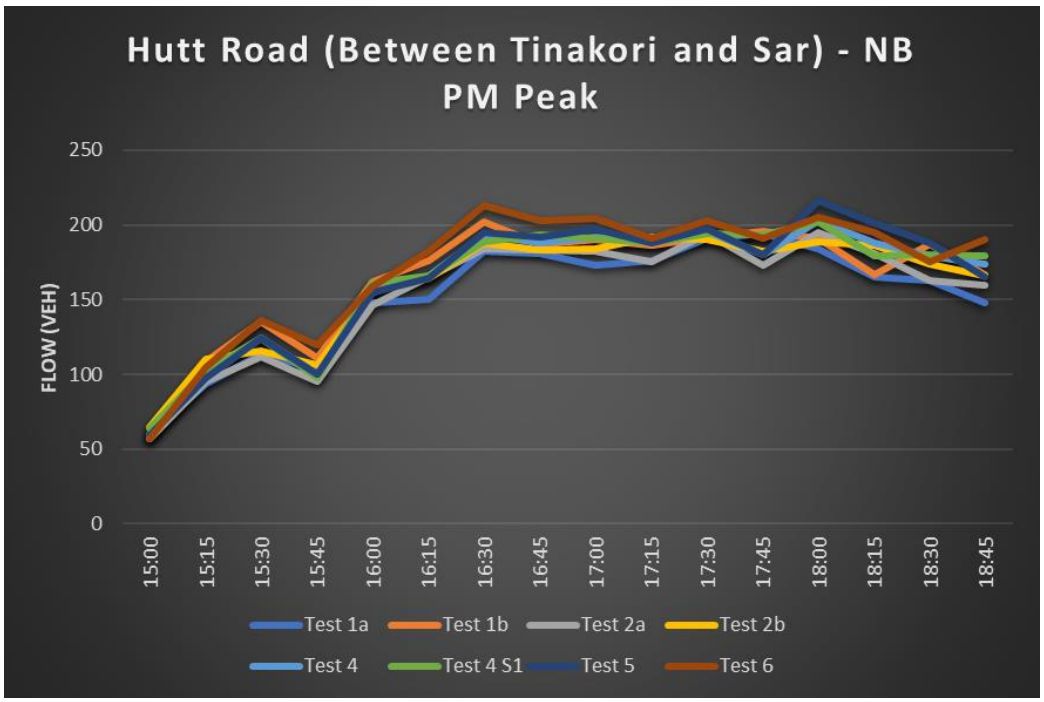


Figure 39: Flow Profile Hutt Road (between Tinakori and Sar) NB PM

AM and PM peak flow profiles on SH1 are shown in Figure 40 and Figure 41 respectively. These both show similar flow profiles between the scenarios in both peak periods as is expected due to the sub network model not allowing for route choice changes to and from the state highway.

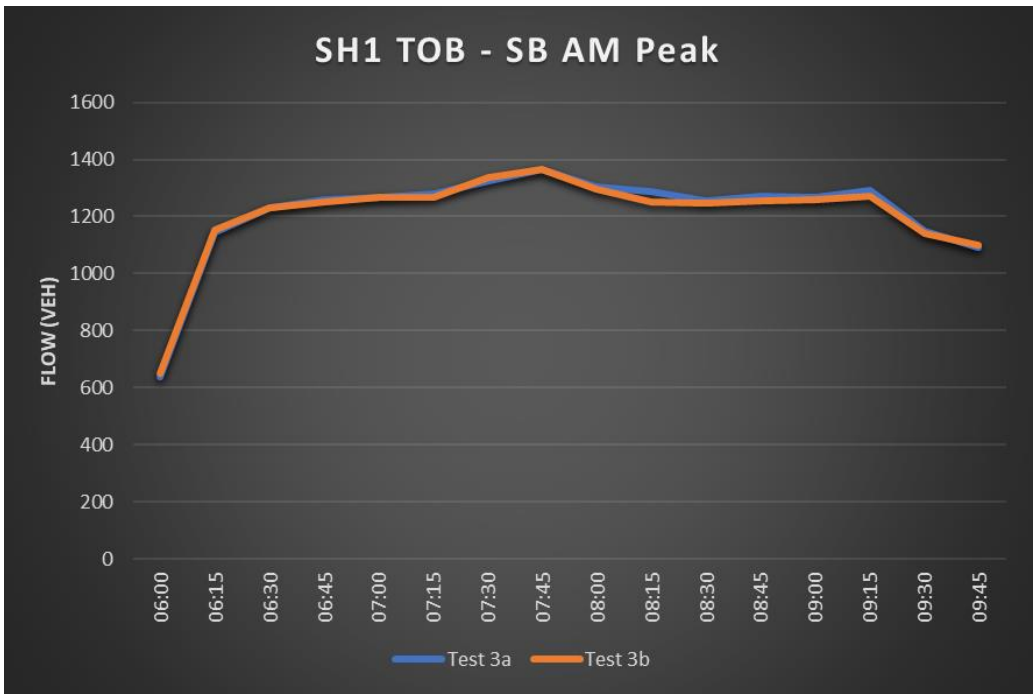


Figure 40: Flow Profile SH1 Thorndon Overbridge SB AM

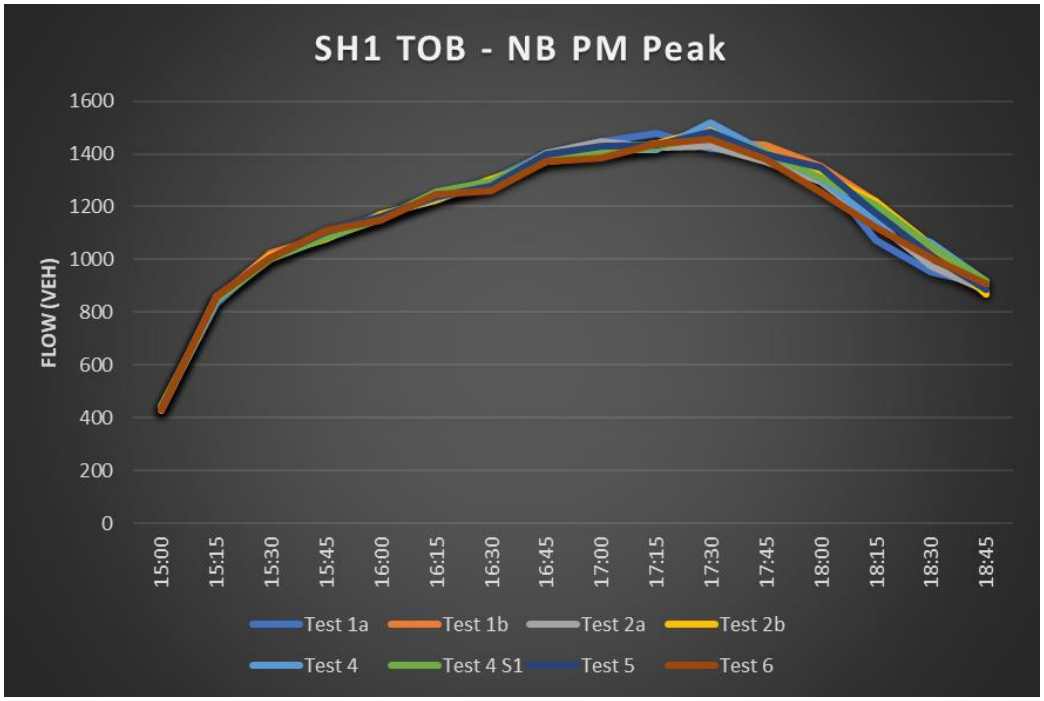


Figure 41: Flow Profile SH1 Thorndon Overbridge NB PM

Figure 42 show the flow profile for the SH1 Aotea Off Ramp in the AM peak and Figure 43 shows this for the PM peak. The AM peak shows similar through put in both scenarios. The PM peak shows a clear differentiation between the current and future demand scenarios, with the exception of test 6, where all ferry trips are shifted onto Hutt Road.

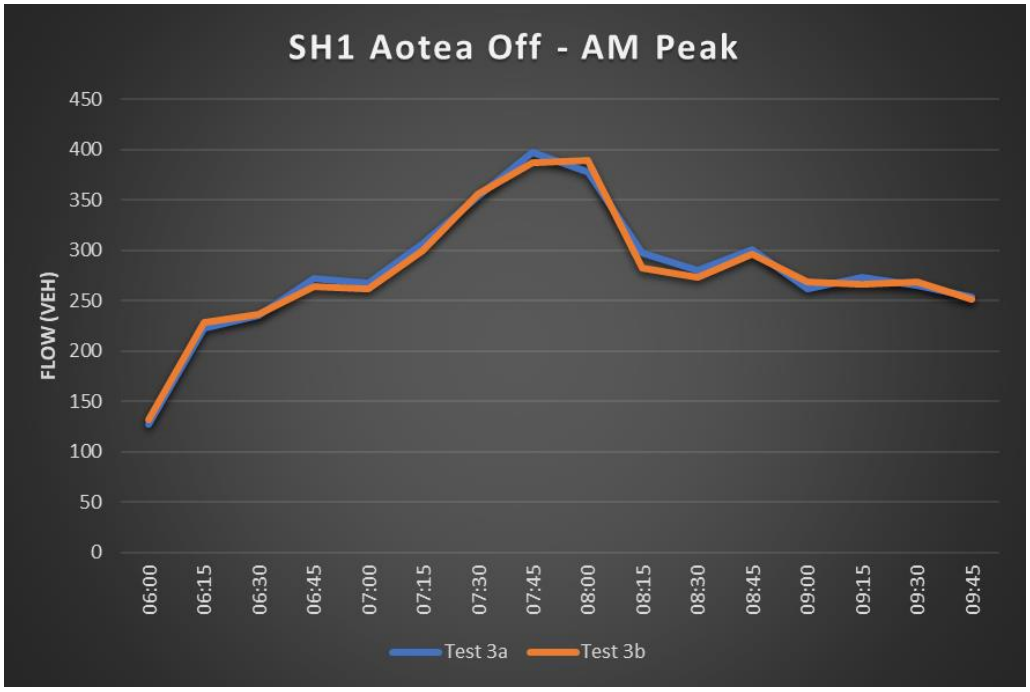


Figure 42: Flow Profile SH1 Aotea Off Ramp AM

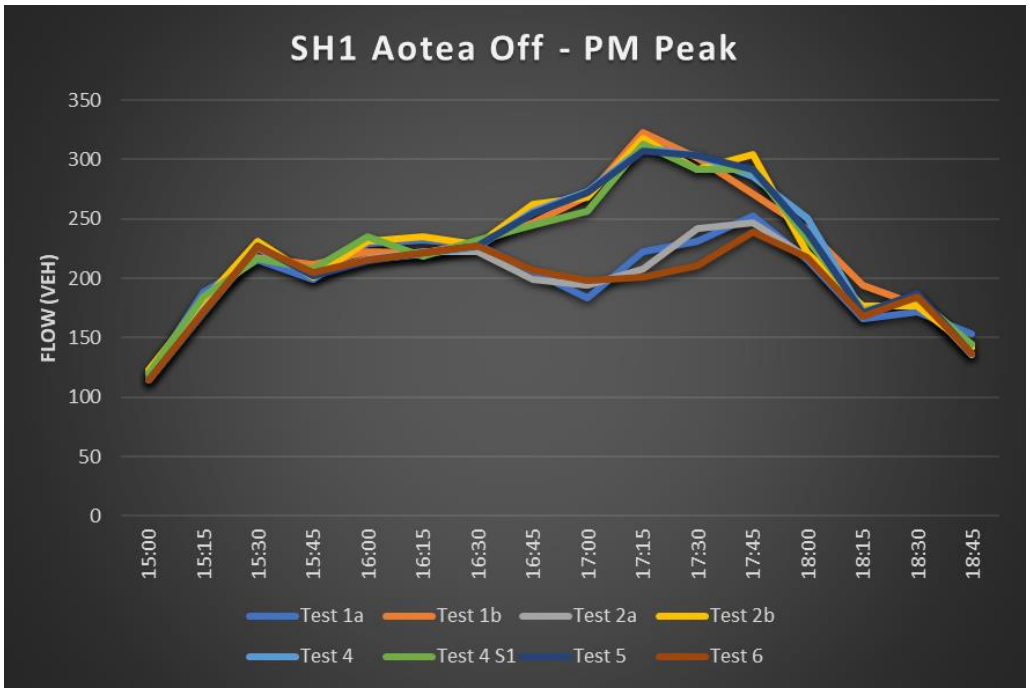


Figure 43: Flow Profile SH1 Aotea Off Ramp PM

Flow profiles on Aotea Quay in the northbound direction is shown in Figure 44 for the AM and Figure 45 for the PM. Test 3a shows a dip at 8am, coinciding with the ferry loading traffic. In the PM peak, test 6 shows less through put through the peak, reflecting the long queues forming in this scenario.

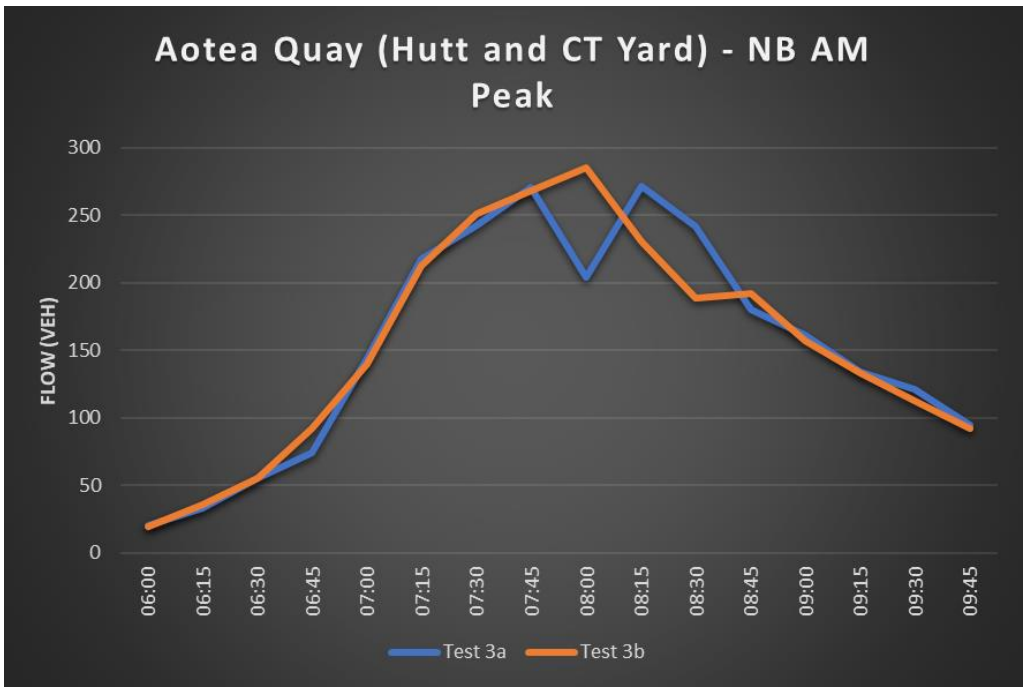


Figure 44: Flow Profile Aotea Quay (Btwn Hutt Road and CT Yard) NB AM

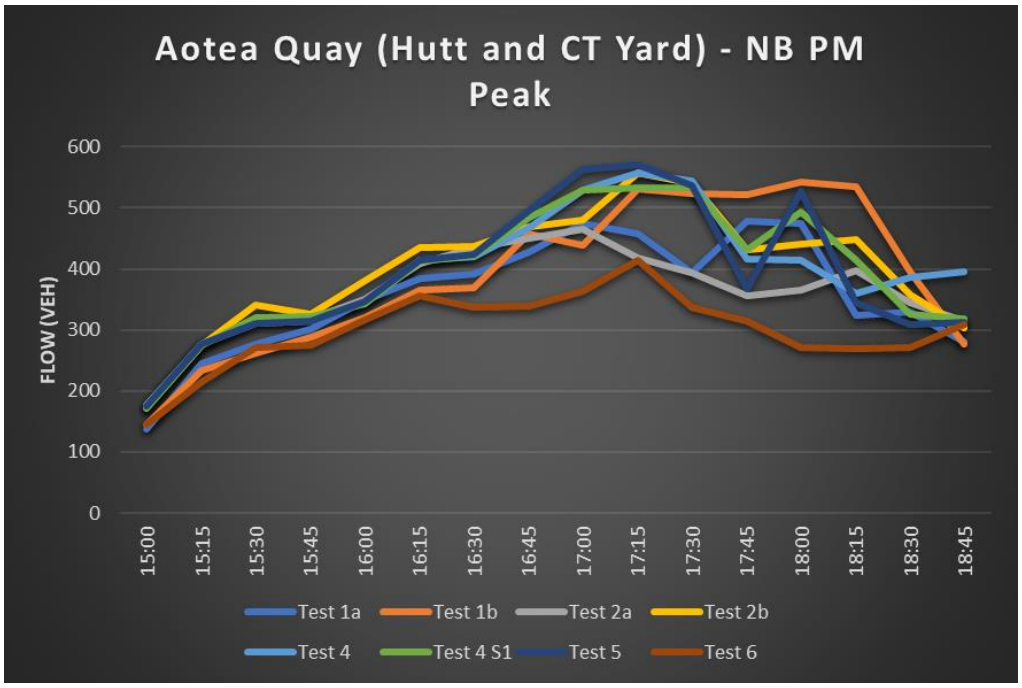


Figure 45: Flow Profile Aotea Quay (Btwn Hutt Road and CT Yard) NB PM

The southbound direction flow profiles on Aotea Quay are shown in Figure 46 and Figure 47 for the AM and PM peaks respectively. In the AM peak, Test 3b shows a reduced through put later in the peak compared to Test 3a. In the PM peak, test 6 again shows low throughput. The current ferry scenarios show similar throughput to each other, as do the other future ferry scenarios. Test 1b interestingly shows low throughput in the first half of the peak and high in the second half.

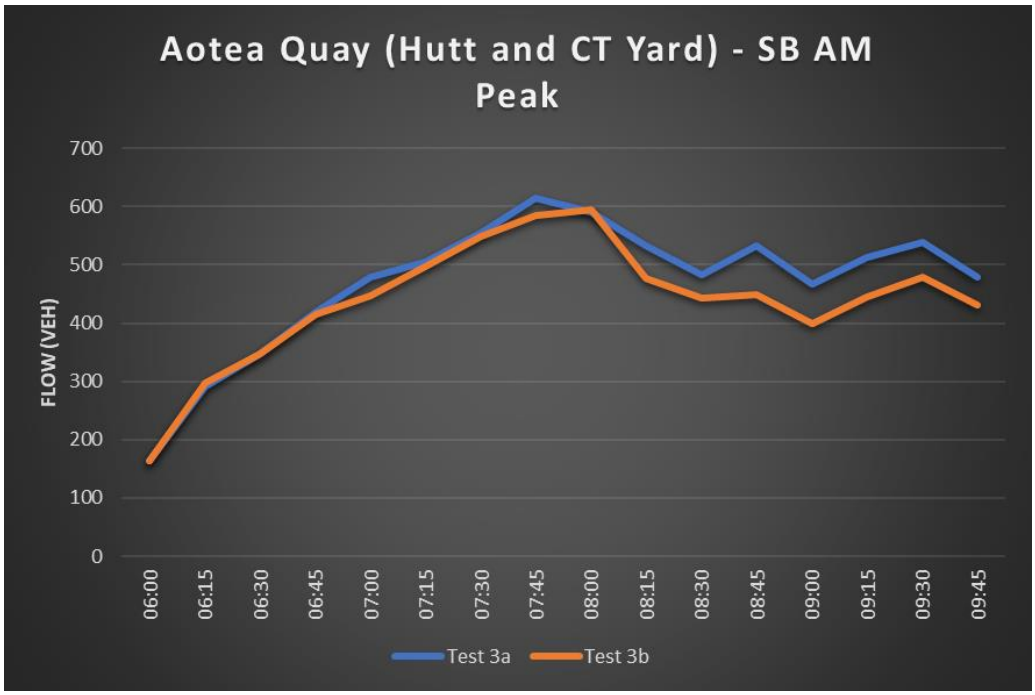


Figure 46: Flow Profile Aotea Quay (Btwn Hutt Road and CT Yard) SB AM

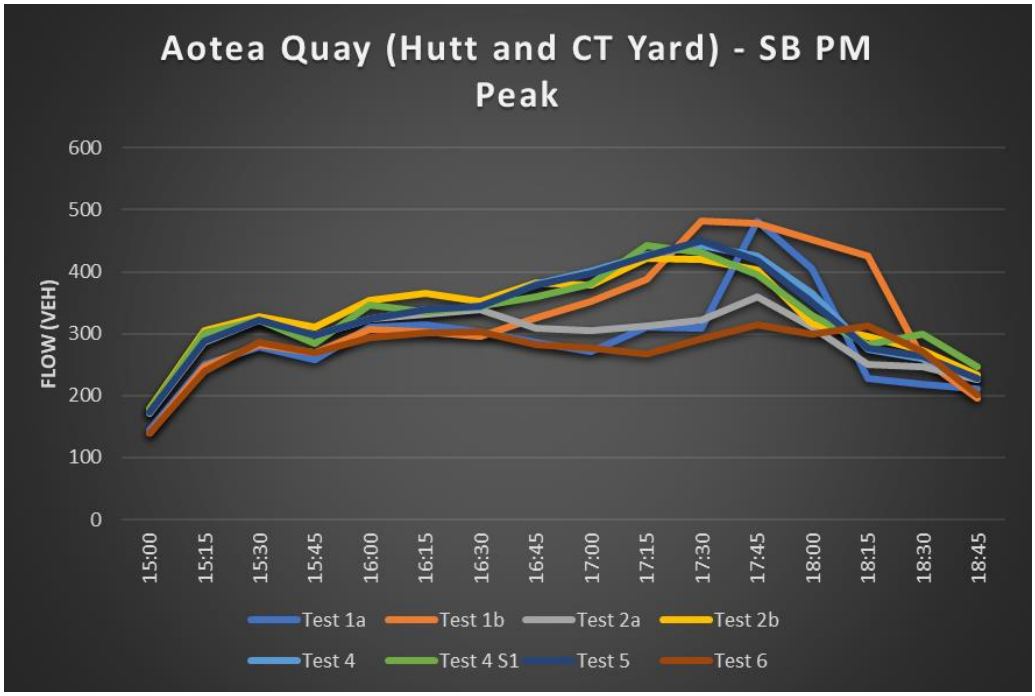


Figure 47: Flow Profile Aotea Quay (Btwn Hutt Road and CT Yard) SB PM

5.10.3 Travel Time Comparisons

This section compares travel times along Hutt Road, Aotea Quay and SH1 in both direction between the options. The travel times presented are the average of the second hour of each peak, 8-9am for the AM and 5-6pm for the PM.

Modelled travel times are compared along Hutt Road in the North and Southbound directions in Figure 48 and Figure 49 respectively. The Northbound direction shows similar performance between the scenarios. The Southbound direction shows the AM peak scenarios (Tests 3a and 3b) with around 800 more seconds travel time (over 13 minutes) approaching the Kaiwharawhara intersection over the PM peak scenarios and free flow beyond this point. The PM peak scenarios show a flat profile, except for tests 1b and 6 which both show delays approaching the Aotea bridge, reflecting the queues which form from Aotea Quay.

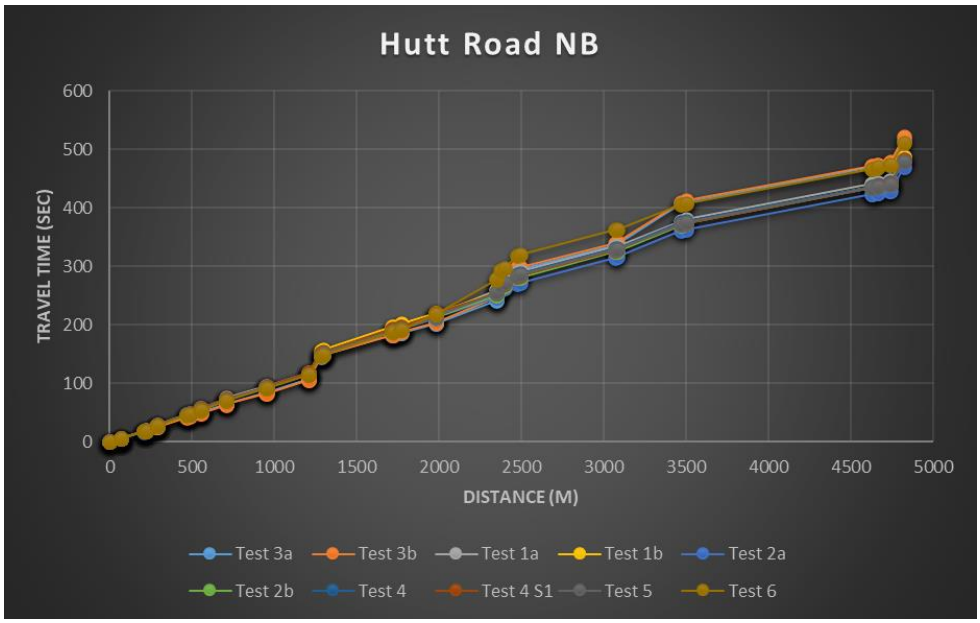


Figure 48: Travel Times Hutt Road Northbound

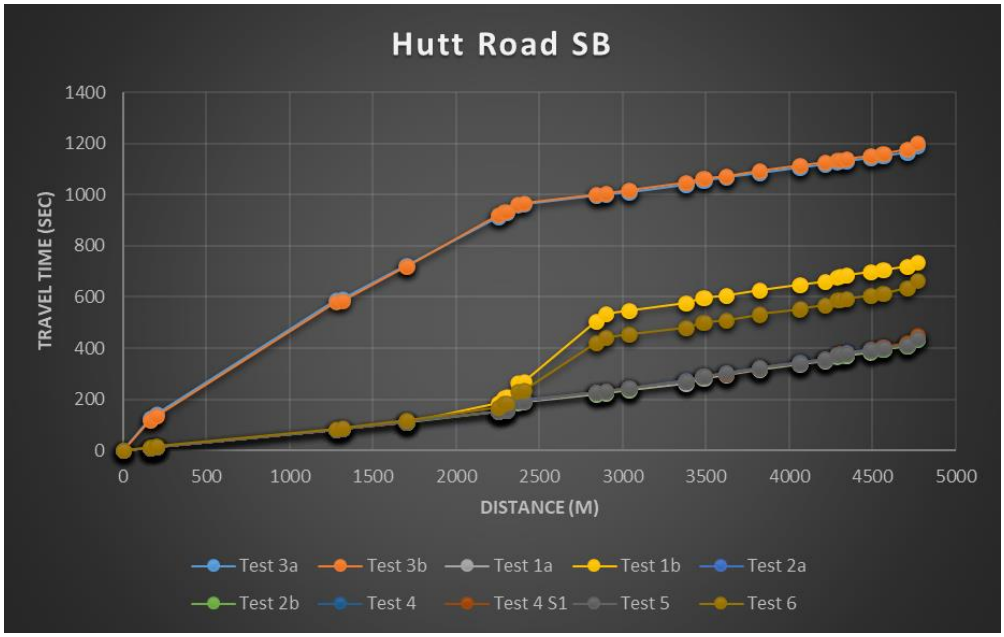


Figure 49: Travel Times Hutt Road Southbound

Figure 50 compares Aotea Quay in the northbound direction. Tests 3a and 4 S1 show the worst performance along this route at just under 500 seconds travel time.

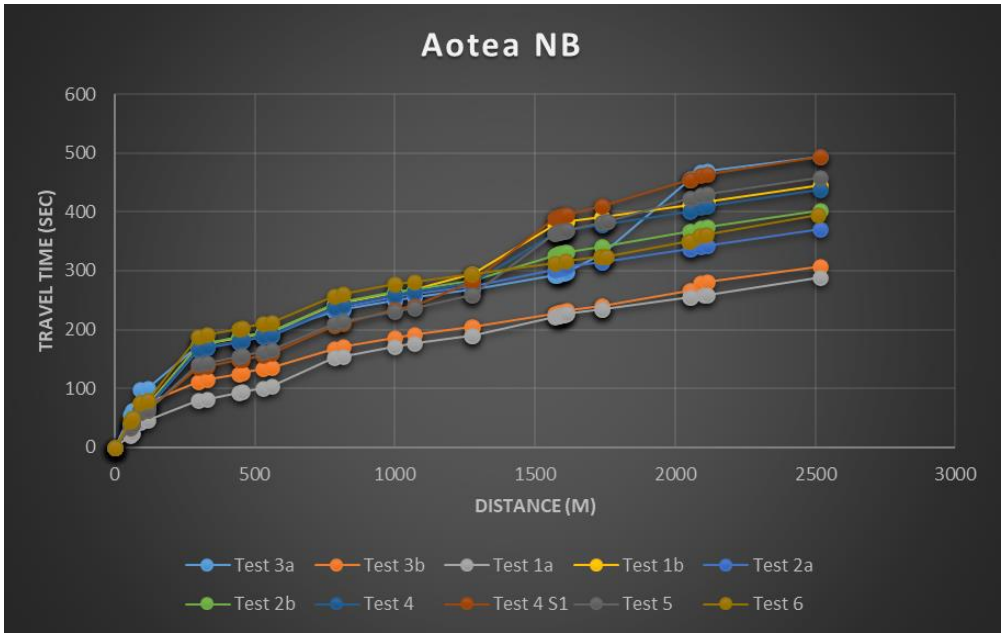


Figure 50: Travel Times Aotea Quay Northbound

Figure 51 shows Aotea Quay travel times in the southbound direction. Test 1b shows high delays on the approach to the terminal, reflecting the queues which form in this scenario. Test 6 also shows delays on the ferry terminal approach albeit to a lesser extent. Test 3b shows increasing delays beyond the CT Yard on the approach to the Bunny Street intersection.

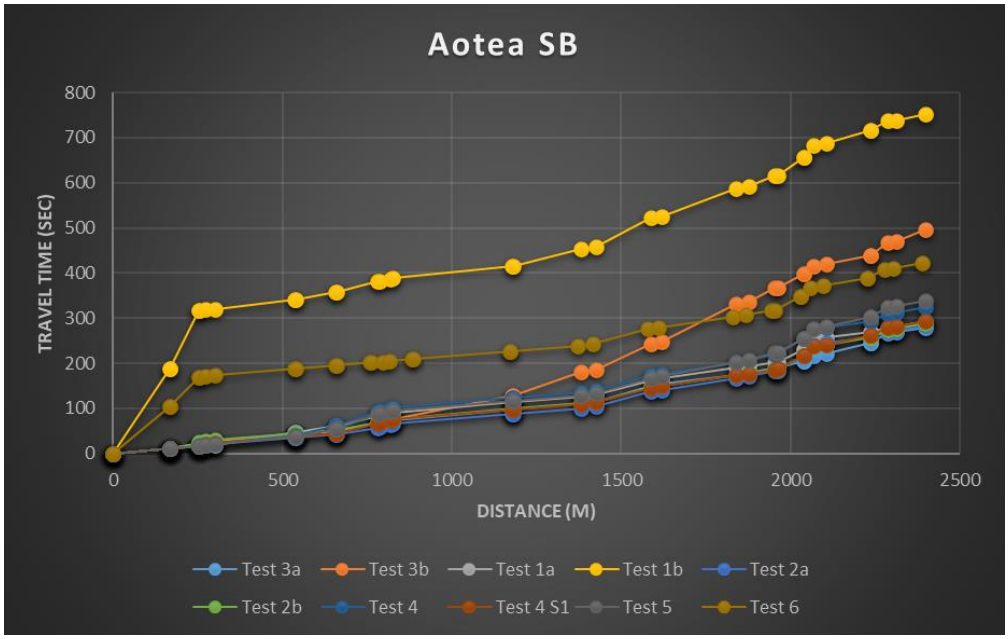


Figure 51: Travel Times Aotea Quay Southbound

Figure 52 and Figure 53 show travel times along SH1 in the Northbound and Southbound directions respectively. No significant delays are seen in any of the scenarios in either direction, indicating the motorway is not impacted by any of the network configurations tested.

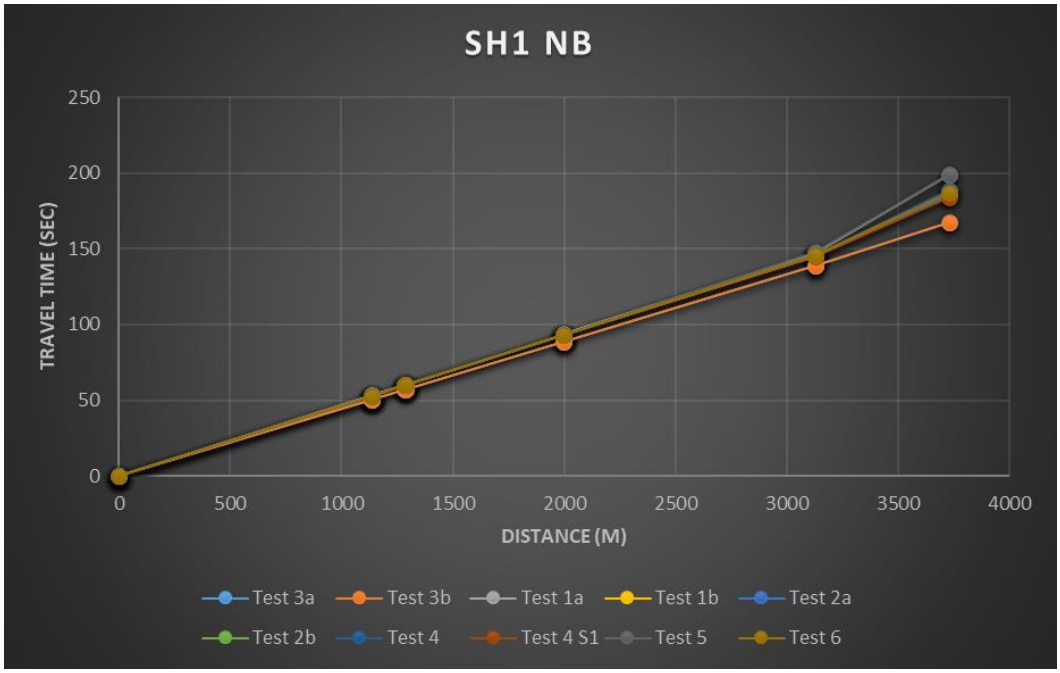


Figure 52: Travel Times SH1 Northbound

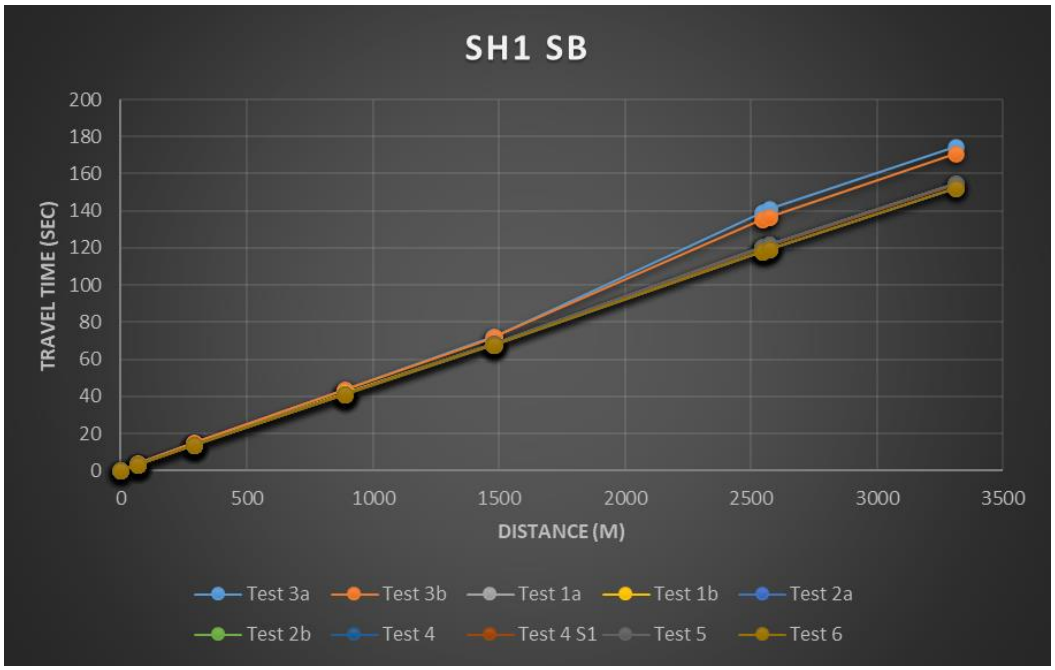


Figure 53: Travel Times SH1 Southbound

6. Summary

Table 5 summarises the overall modelling results, together with the impact of the different options on key parts of the network.

It shows the roundabout is not able to mitigate the ferry demands alone and additional infrastructure is also required; especially with the future ferry demands and required 1 hour turnaround for ferry unloading. Signalising the Aotea Quay/Ferry Terminal intersection and providing a direct connection from the terminal onto SH1 mitigates most of the network impacts from future ferry demands, particularly in the PM peak, though there is potential for queues to form back onto Hutt Road in the AM peak. The sensitivity test with larger trucks, which represents the worst case for truck demands, shows the terminal configuration is critical to ensuring enough stacking space is provided on site to cater for the demands.

Table 5: Results Summary

Test	Intervention	Hutt Road	SH1	Aotea Quay		Overall Results
Test 1a	Signalised roundabout, current ferry, PM					Moderate impacts with potential for Aotea Quay queues to extend back onto SH1
Test 1b	Signalised roundabout, future ferry, PM					Runs through but only just, significant queuing, wider network impacts particularly on Hutt Rd
Test 2a	Signalised roundabout and signalised intersection, current ferry, PM					Limited Network impacts
Test 2b	Signalised roundabout and signalised intersection, future ferry, PM					Limited network impacts, no queuing on HR
Test 3a	Roundabout and signalised intersection, Current Ferry, AM					Limited network impacts which clear within 30 mins of ferry. Queuing and delays on Hutt Road but unrelated to ferry terminal.
Test 3b	Roundabout and signalised intersection, 2026 Ferry, AM					Similar to Test 3a with moderate impacts
Test 4	Signalised roundabout and signalised intersection, port trucks to roundabout, Future Ferry, PM					Limited network impacts, no queueing on HR but some potential queuing from trips arriving to the ferry terminal
Test 4 Sensitivity	Test 4 with high truck ferry demands with larger truck vehicles					Queues form on Aotea Quay – potential for further queues if insufficient Truck stacking space provided/
Test 5	Signalised roundabout and signalised intersection, force port trucks to roundabout					Similar to Test 4
Test 6	Turn back loop and signalised intersection, force port trucks to use SH1 and roundabout					Right Turn Queues back onto Hutt Road. Aotea Quay throughput also adversely impacted

In addition to the tests run to date, the following additional tests could be run to further understand the required level of intervention:

- A current and future test could be run with the signalised terminal access and without the signalised roundabout. This would determine if just the signalised intersection with the direct connection onto SH1 might be sufficient to cater for the ferry terminal. This would determine whether the removal of the proposed turn around facility at the CT Yard intersection would have unforeseen consequences.

- A Truck heavy ferry crossing sensitivity test could also be run through the AM peak. This may cause issues with the Hutt Road capacity reduction which would be useful to understand.

- A sensitivity test of the turnaround facility (test 6) could be run with high HCV demands to understand if there is a potential problem. Under the high car future ferry demands the facility doesn't show any major performance difference between tests 4, 5 and 6, however test 4 with high HCV does show network impacts.

The Thorndon Quay/ Hutt Road (TQHR) project is currently an uncommitted project. While the TQHR option included in this analysis is considered the most likely outcome, there may be future work required for the LGWM integration with the ferry terminal as the detailed design of TQHR progresses.